Faculty Mentors' Influence on Latino/a/x STEM Undergraduates' STEM Identity Development

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Faculty Mentors’ Influence on Latino/a/x STEM Undergraduates’ STEM Identity Development

by

Sandy Cerda-Lezama

A thesis submitted in partial fulfillment of the requirements for the degree of

Master of Science
in
Psychology

Thesis Committee:
Karlyn Adams-Wiggins, Chair
Ellen Skinner
Eric Mankowski

Portland State University
2024
Despite Latino/a/x college student attendance rising substantially over the past decades (Krogstad, 2015; McFarland et al., 2018), their graduation rates do not match the increased admission rates. In addition, Latino/a/x students are considerably underrepresented in STEM. However, research suggests that when these students are encouraged by social partners to have meaningful participation and given resources such as mentoring, this eases the barriers they experience (Dueñas & Gloria, 2020; Hurtado et al., 2009). The current study utilized interviews with 11 Latino/a/x STEM undergraduates (aged 18-29) to understand how faculty mentors influence their STEM identity development. Students shared answers about how faculty promoted and inhibited their STEM identity development through conversations about their sense of competence, sense of belonging, and experiences of participation in their environments.

Undergraduate research programs were a positive source of skill obtainment, providing students the chance for close mentorship and relationship building with professionals in their fields. However, these programs were only partially responsible for a strong STEM identity. The results section concludes with students’ explicit suggestions for faculty mentors to promote a better sense of competence, belonging, and participation for Latino/a/x STEM undergraduates. The conclusions drawn from this study highlight rich, in-depth recommendations for the mentors and faculty of Latino/a/x STEM undergraduates from the students, who are the experts in the issues they face as underrepresented minorities in scientific fields.
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I would like to acknowledge the faculty mentors that have impacted my life the most in such a positive way. Thank you…

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I want to acknowledge and thank the Global Diversity and Inclusion Program and Diversity Action Council at Portland State University for offering this project a mini grant, which was used to provide participants compensation for their time in interviews.

This thesis would not have been possible without the support of my thesis committee:

Dr. Karlyn Adams-Wiggins, Dr. Ellen Skinner, and Dr. Eric Mankowski.
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Chapter 1: Introduction

In the United States, attendance among Latino/a/x college students has risen substantially (Krogstad, 2015; McFarland et al., 2018), making Latino/a/x students the largest group of racial/ethnic minorities enrolled in universities (Wagner, 2015). Honoring parental sacrifices and avoiding the cycle of generational poverty are some of the main reasons why Latino/a/x students pursue higher education (Jabbar et al., 2019). However, despite these advancements, there continue to be significant disparities with their white counterparts in their experiences on campus and graduation rates (National Center for Education Statistics, 2005; Estrada et al., 2016; American Psychological Association [APA], 2019). Higher education, and education broadly, may be actively discouraging and unsupportive for Latino/a/x students (Dueñas & Gloria, 2020; Grant & Ghee, 2015). Latino/a/x students, as well as other minority students within higher education, often experience multiple challenges based on their identities (i.e., hostile environments). These challenges may be discouraging and be experienced as unsupportive (Dueñas & Gloria, 2020; Grant & Ghee, 2015). In addition, challenges, such as being the first person in their families to attend college and lacking necessary materials or academically supportive environments to complete their schoolwork add to existing challenges and present risks for degree completion (Camacho Liu, 2011). Further, Portes and Rumbaut (2014) explain that lower levels of parental educational attainment within Hispanic/Latino/a/x households influence these students' lower degree attainment. Generational status also influences educational outcomes: Second-generation immigrant college students across racial/ethnic groups are more likely to be enrolled as
full-time students at four-year colleges than first-generation immigrant students, who are more likely to enroll at two-year institutions if they immigrated after childhood (Arbeit et al., 2016). These differences are attributed to second-generation students' greater familiarity with the educational system in the earlier years of their academic careers (Baum & Flores, 2011; Hernandez et al., 2011) and higher cultural assimilation among the groups' parents (Weller & Turkon, 2015).

In higher education, one of the most significant contrasts between Latino/a/x students and their white counterparts is their underrepresentation in STEM (science, technology, engineering, and mathematics) (Saw et al., 2018; Landivar, 2013; Riegle-Crumb & King, 2010). Based on findings from their longitudinal study, Chang and colleagues (2014) concluded that this underrepresentation is due to unequal preparation and access to educational opportunities. Consequently, the culture associated with STEM has led the field to become one in which Latino/a/x students have trouble with a sense of belonging and identification (Hurtado et al., 2009; Landivar, 2013; Riegle-Crumb & King, 2010; Saw et al., 2018). Existing research suggests that when Latino/a/x undergraduate students select majors in STEM, many feel the general need to constantly prove their academic competence to others due to feeling like they do not belong in their educational environments (Hurtado et al., 2009). First-generation Latino/a/x college students report a lower sense of belonging and lower feelings of mattering within their universities (Dueñas & Gloria, 2020). This lower sense of belonging may be due to them not knowing what resources they can use or not establishing sufficient connections compared to continuing-generation White students (Grant & Ghee, 2015). If educational
differences are understood and addressed with appropriate resources, this can diminish disparities in STEM achievement (Dueñas & Gloria, 2017). For example, Dueñas & Gloria (2017) advise university faculty that more intensive counseling encouraging students to participate meaningfully improves feelings of belonging at their institutions in several different ways. First, a core Latino/a/x value, *familismo*, may lead students to thrive if they identify environments, such as student organizations (Dueñas & Gloria, 2020), where they can have and interact with an academic "family." Second, intensive counseling that can mirror a mentoring relationship between faculty and students will benefit students' persistence within their universities (Dueñas & Gloria, 2020). Lastly, increased counseling and mentorship will provide students with more knowledge to navigate their institutions better.

**Why Look at Latino/a/x Students in Particular?**

There are three reasons why the current study focuses on Latino/a/x students. The first reason is that among the growing percentage of minorities in the United States, the Latino/a/x community has the highest growth rate. These percentages are predicted to be the following in the year 2050: Hispanic: 24.6%, Black: 13.1%, Asian: 7.9%, Multiracial: 3.8%, Other: 0.9%; constituting 50.3% of the population (Frey, 2018). According to Pew Research Center (2016), the Latino/a/x population in the United States is also disproportionately younger than other racial/ethnic groups, with a median age of 19. In addition, this younger group within the Latino/a/x population is more likely to be English-speaking and second-generation than the older Latino/a/x population, as children do not typically immigrate to the United States (Pew Research Center, 2016). These
factors may help explain why Latino/a/x students are also the minority group with the highest percentage of students enrolled in universities (Wagner, 2015), which leads to the second reason. This increase in admission rates in the Latino/a/x community within the past decades demonstrates that this group of students has the full capability to make it to higher education environments. A struggle to maintain Latino/a/x students' education and STEM may be attributed to social settings that do not provide sufficient resources, leading to their low retention (Camacho Liu, 2011; Chang et al., 2014). During a talk about academic motivation and the goal to revolutionize education, Sir Ken Robinson (2019) states: "If you have an average of 20% or more children not completing high school, you cannot blame the kids at that point." This talk was given in hopes to revolutionize education to also account for how educational institutions and leaders play a role in students’ success by not assigning all responsibility to students when they encounter educational barriers. I would apply this same mentality to higher education. The third reason for looking at this population will be described further in the reflexivity statement within the methods section of the current manuscript.

**The Social Significance of this Study.** The growing Latino/a/x college population makes it imperative that researchers and institutions are aware of the experiences these students go through. Since the beginning of American history, ethnic/racial minorities, who have been marginalized members of society, have experienced societal barriers linked to longer histories such as colonialism and slavery. Some of these barriers include disparities in generational poverty, family disruption, substance abuse, and violence (Watts et al., 1999) in contrast to their White counterparts...
MENTORING LATINO/A/X STEM UNDERGRADUATES

(American Psychological Association [APA], 2019). In addition to many of these barriers, ethnic/racial minorities have also experienced social injustices, such as inequality, segregation in teaching and schooling (Orfield et al., 2016; Smedley et al., 2001), and systemic underrepresentation in higher education (Campbell & McKendrick, 2017; Hurtado & Ruiz Alvarado, 2015; Chang et al., 2014). Society must provide for the needs of students within racially and economically oppressed groups because today's young students will be future leaders within a society that has always been diverse. Having leaders with ethnic/racial minority backgrounds can end a generational cycle within society in which leaders are unaware of, ignore, and lack concern for the problems that marginalized people experience, and where minorities have been excluded from opportunities to become leaders themselves in the first place (Reimer et al., 2020). The past literature describing Latino/a/x student disparities and barriers suggests that access to education alone will not correct racial marginalization. For progress to occur, equal opportunities for all students must be available, including institutions that emphasize accountability structures and have faculty who provide adequate support, such as assistance with navigating their universities (Acuña, 1982; Dueñas & Gloria, 2017; Orfield et al., 2016). An example of this is mentoring programs within education systems, which have demonstrated significant benefits for different populations of students across the United States (Gordon et al., 2013; Karcher & Herrera, 2007; Thompson & Kelly-Vance, 2001). Minorities have lacked access to essential resources that would allow them to thrive. Thus, it is necessary for society to implement programs for everyone, from the
beginning of early through higher education, to prevent an opportunity gap among students due simply to systemic disparities based on demographic factors.

Why Would We Look at Student Participation in Research Programs?

Latino/a/x students' underrepresentation and limited sense of belonging led researchers to identify practices that are beneficial to these students' persistence in higher education, as well as within STEM fields (Chang et al., 2014; Chelberg & Bosman, 2019; Dueñas & Gloria, 2020; Haeger et al., 2016; Nagda et al., 1998; Schultz et al., 2011). Past studies revealed that URM undergraduate students who were informed about and encouraged by social partners in university settings to participate in undergraduate research had an increased likelihood of obtaining or continuing to progress toward completing a STEM degree by a significant percentage (Russell et al., 2007; Chang et al., 2014). Haring (1999) argued that the literature on minority mentoring programs for college students reveals the difficulties of accurately evaluating these programs considering the continued overwhelming underrepresentation in degree attainment from these groups. Literature today demonstrates that these programs are effective resources. They significantly increase the likelihood that Latino/a/x students will persist and obtain STEM degrees compared to those not in the programs (Chang et al., 2014; Russell et al., 2007). However, the disparities, especially underrepresentation in STEM degree attainment, that Haring (1999) described continue today.

The current study's interest in student participation in research programs was motivated by the significant difference in degree attainment between STEM majors in undergraduate research (UGR) and those who are not students in UGR programs.
Students in URG experience a higher degree of direct interactions with faculty mentors outside of the classroom. When these interactions are primarily positive, it allows them a unique experience that can strengthen their researcher identity and allow them to obtain additional support (Ceyhan & Tillotson, 2020; Estepp et al., 2017; Estrada et al., 2018; Seymour et al., 2004; Russell et al., 2007). Despite literature demonstrating the significant role mentors play in undergraduate research programs, little work allows students to use their voices to explain how their social partners helped or inhibited their persistence as STEM majors. Additionally, despite the understanding of practices that are beneficial to students' persistence in higher education, existing literature overemphasizes comparison between successful and unsuccessful students, often with the use of traditional quantitative methods (Mervis, 2006; NIH, 2005).

However, this would illustrate deficit-oriented (Valencia, 2010) emphasis on student qualities (Mervis, 2006) without accounting for opportunity gaps and lacks the benefit of understanding those students' perceived positive attributes of the programs (NIH, 2005). It is essential to consider that, like how positive undergraduate research experiences contribute to beneficial outcomes for Latino/a/x students, negative experiences are highly detrimental, most commonly affecting their career choices and overall mental health (Frederick et al., 2021). Because of past research's emphasis on student qualities alone, we know little about what is happening in relevant social interactions and how students experience those interactions. This is a problem considering that social partners play one of the most significant roles in persistence in
higher education (Chelberg & Bosman, 2019; Dueñas & Gloria, 2020; Fries-Britt, 2000; Haeger et al., 2016).

**A Shift in Attention**

The model that guides the current study is Wenger’s (1998) Communities of Practice Framework. It suggests that learning experiences are influenced by how one identifies within the community they are in, how often they can implement practice, and whether they feel a sense of community and competence. I propose shifting our attention to communities of practice rather than students. The current study will employ a critical paradigm (i.e., Guba & Lincoln, 2005) utilizing subjectivity to transform Latino/a/x STEM students’ experiences. To address gaps in previous work on program effectiveness, this project will solicit Latino/a/x STEM student perspectives about their experiences with faculty mentors. It will use UGR programs and classrooms as primary context for understanding how mentor/mentee relationships influence students’ science identity development in STEM. The key to understanding program effectiveness comes from the students themselves.

As was mentioned, Latino/a/x students’ increased attendance rates demonstrate that students have the ability. These changes could result from new extracurricular after-school opportunities and resources within K-12 education (Oberle et al., 2019). In addition to programs that facilitate students' success, however, social partners play one of the most significant roles in persistence in higher education (Chelberg & Bosman, 2019; Dueñas & Gloria, 2020; Fries-Britt, 2000; Haeger et al., 2016). Not only do Latino/a/x students experience underrepresentation in higher education, more observed through
STEM majors, but they face a double burden because they also do not see faculty that look like them (Castellanos & Gloria, 2007; Gloria and Rodriguez, 2000). Because most faculty in higher education are non-minority members, they may be unaware of financial barriers, familial responsibilities, or feelings of the imposter phenomenon that often accompanies students who are members of minority groups. This must change. A shift may allow researchers to understand and share more accurate suggestions to Latino/a/x students’ more powerful social partners on the role they play, either positively or negatively, in Latino/a/x students' scientific identity development. Thus, this study will seek Latino/a/x STEM undergraduates' voices through semi-structured qualitative interviews about their experiences with mentors and faculty from their institution. This study will view the participants as the experts on the experiences Latino/a/x students face, with the goal that their narratives can contribute to a better understanding of what they need from their social partners and what they believe would help them navigate their educational experiences and develop a stronger scientific identity.
Chapter 2: Literature Review and Present Study

Mentoring

Now that I have introduced past literature on why Latino/a/x students in STEM and mentor qualities are worth studying, I will expand on essential details about this topic. I will begin with possibly the most crucial subtopic, mentoring. The primary component of mentoring is having a close personal connection between a mentor and a mentee (Tolan et al., 2013). A novice develops skills by working and participating in skills they cannot yet do alone with someone who has more expertise than they do (Rogoff, 1990; Wenger, 1998). Mentors are typically older and have more experience than their mentees; thus, they can provide mentees with appropriate guidance and resources (Freedman, 1993). Researchers have identified mentoring as an excellent resource for overcoming obstacles presented to students of all ages (Clarke-Midura et al., 2018; Crisp et al., 2017; Hund et al., 2018; Kuperminc et al., 2020; McDaniel & Besnoy, 2019). Accompanied by the many resources these mentors provide, mentors can also motivate their mentees to set goals, including improving their academics and behavior (Tenenbaum et al., 2001). Ideally, mentors are role models who share skills and knowledge and who offer personal support (Gordon et al., 2013). Findings have demonstrated that students work harder due to their motivation to impress their mentor (Thompson & Kelly-Vance, 2001). Mentors help mentees by spending time working on their homework assignments and teaching them practical studying skills, compensating for their diminished opportunities (Freedman, 1993; Gordon et al., 2013). Having this
support system increases the likelihood that students will persist and improve academically (Thompson & Kelly-Vance, 2001).

In their study about mentorship for first-generation college students, Ahmed and colleagues (2021) found that students considered mentorship highly valuable, especially if their mentors shared a similar academic track. This is because mentors were able to advise them on possible experiences and challenges with their specific major (Ahmed, 2021). College students with mentors on similar academic, or career tracks, also experience improved academics and other hands-on skills because they can apply suggested and effective methods to feel confident about concepts they are learning or understanding the next steps they should be taking in their academic career (Ahmed et al., 2021; Ceyhan & Tillotson, 2020; Chelberg & Bosman, 2019). Additionally, students’ confidence level regarding their academic belonging was higher after mentoring programs than prior to their participation (Ahmed et al., 2021). It has also been demonstrated that mentors play a significant role in guiding mentees’ professional identities because the shared affinities and opportunities to discuss a shared identity can help strengthen the importance of that identity (Long, 2018). Rose and colleagues (2005) describe mentors within educational environments as guides who are also highly skilled at referring their mentees to the correct resources, especially when a situation is beyond the mentor’s scope of expertise. Lastly but also importantly, findings suggest that a good mentorship relationship is one where the mentor keeps track of the mentee’s progress over time, and shares this information with mentees (Rose et al., 2005).
Studies have demonstrated that underrepresented minority (URM) students who have participated in mentoring programs report that their experiences were enriching and gave them academic support (Chelberg & Bosman, 2019). Mentors can help Latino/a/x students feel a sense of relatedness and understanding of their academic identity, which they usually do not receive at home, as many are first-generation college students (Chelberg & Bosman, 2019; Haeger et al., 2016). Studies have demonstrated that quality mentorship also influences URM students’ overall science identity, which helps predict STEM career choice after completing an undergraduate degree (Estrada et al., 2018; Haring, 1999). This past literature can also support the research by Torres and Hernandez (2009). They found that mentors play a significant role in students’ decisions and ability to persist in their institutions (Torres & Hernandez, 2009), as it has been previously discussed that Latino/a/x students have a more difficult time doing so (Camacho Liu, 2011). In addition, findings also demonstrate that an identified mentor who supports Latino/a/x students led to the students having higher satisfaction with faculty (Torres & Hernandez, 2009), a “binding” effect considering that many Latino/a/x students have difficulty identifying with faculty at their universities (Castellanos & Gloria, 2007; Gloria and Rodriguez, 2000).

Fries-Britt (2000) argues that it is essential for faculty to understand the role that racial identity development plays in other types of identity development for students who are learning and developing a strong sense of self. Thus, for Latino/a/x undergraduates in STEM, the science identity they are developing would be strengthened if faculty understood identity integration; how their racial identity influences their identity
processes in school. Faculty should learn more about theories that shape the outcomes and identity development of minority students, such as critical race theory (Ladson-Billing & Tate, 1995; Dixson & Rousseau Anderson, 2018; Taylor et al., 2009). Findings from Dueñas and Gloria’s (2020) study imply that advisors and other faculty who serve as mentors should know different ways that Latino/a/x students, who are often first-generation students with difficulties navigating campus resources when compared to continuing-generation students, can be involved on the campus. That way, this information can be passed on to them. Additionally, mentors and faculty who serve as cultural navigators for Latino/a/x students by understanding the cultural orientations and values of the students help those students feel a sense of belonging and mattering, which can lead to success (Dueñas & Gloria, 2020). It can additionally lead to a higher level of engagement in their college experiences (Torres & Hernandez, 2009). Below are two tables. Table 1 lists characteristics that make a good mentor, and Table 2 lists the effects of mentoring; both as described from the above literature.
Table 1  
*Characteristics of High-Quality Mentors*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Providing mentees with appropriate guidance and resources (Freedman, 1993)</td>
<td></td>
</tr>
<tr>
<td>Serving as role models (Gordon et al., 2013)</td>
<td></td>
</tr>
<tr>
<td>Sharing skills and knowledge (Ceyhan &amp; Tillotson, 2020; Gordon et al., 2013)</td>
<td></td>
</tr>
<tr>
<td>Offering personal support (Ceyhan &amp; Tillotson, 2020; Gordon et al., 2013)</td>
<td></td>
</tr>
<tr>
<td>Spending time working on mentee’s homework assignments (Freedman, 1993; Gordon et al., 2013)</td>
<td></td>
</tr>
<tr>
<td>Teaching mentees practical studying skills (Freedman, 1993; Gordon et al., 2013)</td>
<td></td>
</tr>
<tr>
<td>Having a similar academic track to advise mentees on possible experiences and challenges (Ahmed, 2021)</td>
<td></td>
</tr>
<tr>
<td>Discussion of mentor and mentees’ shared academic identity (Long, 2018)</td>
<td></td>
</tr>
<tr>
<td>Referring mentees to correct resources (Rose et al., 2005)</td>
<td></td>
</tr>
<tr>
<td>Keeping track of mentees' progress over time (Estepp et al., 2017; Rose et al., 2005)</td>
<td></td>
</tr>
<tr>
<td>Passing down information (Dueñas &amp; Gloria, 2020)</td>
<td></td>
</tr>
<tr>
<td>Serving as cultural navigators (Dueñas &amp; Gloria, 2020)</td>
<td></td>
</tr>
<tr>
<td>Understand the cultural orientations and values of mentees (Dueñas &amp; Gloria, 2020)</td>
<td></td>
</tr>
<tr>
<td>Interacting with students (Estepp et al., 2017)</td>
<td></td>
</tr>
<tr>
<td>Listening and understanding students’ interests (Estepp et al., 2017)</td>
<td></td>
</tr>
<tr>
<td>Being organized (Estepp et al., 2017)</td>
<td></td>
</tr>
<tr>
<td>Requiring students to be responsible (Estepp et al., 2017)</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* This table demonstrates characteristics that make a good mentor.
Table 2

*The effects of mentoring*

| Mentees’ increased ability to overcome obstacles (Crisp et al., 2017; Hund et al., 2018) |
| Enriching academic support (Chelberg & Bosman, 2019) |
| Mentee’s increased sense of relatedness to their academic identity (Chelberg & Bosman, 2019) |
| Effective goal setting to improve mentees’ academics and behavior (Tenenbaum et al., 2001) |
| Mentees’ heightened motivation to work hard and impress their mentor (Thompson & Kelly-Vance, 2001) |
| Persistence in school (Chang et al., 2014; Chelberg & Bosman, 2019; Dueñas & Gloria, 2020) |
| Mentees’ practice and learning of hands-on skills (Ceyhan & Tillotson, 2020) |
| Applying suggested and effective methods provided by mentors (Ahmed et al., 2021) |
| Mentees understanding the next steps they should be taking in their academic career (Ahmed et al., 2021; Chelberg & Bosman, 2019) |
| Increased confidence level (Ahmed et al., 2021) |
| Sense of academic belonging (Ahmed et al., 2021) |
| Guidance for professional identities (Long, 2018) |
| Influences overall STEM identity (Estrada et al., 2018) |
| Guides STEM career choice (Estrada et al., 2018) |
| Decision and ability to persist in their institutions (Torres & Hernandez, 2009) |
| Higher satisfaction with faculty (Torres & Hernandez, 2009) |
| Higher level of engagement (Torres & Hernandez, 2009) |

Note. This table demonstrates the effects of mentoring.

**Latino/a/x students in STEM at the undergraduate level**

Research has focused on Latino/a/x undergraduates’ experiences in STEM. Hagedorn and colleagues (2007) investigated the effect of Latino/a/x, or same-ethnicity, peer representation level at a community college on Latino/a/x students’ academic success. The researchers did this by collecting Latino/a/x students’ GPA and other
institutionally relevant measures of academic success. Their analysis demonstrated a significantly positive correlation between representation and GPA, confirming that when Latino/a/x students see others who are like them, educational outcomes are strengthened (Hagedorn et al., 2007). These findings have been further supported by more recent work. Rincón (2020) also explored the relationship between Latino/a/x representation and student retention, using STEM students as their specific target population. Rincón gathered data from Latino/a/x students from 6 different institutions, and the results, similarly to Hagedorn and colleagues (2007) revealed a significant relationship between the level of same-ethnicity peers and student outcomes (Rincón, 2020). As was mentioned in the introduction, however, Latino/a/x students are currently underrepresented in STEM majors at universities (American Psychological Association [APA], 2019; Estrada et al., 2016; National Center for Education Statistics, 2005), consequently making them underrepresented in the STEM fields in general (Saw et al., 2018; Landivar, 2013; Riegle-Crumb & King, 2010).

The barriers Latino/a/x students face based on lack of representation among peers are also reflected in underrepresentation among faculty, as Latino/a/x students also struggle to find faculty with backgrounds and experiences similar to theirs (Castellanos & Gloria, 2007; Gloria and Rodriguez, 2000). The key role that representation plays in Latino/a/x students’ outcomes implies that if underrepresentation and lack of understanding of Latino/a/x students’ experiences persist, disparities in academic success may continue. Students from underrepresented groups experience dismissiveness toward their achievements and failure to recognize their competence. For example, through
qualitative methods using focus groups. Hurtado and colleagues (2009) found a common theme that Latino/a/x students receive messages from social partners that they are only succeeding because of additional supportive resources provided to them because they are minorities, such as research programs structured specifically for minorities, or having increased opportunities simply because of their minority status rather than because of their academic qualifications. This further influences their constant pressure to prove their academic abilities and competence to other social partners who aren’t similar to them, as to why they are also able to succeed in science (Hurtado et al., 2009). Another finding that emerged from the study was that Latino/a/x students also frequently received messages from their instructors that they were unprepared for the class if there were concepts that the students did not understand. Adding the effects of frequently negative messages to Latino/a/x students’ general difficulties, such as a lack of educational access (Camacho Liu, 2011; Taningco et al., 2008), often leads to harmful effects. For example, students can eventually become skeptical about their own intellectual skills within rigorous fields, bringing them closer to the stereotype threat of failing to succeed (Hurtado et al., 2009). This suggests that many Latino/a/x students are within contexts in which they are not merely having an “imposter” mindset but are having it imposed by social contexts where skepticism of their competence is common and their accomplishments are devalued, specifically, because they were not achieved in direct competition with a White “comparison group”.

However, Hurtado and colleagues’ (2009) study findings revealed that students were highly motivated to take initiative for change, such as attending office hours to ask
questions more comfortably. Implications from these findings are that in addition to faculty’s major role in student outcomes, students are interested in identifying faculty who can support them. This also supports Fries-Britt’s (2000) notion that when faculty, regardless of whether their racial/ethnic background is like their students, have and share knowledge about useful resources to students, it contributes to positive outcomes for students. This demonstrates the importance of representation and understanding of Latino/a/x experiences (Fries-Britt, 2000).

Estepp and colleagues (2017), as well as Estrada and colleagues (2018), suggest that participation in undergraduate research and the practices that they involve strengthen students’ scientific identity, and there are several studies that support their findings. For example, earlier work revealed that positive outcomes of undergraduate researcher experiences include personal and professional gains, thinking like a scientist, better skills, and graduate school preparation (Seymour et al., 2004; Russell et al., 2007). Additionally, Russell and co-authors (2007) discovered that students who participated in undergraduate research experienced more confidence and competence in their knowledge of the research process. These feelings could be higher due to messages they get from their mentors. More recent studies have supported these findings, revealing that STEM students who participate in a research mentor program report higher confidence in their research skills and understanding of the research process, and in addition reported that they found the resource to be enriching and to provide academic support and understanding that they usually do not receive at home (Chelberg et al., 2019; Haeger & Fresquez, 2016). Undergraduate research programs with direct interactions with faculty mentors and
mentoring postgraduates have been shown to provide students with a high level of support, including personal, emotional, and professional support; these various levels of support increase students’ engagement in their field of study (Ceyhan & Tillotson, 2020). For example, in their study, Ceyhan & Tillotson (2020) described intellectual support, such as mentor scaffolding focused on important terminology and tools that are important in a lab, and how such support allowed students a better understanding of and promoted scientific processes that would be necessary for their projects. Similarly, for example, professional support, such as academic advising, allowed students to feel they had guidance, increasing their engagement and socialization skills within their scientific community. The study also revealed that while clear responsibilities and expectations are beneficial for students’ scientific development, social and emotional support, such as accessibility and understanding, also benefited their experiences within their scientific projects (Ceyhan & Tillotson, 2020).

**Latino/a/x student Participation in Research at the Undergraduate Level**

Although there is limited research about Latino/a/x students in undergraduate research, it has been shown that the scaffolding obtained from these programs allows students to feel like they can persist in STEM fields (Nagda et al., 1998; Schultz et al., 2011). Professors’ support may not be enough to give the necessary guidance, assistance, and hands-on experiences to engage undergraduates in STEM fields and research (Ceyhan & Tillotson, 2020). Students’ intent to persist in STEM fields is highly influenced by the opportunity to develop expertise in scientific tasks, and this increased confidence in skills accompanies self-acknowledgment that they are competent enough to
identify themselves as researchers or scientists (Frederick et al., 2021). Past studies revealed that URM undergraduate students who were informed about and encouraged by social partners in university settings to participate in UGR had an increased likelihood of obtaining or continuing to progress toward completing a STEM degree at a significantly higher percentage (Chang et al., 2014; Russell et al., 2007). Additionally, Latino/a/x students’ participation in undergraduate research contributed to them considering graduate education (Villarejo et al., 2008). To expand on the previous discussion about the importance of faculty’s cultural competence, research has found that when Latino/a/x students’ faculty mentors are culturally competent, they are more likely to pursue a graduate degree (Morales et al., 2021). This further enhanced students’ engagement throughout their research activities (Frederick et al., 2021). Similar to how positive undergraduate research experiences contribute to beneficial outcomes for Latino/a/x students, however, negative experiences are highly detrimental, most commonly affecting their career choices and overall mental health (Frederick et al., 2021). Below is a table, Table 3, that lists the advantages of participation in undergraduate research (UGR) programs, as described from the above literature.
Table 3  
**Advantages of participation in URG programs**

- Strengthening students’ scientific identity (Estepp et al., 2017; Estrada et al., 2018)

- Personal and professional gains (Seymour et al., 2004; Russell et al., 2007)

- Thinking like a scientist (Seymour et al., 2004; Russell et al., 2007)

- Better skills and graduate school preparation (Seymour et al., 2004; Russell et al., 2007; Villarejo et al., 2008)

- Increased confidence and competence in knowledge of the research process (Chelberg et al., 2019; Haeger & Fresquez, 2016; Frederick et al., 2021; Russell et al., 2007)

- High level of support, including personal, emotional, and professional support (Ceyhan & Tillotson, 2020)

- Students feeling that they can persist in STEM fields (Nagda et al., 1998; Schultz et al., 2011)

- **Increased persistence or obtaining a STEM degree** (Chang et al., 2014; Russell et al., 2007)

*Note.* This table demonstrates the advantages of participation in undergraduate research programs.

**Gender and STEM.** There are also gender considerations that should be kept in mind when examining undergraduate students in STEM. One study (Riegle-Crumb & King, 2010) examined data from a nationally representative sample and found within universities, there is a notable gap in STEM participation among racial/ethnic groups, with White populations having higher percentages of students who are enrolled in STEM majors compared to Hispanic/Latino/a/x students. In addition to that, it was revealed that there was also a gender disparity, in which a higher percentage of males were enrolled in STEM majors compared to females. This was the case for all groups separated by ethnicity, as well as overall. Similarly, women are highly underrepresented in STEM occupations (Landivar, 2013). A different study that explored contexts outside of academics specified that males were employed in STEM fields at twice the rate that women were (Landivar, 2013). It is important to consider that these differences are observed in earlier student experiences (Saw et al., 2018). Saw and colleagues found that
female students, Black, and low SES high school students reported a lower percentage of
STEM career interests compared to White male students. When considering the
intersectionality of race, gender, and SES, these findings imply that ethnic/racial
minorities who identify as female are less likely to report interests in STEM, particularly,
Black females from low SES backgrounds.

Undergraduate research programs found at universities. There are a few
undergraduate research programs that can be found at several universities across the
United States. One undergraduate research program in many higher education settings is
the McNair Scholars program. This program trains undergraduates for research in
graduate-level settings. It allows underrepresented students to gain research experience
and obtain more experience in scholarly work (McNair Scholars Program, 2014).
Underrepresented minority student representation could potentially rise with their
exposure to this experience (Renbarger & Beaujean, 2020). A meta-analysis conducted
by Renbarger and Beaujean (2020) revealed that the opportunity to work closely with a
faculty mentor allowed students to learn how to create high-quality relationships with
other professionals, and it also helped them develop positive beliefs about their own
competence. An earlier study conducted about the McNair Scholars Program alumni
revealed that McNair alumni stated that the financial support, research exposure,
internship opportunities, and mentoring were helpful for their educational experiences
(Grimmett et al., 1998). Additionally, Renbarger and Beaujean (2020) revealed that
students who participated in the McNair Scholars program were more likely to attend
graduate school compared to students who did not participate.
Another research program is known as BUILD EXITO. BUILD EXITO is an NIH-funded program that seeks to provide support, mentoring, and training opportunities to college students interested in research, hoping that those resources contribute to diversifying STEM fields (Keller et al., 2017; Richardson et al., 2017; Valantine & Collins, 2015). The BUILD EXITO program has been implemented in multiple higher education institutions, including a total of 11 colleges in the United States and a few U.S. territories (Keller et al., 2017; Richardson et al., 2017). In addition to training opportunities that can ideally hone students' scientific skills, provide scaffolding for their projects, and provide a community to students, one of the program's most significant contributors to students' abilities to persist in degree completion is the program's financial assistance component (Richardson et al., 2017). The university that is primarily awarded funding for the BUILD EXITO Program locally is Portland State University (PSU), a public university that has a diverse group of students in the program, including minorities, first-generation college students, and transfer students (Keller et al., 2017; Richardson et al., 2017). The process of the program's evaluation values students being a part of the process, with the implementation of surveys, individual interviews, and focus groups to collect data. The current study's methods will be explained in detail in upcoming sections, but participants will consist of PSU students, some of whom will be part of the BUILD EXITO and McNair Scholars programs.

**The Role of Participation in Clubs and Organizations.** Billingsley and Hurd (2019) investigated whether the role of extracurricular activities serves as a mechanism for counteracting the damages of discrimination on underrepresented students’ academic
motivation. They found that extracurricular activities did ameliorate the harmful effects of discrimination on underrepresented students’ mental health, consequently aiding students in their academic outcomes. Extracurricular clubs and organizations in universities give students the opportunity to network with other students, which can allow for the development of support systems that protect against difficult barriers, such as discrimination (Billingsley & Hurd, 2019). Additionally, Chang and colleagues (2014) conducted a study about the factors contributing to retention of students from underrepresented groups. When students participated in extracurricular clubs and organizations within their universities, this contributed to their chances of persisting in STEM majors. Many clubs consist of a targeted membership. Most members have a common identity that allows for the development of a community that shares an understanding of experiences based on that identity (Chang et al., 2014). Chang and colleagues (2014) suggest that when universities create spaces in which similar students can engage, it can influence further connection through academic activities, such as studying. The authors recommend that institutions provide culturally specific organizations that also aid students in developing STEM majors. The different contexts for students' participation in extracurricular activities that will be examined for the current study are detailed in Appendix A. These will include other clubs and organizations in addition to the above-mentioned research programs, McNair and BUILD EXITO.

Conclusion
Previous findings demonstrate that there are several factors from social partners that can bolster Latin/o/a/x students’ scientific identity development. Mentoring in general helps students persist and improve academically, and mentees also work harder to impress their mentors (Thompson & Kelly-Vance, 2001) and find time spent with their mentors highly valuable, especially if their academic identities are similar (Ahmed et al., 2021; Chelberg & Bosman, 2019; Haeger et al., 2016). Participation and mentorship specifically in undergraduate research strengthened URM STEM students’ science identity, which helps predict STEM career choices after completing an undergraduate degree (Estrada et al., 2018; Haring, 1999). Additionally, research has shown that extracurricular activities help students cope with the damages that discrimination has on their academic performance. Additionally, student participation in extracurricular clubs and organizations contributes to their chances of persisting in STEM majors.

**Present Study**

**Theoretical/Conceptual Framework**

A community of practice (Wenger, 2015) is a group that is formed by people who share a common passion/interest or concern for something they do in their lives. As members of this shared domain, together they regularly learn, participate in joint activities, form experiences, and collaborate, develop a shared repertoire of resources, and share information to advance their general knowledge of the domain. Although the term ‘communities of practice’ is new, the phenomenon it refers to has existed for as long as people have learned and participated together. Whether they realize it or not, everyone belongs to several communities of practice and will be part of numerous communities in
their lives. An example of a community of practice might be a group of underrepresented minority students in a lab who are aspiring to become scientists. Some examples of participation in these students’ labs include problem-solving, requesting information, seeking experience, coordination and synergy, and discussions.

A community of practice that allows individuals to feel competent, the need to belong, and like they can participate can improve their commitment to identifying with that community. For schools to be able to better implement this environment for underrepresented minority students in STEM, researchers must center their attention on complexity, educational contexts, and issues of ethnic, cultural, and gender diversity. The current project is about describing what these four components look like for Latinx students in STEM if we understand labs and classrooms as STEM communities of practice. With an emphasis on the identity component, the assumption is that they can end up on outbound trajectories, such as developing marginal identities, if the other three components of Wenger's model are problematic, or the mentors/faculty orchestrate learning poorly. Conversely, they could end up on inbound trajectories, such as developing STEM identities of legitimate peripheral participation, if mentors/faculty positively orchestrate the other three components of Wenger's model. Below is an adapted version of a diagram mapping out Wenger’s (2009) sociocultural theory of learning in relation to the current project. There are four components, and the emphasis for the current project is learning as becoming/ identity, bolded on Figure 1 below, with the other three components being intertwined with the identity development process.
Social and Academic Integration. Tinto's (1993) integration framework is rooted in the belief that the more college students are socially and academically integrated into their universities, the more likely they are to obtain their college degrees. If they are not integrated into their university, they are isolated and risk withdrawing from their commitment to their university. However, to be integrated into their universities, Tinto believed that students must transition out of their family systems to succeed in their new environment. Guiffrida (2006) explains that researchers have criticized Tinto's framework due to failing to consider the role that family plays in minority students' identity and success. That is why several researchers have tried to integrate culturally sensitive orientations into Tinto's theory, such as considering home
systems and replacing integration, which expects rejecting previous norms, with connection, which allows students to tie both former and new norms together (Guiffrida, 2006). The updated framework would consider the core value of *familismo*, which Dueñas and Gloria (2017) view as critical for Latino/a/x students and reaffirms findings from Dueñas and Gloria's (2020) study that recommends that advisors and other faculty within universities should understand ways that Latino/a/x students navigate their college journey and how their previous experiences affect their progress. By conducting 238 semi-structured interviews with students and faculty at colleges, Deil-Amen (2011) found a social and academic integration influenced one another and become a meshed term better known as socio-academic integration. Socio-academic integration was the integration that most participants frequently experienced. An example of this was student-faculty interactions, including social interactions between students and faculty in academic settings such as classrooms. They found that positive social interactions with faculty improve academic performance and students' sense of belonging, and in addition, students themselves identified faculty as an essential source of social capital (Deil-Amen, 2011). Like the critical findings regarding faculty roles, Holloway-Friesen (2021) confirmed past research that mentoring enhanced Hispanic undergraduates' academic and social integration outcomes. Mentoring has been demonstrated to help students belong in their institution, and feelings of fit between students and their institutions reinforce the commitment to their academics (Holloway-Friesen, 2021). In the current study, student and faculty mentor interactions will be analyzed to determine what processes help shape

**Critical Theory Paradigm.** The current study utilizes a critical paradigm. Positivist and postpositivist researchers do not assume that it is their responsibility to implement action, instead of viewing those things like advocacy, which could reduce validity and objectivity and contaminate their results (Guba & Lincoln, 2005). On the other hand, the critical theory paradigm, a well-established paradigm for inquiry (Lincoln et al., 2017), prioritizes social transformation and reframes the question of objectivity (Guba & Lincoln, 2005). Researchers often seek transformation in the form of empowerment for their target population (Guba & Lincoln, 2005). The critical inquiry aims to implement positive change for people oppressed by more privileged or powerful others (Lincoln et al., 2017). Objectivity is determined if researchers justify how their work is based on community agreement (Cohen & Crabtree, 2006). The quality of this inquiry is judged by its ability to bring action and change toward equality that benefits society (Lincoln et al., 2017). In terms of control, the critical theorist believes that power will return to the community (Guba & Lincoln, 2005). The work of critical theorists includes the voices of both the researcher and participants (Guba & Lincoln, 2005).

Therefore, as a researcher in a privileged position relative to participants and as a member of a marginalized group, my goal for the present study is to foster empowerment for my participants.

**Past work on successful mentors of Latinx students.** Estepp and colleagues conducted a mixed-methods study to learn about the practices of 15 McNair Scholars...
mentors who successfully mentored Hispanic undergraduate researchers to accomplish their tasks. The mentors in the study identified behaviors such as interacting with students, listening, and understanding students’ interests, being organized, requiring students to be responsible, and monitoring students’ work as being both task and relationally oriented. Results from Estepp and colleagues’ study informed that there are two possible overarching themes that could be observed in the current study. Those themes include skill-building and relational (See Table 5) support from mentor(s)/faculty. However, in their study, the mentors alone, rather than students, were the ones who shared what has helped them guide Latinx to persistence. The goal of the current thesis’ study results was to be composed of students’ perspectives. Nevertheless, Estepp and colleagues’ work guided the current thesis for the themes that could have arisen.

It was anticipated that participants of the current thesis will mention the importance of skill-building and relational support on their science identity development. For skill-building support, it was anticipated that participants will state some mentor/faculty qualities that increase scientific skills and scientific identity. These include the following: providing examples of typical article formats, showing examples of other research to help students get ideas, to provide feedback, pairing them with graduate students working on similar projects, hands-on, participating with research, discussing scientific methods, and helping students find material for their research projects. For relational support, it was anticipated that participants will state that some mentor/ faculty qualities make them feel support in the relationship and allow a welcoming atmosphere to develop their scientific identity. These include the following:
being a good lister, scheduling regular meetings, discussing goals, and barriers, frequent contact via email, and monitoring progress. See Table 4 below for a summary of the two themes found.

Table 4
Good mentor qualities (Estepp et al., 2017)

<table>
<thead>
<tr>
<th>Skill-Building Support</th>
<th>Relational Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Providing examples of typical article formats</td>
<td>Being a good lister</td>
</tr>
<tr>
<td>Showing examples of other research to help students get ideas</td>
<td>Scheduling regular meetings</td>
</tr>
<tr>
<td>Providing feedback</td>
<td>Discussing goals and barriers</td>
</tr>
<tr>
<td>Pairing them with graduate students working on similar projects</td>
<td>Frequent contact via email</td>
</tr>
<tr>
<td>Hands-on participation in research</td>
<td>Monitoring progress</td>
</tr>
<tr>
<td>Discussing scientific methods</td>
<td></td>
</tr>
<tr>
<td>Helping students find material for their research projects.</td>
<td></td>
</tr>
</tbody>
</table>

Note. This table demonstrates good mentor qualities as suggested by Estepp and colleagues (2017).

Purpose of the Current Study

Educational research can play a crucial role in understanding and diminishing disparities in STEM. However, for too long, researchers have implemented interventions that focus only on improving the qualities of Latino/a/x students to increase their success. As Rappaport (1981) suggests, researchers must trust that the citizens in need, in this case, Latino/a/x undergraduates, rather than myself, are the experts in knowing the resources that will improve their circumstances and give them control over decision-making. Latino/a/x students in STEM may experience power differences from both faculty mentors and their White peers. If a researcher is interested in learning about
power differences and experiences of inequality within marginalized and oppressed
groups, research methods that allow those groups’ voices to be heard are very important
(Ravitch & Riggan, 2016).

While Estepp and colleagues (2017) provide fruitful knowledge about effective
strategies of successful mentors, I believe that a lack of student-perspective was an
important limitation of their study. In the current study, it was students who provided
perspectives on strategies they believed are effective, and thus the current study’s results
section includes participant quotes to demonstrate examples and the prevalence of the
themes. The current study also asked students about what kinds of mentor behaviors were
not helpful, something we can’t typically learn from mentors themselves. It is essential to
provide thick descriptions for supporting qualitative research’s trustworthiness (Geertz,
1973).

Qualitative methodologies will enable participants to expand in detail and provide
helpful examples, not limiting them to only a set of possible responses as do solely
quantitative methods (Queirós et al., 2017). Along with contributing to the development
of programs through their excerpts describing their experiences, these students will have
the chance to feel empowered through their participation (Maton, 2008). The research
question examined for the current study is: How do faculty mentors influence the STEM
identity development of undergraduate Latinx students? More specifically, what are some
faculty mentor practices that promote or undermine the STEM identity development of
undergraduate Latinx students?
Chapter 3: Methods

**Reflexivity.** Mann and Kelly (1997) describe the practice of reflexivity as one's understanding that their lived experiences and positionalities influence their knowledge. This consciousness plays a central role in research findings, and it is an essential component of qualitative research because it helps honor all of those involved in the study (Palaganas et al., 2017). However, Barusch and colleagues (2011) have pointed out a lack of reflexivity practices, even within qualitative work. They highlight that those authors may fear this practice could strike those reading their narratives as unprofessional, and therefore they rely on safer strategies that demonstrate the rigor in their work, such as with quantifiable and deductive methods. I, too, believe that as a researcher myself, whose work reflects my own experiences, I must be conscious that I am part of the environments I study (Ackerly & True, 2010). Thus, before the methodological discussion of the proposed study, I provide a reflexivity statement that briefly details my experiences as a researcher, past mentee, and past Latina in undergraduate research. Similarly, research assistants who worked on this project alongside me also completed reflexivity statements, which are included in the appendix portion of the current manuscript (see Appendix B).

As a researcher, I am eager to dive deep to discover the needs of other minority groups in my future work. For now, I focus on this specific demographic because it is one I have considerably high expertise in, and my third reason why, I am focusing on this group of students, as I am Latina. This work will help me keep expanding my knowledge of other minority groups to bring “action” in the most effective way possible in my future
career. I was a first-generation college student raised in a low SES household in Massachusetts and Oregon. From the third grade until high school, I experienced discrimination from my classmates and teachers and often felt classified as unimportant. I struggled as a student upon being pulled out of bilingual education in third grade, which was supposed to be completed ideally at the end of my sixth grade. Before that, I excelled in my studies but later became unmotivated and did poorly in academics the remaining of my elementary and partial middle school, as I did not have teachers who I perceived as caring for my improvement in their classes. I grew older and as I became more accustomed to the English language, it greatly influenced my academic performance and understanding of the content in my classes. I completed my 8th grade with better grades. Inspired by my resentment to previous teachers and classmates to prove my abilities, I became determined to excel in school again.

However, soon into high school, my motivation, initially fueled by resentment, quickly changed for the better. For the first time, I experienced a high level of attention from faculty that I had not had before. I identified three teachers who inspired me, demonstrated kindness, and took the time to leave comments on my work. Later, I was fortunate to obtain my associate degree at a community college with a full-ride scholarship because of my high academic achievements in high school, in addition to other financial aid. At my community college, it was the first time, at the age of 17, that I ever saw Latino/a/x faculty in an academic setting, and I quickly began to admire them. They helped me imagine myself being in their position several years from then, and I believe I could make it far, too. When I transferred to a four-year university, I received
the same level of high-quality mentoring. I had very few Latino/a/x mentors in my life, but those few made their mark on me. Fortunately, my other non-Latino/a/x mentors were knowledgeable about first-generation minority college students' struggles, always reminded me I was doing very well, and constantly shared opportunities to enhance my academic skills.

During my undergraduate education, although not part of an established undergraduate research program, I was part of a few research teams. I received high-quality scaffolding that prepared me to become a researcher and made me feel confident about proceeding to graduate education. Today, I continue to grow every day under the guidance of my current advisor, a person of color. Their advice has made me feel excited about how my work could contribute to my community. Sometimes, I still felt like I did not belong in my classrooms, especially with my memories as a younger student. But my research mentors and involved professors have made all the difference in my perseverance. I have always been capable, but I also had many helping hands. I often think about all my Latino/a/x friends who hoped to achieve higher education but, despite being highly capable, did not reach their hopes. I also wonder how significantly different it would have been if they all had the opportunity to be mentored by faculty who provided them with resources, the practice of important skills, and time. That is why instead of wondering, through this current study, I want to better understand how faculty mentors may contribute to other Latino/a/x students’ success.

**Qualitative Approach.** Semi-structured qualitative interviews were conducted for the current study. See the specific interview script and questions in Appendix A.
Before the recruitment process began, the principal investigator and committee chair conducted, recorded, and reviewed a few pilot interviews, allowing the team to determine if the interview protocol was satisfactory. Evaluation of protocol satisfaction includes asking the interviewees of the pilots about their experiences with the interview, the amount of responsiveness the questions generated, and whether the questions generated content relevant to the research questions. This study had culturally matched interviews, which means that all interviewers were of Latino/a/x ethnicity. Interviewers can create a more trusting and comfortable environment with similar positionalities (Lincoln et al., 2017). Data are constructed in the interaction between participant and researcher: Rapport and trust matter for data trustworthiness. Before the interview date, students were allowed to request gender-matched interviews if they preferred.

**Data collection.** Upon obtaining institutional review board (IRB) approval, the recruitment process began in the summer term of 2022 and continued until the winter term of 2023. A study recruitment flyer was created to spread awareness of my thesis study and was posted throughout the entire college campus. See Appendix A to view the recruitment flyer. In addition to hanging recruitment flyers, 15 professors in STEM, 14 Latinx-specific and STEM-specific clubs and organizations or representatives of those clubs and organizations, six undergraduate research programs or faculty representatives of those programs, the Chemistry department, and seven senior and graduate students, were contacted to spread the word about the current study. Furthermore, I presented my thesis proposal to BUILD EXITO faculty and visited two college courses for recruitment. Finally, the current study also implemented snowball sampling, in which participants
were asked to share information about the study with their peers after each interview. These efforts to recruit resulted in 57 outlets I explicitly notified about my study. This does not include the ones that those outlets themselves shared.

**Participants.** The current study sought Latino/a/x STEM undergraduate students’ participation to understand how contexts and social partner qualities can be improved to serve their institutions. Latino/a/x STEM students in UGR and those not in URG programs within the university were recruited. The initial desired number of participants was an equal split of 10-20 for those two groups, similarly with an equal representation of gender identity. The study sought students aged 18-29 at Portland State University and in science – including natural and social science, technology, engineering, and math majors to participate.

A total of 20 students filled out the pre-screen survey. One student did not fit the participant characteristics requirement, one failed to provide clear contact information for researchers to reach out to, and six no longer replied when a follow-up to schedule the interview was sent. This left 12 students who were interviewed; however, one student’s interview was dropped upon discussion that they did not entirely fit participant characteristics requirements, leaving the study with a total of 11 participants and 60–90-minute, in-depth interviews that took place from the start of August 2022 until the end of January 2023. I interviewed ten students, and a research assistant interviewed one. I cleaned eight transcripts, which entailed organizing formatting, correcting wording mistakes made from the Zoom application’s transcription, adding time stamps every five minutes, and making grammar corrections only if they continued to match the audio
provided by Zoom. Two transcripts were cleaned by the research assistant who provided a reflexivity statement, and one was cleaned by another who preferred not to provide a reflexivity statement.

Participants' ages ranged from 18 through 29, including one Freshman, one Sophomore, two seniors, and seven Seniors. Majors included Social Science, Social Work, Biology, Psychology, Computer Science, Math, Engineering, and Public Health. Three students had minors, including Child, Youth, and Family Studies (CYFS), Philosophy, Spanish, and Math. All participants identified themselves as Mexican, with one being half-Mexican and half-Guatemalan. Eight participants identified themselves as female, and three identified themselves as male. All participants were first-generation college students. 10/11 students were considering graduate or professional school. Four students were involved in undergraduate research programs, including BUILD EXITO and the McNair Scholars program. Nine students were involved in a Latin, culturally specific program or organization. Four students were involved in a STEM-specific program or organization. One student's overall rating of Portland State University was excellent, eight students' ratings were good, and two students' ratings were average. See Tables 5 and 6 below for demographic information.
Table 5  
*Participant Demographic Information*  

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Age</th>
<th>Major</th>
<th>Minor</th>
<th>Class Standing</th>
<th>Nationality</th>
<th>Gender</th>
<th>ID</th>
<th>College Gen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jose</td>
<td>23</td>
<td>Social Science</td>
<td>N/A</td>
<td>Senior</td>
<td>Mexican</td>
<td>M</td>
<td>1st</td>
<td></td>
</tr>
<tr>
<td>Karla</td>
<td>19</td>
<td>Social Work</td>
<td>N/A</td>
<td>Sophomore</td>
<td>Mexican and Guatemalan</td>
<td>F</td>
<td>1st</td>
<td></td>
</tr>
<tr>
<td>Stephanie</td>
<td>20</td>
<td>Biology</td>
<td>N/A</td>
<td>Junior</td>
<td>Mexican</td>
<td>F</td>
<td>1st</td>
<td></td>
</tr>
<tr>
<td>Blaire</td>
<td>21</td>
<td>Psychology</td>
<td>CYFS</td>
<td>Senior</td>
<td>Mexican</td>
<td>F</td>
<td>1st</td>
<td></td>
</tr>
<tr>
<td>Jay</td>
<td>24</td>
<td>Computer Science</td>
<td>N/A</td>
<td>Senior</td>
<td>Mexican</td>
<td>M</td>
<td>1st</td>
<td></td>
</tr>
<tr>
<td>Elizabeth</td>
<td>18</td>
<td>Computer Science</td>
<td>Math</td>
<td>Freshman</td>
<td>Mexican</td>
<td>F</td>
<td>1st</td>
<td></td>
</tr>
<tr>
<td>Luna</td>
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<td>Senior</td>
<td>Mexican</td>
<td>F</td>
<td>1st</td>
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</tr>
<tr>
<td>Miguel</td>
<td>20</td>
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<tr>
<td>Catherine</td>
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<td>Philosophy and Spanish</td>
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<tr>
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<td>Senior</td>
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<td>1st</td>
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</tr>
<tr>
<td>Sara</td>
<td>22</td>
<td>Public Health</td>
<td>N/A</td>
<td>Junior</td>
<td>Mexican</td>
<td>F</td>
<td>1st</td>
<td></td>
</tr>
</tbody>
</table>

Note. This table contains the demographic information of the students that participated in the current study.

Table 6  
*Participant Involvement*  

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Undergraduate Research</th>
<th>Latino/a/x Culturally Specific Programs</th>
<th>STEM Specific Programs and Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jose</td>
<td>None</td>
<td>GANAS</td>
<td>None</td>
</tr>
<tr>
<td>Karla</td>
<td>None</td>
<td>GANAS</td>
<td>None</td>
</tr>
<tr>
<td>Stephanie</td>
<td>None</td>
<td>TRiO</td>
<td>Undergraduate Biology Committee</td>
</tr>
<tr>
<td>Blaire</td>
<td>BUILD EXTO</td>
<td>TRiO</td>
<td>None</td>
</tr>
<tr>
<td>Jay</td>
<td>McNair Scholars Program</td>
<td>TRiO</td>
<td>LSAMP</td>
</tr>
<tr>
<td>Elizabeth</td>
<td>None</td>
<td>GANAS and TRiO</td>
<td>Neuroscience Club</td>
</tr>
<tr>
<td>Luna</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Miguel</td>
<td>None</td>
<td>Society of Hispanic Engineers</td>
<td>LSAMP</td>
</tr>
<tr>
<td>Catherine</td>
<td>BUILD EXITO</td>
<td>None</td>
<td>Leading Hispanics in STEM</td>
</tr>
<tr>
<td>Florencia</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Sara</td>
<td>BUILD EXITO</td>
<td>GANAS</td>
<td>None</td>
</tr>
</tbody>
</table>

Note. This table contains information pertaining to students’ involvement on campus.
Procedure. Before the interview, each participant was sent a demographics survey, the consent statement, and a survey about the types of involvement they had on campus (See Appendix A) for them to send back before the interview date. Significant efforts were made to build what Epstein (2008) would call basic trust with participants. For example, the research assistants are Latinx, just like them, and were close in age to almost all of them, and we let them know this during small talk. We engaged at the beginning of the interview to get to know each other when the recording was turned off. Topics of small talk conversations included what parts of Mexico their respective families were from and their educational values. Epstein (2008) also differentiates between basic and high levels of trust building. While I did not engage in significant efforts of high trust building, I let them know of my plans to do this in the future, such as how I planned to share the lessons I learned from my participants’ expertise with PSU’s STEM departments, as well as undergraduate research programs so my findings can serve this community of students. I let them know they would play a significant role in potential program changes. Once small talk was completed, the interviewer began recording the interview on the Zoom application, and the participant verbally consented to be part of the study.

The interviewer gave an overview of the study goals and expressed the importance of their participation in the field’s understanding (See Appendix A). The interviews took 60-90 minutes. (See Appendix A for the full interview protocol) After the interview, participants were debriefed and granted a $20 gift card to incentivize their participation. At the end of the interview, participants were encouraged to assign
themselves a pseudonym that best reflected their own identities, which are used in reporting participant quotes in the results section of the current manuscript. Nine of the participants chose their pseudonyms. Two, Miguel and Luna, said they did not prefer choosing their pseudonym, and thus I chose their pseudonym for them.

Interviews were conducted through the videoconference application, Zoom. One of this application’s most attractive features is its setting to transcribe the recorder calls’ audio verbatim, providing the main user a separate document of speaker notes alongside the video and a separate audio file after a few hours of video processing. This was ideal for me, as I inserted the audio-recorded transcripts of each interview into their own document for the analysis I conducted, which will be described shortly. Inevitably, the Zoom application occasionally commits errors in the transcription process, often due to misarticulation, soft-spoken voices, or background noise. There was a long process of correcting all the transcripts. Each interview was reviewed and revised using the audio file, and the only changes made were to transform participants’ statements into their original and corrected statements. To protect the participants’ identities, the video files generated by zoom were destroyed after observing and accounting for the non-verbal communication and body language of the students; and the audio files were destroyed after the transcription procedure occurred.

**Research Team.** There were two undergraduate research assistants in my research lab who helped with interviewing and the cleaning of transcripts (see Appendix B for Reflexivity Statement). I provided them with appropriate literature to enhance their understanding of the theoretical/conceptual frameworks that guide my study. Our lab has
a focus on the sociohistorical framework, and all members had practiced with the same research methodologies that were planned for the current study. The advisor serving as the chair of the current study’s committee is the advisor who has trained our lab and research assistants. The research assistants were given extensive training in the data collection and interviewing process.

**Interview Protocol.** For the current study, only some sections of the protocol were analyzed; thus, the transcripts were only partially analyzed. The selected sections of the protocol used for this study have to do with Wenger’s (2015) social theory of learning and include the community (belonging), practice (participation), identity (becoming), and meaning (experiences) components. See the highlighted sections in Appendix A to review the interview questions relevant to this study.
Chapter 4: Analysis

Braun and Clark's (2015) six phases of qualitative analysis guided the current study. I followed the six phases manually; software programs for the analyses were not utilized.

**Phase 1: Familiarizing oneself with the data.** Fully transcribed documents of the interviews were obtained using the Zoom application's recording features, but there were many areas for correction. Thus, the research assistant and I listened, followed along, and corrected all the errors. Cleaning the transcripts was exhausting, but it allowed me to familiarize myself with the data and actively brainstorm potential themes. After this, I reread the documents, highlighting excerpts related to STEM identity and faculty mentors. Topics included communication with faculty, acknowledgment of their perspective in STEM environments, critical STEM skills, whether faculty mentors helped with STEM skill development, sense of competence, belonging, identity, and participation. After highlighting relevant areas, I created a new, shorter document with just these topics for each participant, and that new shorter document was the final product of the transcripts I would work with for this project.

**Phase 2: Developing initial codes.** On all 11 shortened transcripts, I left memo comments on the side of the document for each talk turn, summarizing my interpretation of the participants' answers. After this, I made one large document where I compiled all my participant memo comments, allowing me to produce a within-participants summary for each transcript.
**Phase 3: Identifying themes.** I compiled each memo comment in a separate document and categorized them by grouping participants' similar answers to identify themes.

**Phase 4: Refining themes.** For refining themes to ensure they fit the data and that each is distinct from others, the thesis committee chair, Dr. Adams-Wiggins, helped me group similar student experiences and narrowed down the themes found.

**Phase 5: Defining and naming themes.** I continued to refine and define the themes by describing the overall topic or concern. If any themes were too complex, sub-themes were organized to provide more organization. Themes had clear and concise names.

**Phase 6: Developing a report.** Finally, I developed a report to describe the data and demonstrate to readers the validity of the analysis. Along with the write-up, I provide evidence by including extracts from the interviews demonstrating the frequency of the themes.

**Sample Size (Malterud et al., 2015)**

Malterud and colleagues (2015) propose the concept of information power. The more information a sample holds, the fewer participants they will need in the sample. They explain that researchers often seem concerned when qualitative samples are too small rather than validating the quality of the analyses. They suggest not focusing on extensive samples because it could save time and resources collecting unnecessary data and risk not having a thorough analysis. Few participants are adequate if the information power is sufficient and can contribute to new knowledge about the topic. Thus, the
MENTORING LATINO/A/X STEM UNDERGRADUATES

authors illustrate the properties of Information Power with five dimensions that impact the power of a qualitative sample. See Figure 2 below to view an image representation of these properties.

Dimension 1: Aim. A broad study requires a larger sample than a narrow aim to offer sufficient information power. So, if the study’s goal concerns a broad topic, the researcher would either recruit a large sample size or narrow the aim of the study. The current study had a narrow aim as it wanted to investigate faculty mentors’ influence on identity development specifically rather than multiple factors in educational processes (i.e., persistence, motivation, achievement).

Dimension 2: Specificity. A less extensive sample is needed when participants hold characteristics. With convenience sampling, one does not usually obtain participants with specific characteristics, so this sampling method would require more participants to get a broad scope of information. The target sample was narrowed to Latino/a/x students instead of all ethnic/racial minorities. Second, the age range targeted students in higher education only, and not those in K-12. Lastly, the study focused on STEM disciplines.

Dimension 3: Theory. A study that applies specific theories for planning and analysis would require fewer participants. If there was a study starting with no theoretical background or supported by limited theoretical perspectives, the study must establish a way to ground its conclusions and would benefit from a larger sample size. There was a specific theory for planning and analysis, communities of practice.

Dimension 4: Dialogue. A study with clear and robust discussions and details would require fewer participants than a study with unfocused conversations that needed
more detail. Much of this is influenced by the interview skills and rapport of the researcher. In an effort for the interviewer to establish trust, the interviewer and interviewee had a conversation to get to know each other’s’ background and family history and values before the interview. The conversation following the interview protocol provided data of in-depth and meaningful conversations.

**Dimension 5: Analysis.** Cross-case analyses require more participants than projects with in-depth narrative analysis. The current study did not implement cross-case analysis, which would require more participants than projects with in-depth narrative analysis.

This model should be used to estimate the number of participants needed as a stepwise process and not necessarily decided entirely in advance. This way, recruitment can end when the sample holds sufficient information.

Figure 2
*Information power - items and dimensions*

*Note: This table is from Maturana and colleagues’ (2015) work, illustrating the dimensions of the concept Information Power.*
Chapter 5: Results

The qualitative data produced in participant interviews enabled this project to answer the following questions more explicitly: 1) What are faculty mentor qualities that promote Latino/a/x STEM identity development? and 2) What are faculty mentor qualities that undermine Latino/a/x STEM identity development? As was previously stated, using Estepp and colleagues’ (2017) study as a guide, it was anticipated that participants of the current study will mention the importance of skill-building and relational support on their science identity development.

Outline of the Results. Before reporting the findings discovered from the analysis, I will provide an outline of the themes that arose. First, differences in students’ communication level with faculty, felt acknowledgment in their STEM environments, and strength levels in STEM identity will be explained. Second, the STEM skills that students found important will be described within four overarching themes: scientific reading and writing, effective communication, skills for data analysis, and other. It will then be addressed whether students’ faculty mentors in fact promoted their desired skills. Third will be the section pertaining to competence; this includes promoters and inhibitors of a sense of competence in class and labs. The fourth section will outline factors encompassing a sense of belonging, including promoters and inhibitors of a sense of belonging in class and labs. Fifth, there will be a section about students’ participation levels, including if students feel like they can participate in their STEM environments, promoters, and inhibitors of participation in classrooms and labs. Next, the finding that social science and other outside of STEM faculty embody the promoting characteristics
that students find critical, more so than STEM faculty, will be explained. The results section concludes with information identifying students’ explicit recommendations for faculty mentors to better promote a sense of competence, a sense of belonging, and participation for Latino/a/x STEM undergraduate students.

**Communication with faculty**

Students were categorized by high, medium, and low levels of communication with their classroom professors (i.e., office hours, in-class questions, after-class discussions), with medium communication being the level with the greatest number of students. (See Table 22 in Appendix C to view more descriptive information about each participants’ interactions with faculty mentors). Two students, Karla, and Jose stated that they felt they had high communication with faculty. What is interesting about these two students is that neither of them were part of undergraduate research, in which more hands-on mentorship and deeper connection could have been provided to them. Nevertheless, they expressed this high level of communication with professors in the classroom specifically. Karla mentioned feeling nervous to talk to professors at first, but it became easier over time, especially because they were kind and responsive:

> *It was different in college because you could actually have a conversation, which to me, was really different, very new. Cause being in the dual language immersion program in elementary and middle school kind of ruined my relationship with teachers because teachers kept leaving and new teachers would come and they wouldn't be as polite... So... My [Freshmen Inquiry] professor would answer*
really quickly, and he would always be super nice... Around spring term [is when] I started feeling a lot more comfortable.

There were three students, Luna, Jay, and Blaire, who reported that they felt they had a medium level of communication with faculty. Luna and Jay explained their response as being rooted in experiences with both encouraging and intimidating interactions with professors. Luna had some professors who validated her need for help, but also some other professors who became upset with her presence at office hours and this discouraged her from attending. Luna did not participate in undergraduate research, in which more one-on-one attention could have been granted to her:

Every single time I went to office hours I felt like ‘Do I even know my material?’ and didn’t feel confident. I would go in there like ‘I’m here again, I’m so sorry’ and they’re like ‘You’re here for a reason... [it] shows you’re passionate about what you’re learning’. They’d make me not feel ashamed... They have been super gracious whenever I go...

Oh man, no!... I do remember a professor, I totally forgot about this. I think I was traumatized and kept it in the back of my head... I did go to office hours one time and I would ask a question, and then he would be like, ‘Did you not look back at the notes?’... And this professor was a stats professor [who was] really short with their answers. And so, I was very intimidated to go... They would kind of roll their eyes at me when I didn’t understand something. And so that really threw me off and made me not want to come back, because I felt so dumb... Um, and so that
was a feeling that I do not like to have... But I'm like, this is my grades, I'm on scholarships, I have to go, even if I feel terrible.

Blaire expressed that she only attended office hours or sent emails when she had questions and preferred to ask brief questions at the end of class time rather than during. However, she did express that it is easier to talk to professors who are more approachable:

They vary by professor... I try not to participate that much in class because I just generally don't have any questions [or] sometimes because students take up more time in class... With some professors... [and] courses, I do feel like I have questions and speak up towards the end, not during the class time. I do send them a lot of emails. But, with other classes, I just feel like I understand everything. It varies by material and how approachable professors seem... cause some professors I feel incredibly comfortable with... But some are not approachable, or I just don't have any questions.

Further, Blaire, Jay, and Sara all were part of research labs and had engaged with the lab Principal Investigators (PIs) frequently, who promoted their skills in these environments. However, their communication with their professors in classroom settings was described as at a medium level. A possible explanation to this is that students who have a mentor for research are getting more individualized communication from the outset, and thus did not require assistance from professors in their classrooms because they are already spending time with their research mentor. For example, Blaire stated she does not reach out unless she has a question. It may be that students who do not have a
research mentor and experience a welcoming classroom environment, such as Jose and Karla, may be more invested in fostering a relationship with a classroom professor.

Three students, Stephanie, Miguel, and Sara reported feeling having low communication with faculty. Reasons for students' low communication were attributable to them feeling intimidated to engage in class, not feeling welcomed to office hours, and having passive-aggressive or cold interactions with professors. For example, Stephanie mentioned she only attended office hours once:

...there were like 30 students trying to get in (laughs)... I felt like I couldn't talk to the professor... I also had a professor that wouldn't let you ask questions during lectures and wouldn't have office hours unless students asked for it (laughs)...

[The professor] would be very condescending to the entire class and send class-wide emails basically saying he was disappointed in the results of the exams.

Three students' communication levels were not recorded because of interviewer and interview script inconsistencies (i.e., interviewers not addressing every bullet point in the protocol to avoid running out of time). These participants included Elizabeth, Florencia, and Catherine who was part of an undergraduate research lab.

Acknowledgement

Students were categorized by those who felt their perspectives were acknowledged in their STEM environments, those who felt the acknowledgment of their perspectives in STEM environments were dependent on (1) their level of participation, (2) if they felt they had something valuable to offer, and (3) the type of environment they were in, and those who felt their perspectives were not acknowledged in their STEM
environments. (See Table 23 on Appendix C for a table categorizing participants in each of these groups) Two students expressed that they felt their perspectives were acknowledged. Out of these students, only one, Catherine, was involved in undergraduate research. The two students reported feeling acknowledged because they had positive experiences during discussions with mentors, such as receiving encouraging feedback when sharing perspectives, as well as being provided with reassurance when their answers are correct. These students also experienced professors offering respectful explanations if the students’ perspectives did not align with the professors’ expectations. For example, Jose shared that in classrooms:

_Sometimes I hear ‘That's a good idea’, or ‘That makes sense, let’s do that’._

Florencia attributed her felt acknowledgement to her highly supportive environment:

*I don't know if it's just this year, or it's my cohort, or it's always been like this... Here, PSU, or is this commitment [of the] civil engineering department... to make every student feel comfortable... I don't know if it's also because I came from a harsh environment that I just feel that I'm in heaven.*

Four students expressed that acknowledgment of their perspectives in STEM environments was dependent on their level of participation, if they felt they had something valuable to offer, and the type of environment they were in. For example, two students believed their ideas were not acknowledged in class because of their lack of vocalization. Jay answered:

_Do I feel my perspectives and ideas are acknowledged in my classes? Not really. I try not to say a lot of my ideas in classrooms, because... my ideas don't really..._
follow too much into career development. You know, in industry. So, if I do say something people might look at me weird (laughs)... so I try not to.

Two students, Sara, and Miguel felt their ideas were not acknowledged in class because they did not think their own opinions would be relevant to the material being taught. For example, Sara stated:

*In class, you mostly just go there to learn the material. So, I don't know how my opinions would affect it.*

Blaire, Jay, and Sara are part of undergraduate research, and while they did not believe their ideas and perspectives were acknowledged in classrooms, the three did feel acknowledgement in their respective lab spaces. For example, Jay did feel his perspectives and ideas were acknowledged in his lab because his ideas do not need to depend on topics that need to be covered and feels more understood in his train of thought:

*Yeah, definitely, because it's a more creative process. It's more like getting to truly understand a big field. And so, it is better acknowledged, because I think it has a bit more understanding where your train of thought is, which I think is very important.*

Four students expressed that they felt their perspectives were not acknowledged in their STEM environments. None of these four students were involved in undergraduate research. For Karla, Elizabeth, and Luna, it was because they had low experience with talking or raising their hands much in classes. For Stephanie, however, reasons for this were explicitly due to ostracization:
...I felt like I wasn't really heard in that class. I would say something, I'd be ‘Hey, what do you think about this possible experiment?’ And they'd be like ‘Nah’, and they'd be like ‘What do you guys think about this?’ and it'd be almost the exact same thing I said... I swear sometimes they would ignore me. They'd be like ‘can you speak up’ and I'm just like ‘never mind’ because... I was already talking at a normal range.

**STEM Identity**

Students were asked about how they felt about their STEM identity, and were categorized by low, moderate, and high STEM identity, with the low STEM identity level having the greatest number of students. (See table 24 on Appendix C to view a visual of how participants were categorized in the groups) Five students were classified into the Low STEM identity group based on their reports of their identity strength. This low identity group was divided into two clusters, (1) messages that inhibited STEM identity development and (2) lack of experience.

Three students fell into the first category, messages that inhibit STEM identity. Karla, Blaire, and Sara had all received some form of explicit message that made them feel like their specific areas of discipline are not recognized as true STEM fields or like they did not fit the stereotype of what a STEM student should be or the skills they should have. Sara illustrated this issue when she expressed:

*Public Health doesn't sound like its STEM. But it's just technically a major to help you get your pre-requisites in STEM to get into a PA school. My lab is just talking with people and not actually in the lab looking under a microscope and doing that*
type of lab work... So, if I'm in a room with a bunch of those several researchers, I wouldn't feel like... I would feel really intimidated, or I feel like they wouldn't take my type of work seriously.

Two students fell into the second category, lack of experience. Elizabeth and Stephanie expressed they did not have a strong STEM identity because they had not been sufficiently exposed to their respective environments. Stephanie highlighted the toll that lack of research experience and support made on her identity when she stated:

I don't have a strong STEM identity... I feel like I could make it if I had the right support, but right now don't have support and I haven't had any research experience so right now it's hard for me to identify within the STEM field...

One student, Catherine, was classified into the Moderate STEM identity group based on her reports of her identity strength. This group only had one relevant cluster, Pride and feeling valued by the context. She expressed:

Sometimes I randomly come home like ‘Dang, I'm really in science’. I just think it's cool. I value science so much. In my opinion, I'm so honored... I genuinely feel I have [valuable] things to share... and offer to science. Before, I'd be like ‘What! I can't be a scientist!’ But like dude I'm a scientist! (Laughs) I'm a researcher. Like, people ask me what I do. 'I'm a research assistant'. You know. Point blank. That's what I am, and I'm really proud of it...

However, she admitted she felt more confident labeling herself as a scientist or researcher than she did about labeling herself as someone in STEM.
But when I hear the word STEM... I don't know why... When I think of STEM, I'm like, ‘oh, I don't know anymore’ like... but it's the same thing... I'm still doubting it now.

Even though she was actively doing research, she still doubted her classification in STEM in general.

Four students, Luna, Miguel, Florencia, and Jay were classified into the High STEM identity group based on their reports of their identity strength. This group had one large category relevant to pride, including that other people knew or characterized them through their passion for their discipline, they tried to encourage younger students or family to become interested, felt prideful to represent the Latinx community, and their ability to comprehend they have rare skills. For example, Luna shared:

I feel confident in saying that I am a woman in STEM. ...I used to work with high schoolers at a summer camp [and would ask them] 'what's your favorite subject?', because I was like... ‘Please say math!’, but (laughs) none of them would say math! And I'm like “but math is so fun!” .... They know that I have a passion for math. Or they would say something like, ‘I hate doing this equation’, and then they’re like ‘don't say that in front of [Participant name] because she loves math!’ It's just something that people know that I [enjoy]. So, I feel like that is a big part of my identity... I'm always that one person... 'if you have any questions, let me help you’. I would advertise myself.

Although Jay was the only student from this high STEM identity group who is involved in UGR, an interesting similarity that these four students share is that their majors fall
within what is often stereotyped as hard STEM disciplines: Math, Engineering, and Computer Science.

Jose’s response was not recorded for the STEM identity section because the interviewer missed this portion of the protocol.

**Important STEM Skills**

There were four overarching categories of skills participants reported as important to them. These included three specific groupings: skills for scientific reading and writing, skills for effective communication, and skills for data analysis skills. Some skills mentioned by participants did not fit into these three categories and thus were placed into a fourth category labeled “other relevant skills”. (See Table 25 in Appendix C to view a full description of each skill that all participants found important)

Eight students reported the importance of scientific reading and writing, which included three different subthemes: (1) how to read for the purposes of scientific writing (i.e., the creation of literature reviews for their own understanding or creation of their own new work, understanding how a study is written, parsing articles, etc.), (2) knowledge of the structure of scientific writing (i.e., knowledge of APA and MLA formatting), and (3) using scientific writing skills to directly develop a scientific identity/develop as a scholar (i.e. development of research questions). For example, Karla mentioned it was important for her to understand:

*Note taking skills and paraphrasing as well. Learning how to do citations [in APA].*
Jay highlighted the importance of knowledge of the structure of scientific writing when he mentioned “being able to parse articles”, “being able to find related articles”, and “critical thinking on how to stay within the scope when you’re looking to research”.

Catherine learned a lot of things in her lab:

For example, reading literature reviews, and summarizing... I know doing research is very heavy on being able to understand how a study is written, being able to read it and understand what previous people did so that you can do your own thing and be able to use the same format to communicate that to the public, I understand, that's a big part.

The second most important skill mentioned among four students was effective communication, including communicating effectively within teams and to the broader community. Miguel mentioned it was critical for mechanical engineers to:

...summarize a complicated idea for projects or products, and be able to explain it to somebody like they're in sixth grade or fifth grade... In my degree, we're talking a lot with people that don't really know what's going on with the product. [Being able] to tell them ‘This can happen because of this, so, we need this important expensive equipment because it helps with... that’ and being able to explain those types of things.

Sara demonstrated the importance of liaising with participants when she stated:

Since we [recruit] people... having the ability to communicate... and talk to them in the way that's convincing, but not pushing them to take the survey. Also being clear when you talk to people.
Third was data analysis skills, such as using software or theories, which three students reported as crucial within their area of discipline. Blaire discussed the importance of using software programs to analyze data:

*In the other lab that I worked in this summer at the University of [State] I was able to learn how to use SPSS… I hadn't had that exposure until I went there to work on another project. So, I like learning about [that]… or [learning] how to use R or all these other research tools or program software… that'd be helpful as well. Maybe in undergrad so it's not that scary once you get into grad school…*

Jay made a point about extracting information from data:

*The scale of applying theory to… or current tools to achieve a certain understanding of data. So being able to extract information from data.*

Lastly, there were other relevant skills that were talked about by a few students and did not fit anywhere else and thus did not justify their own separate categories. One thing that only two students discussed was the importance of math, such as understanding the math relevant to coursework, learning about the history of math, and understanding the fundamentals of math and that everything builds off them and each other.

For example, Luna shared that she took: *this one course… [in which we] had to do our own research about anything that we wanted. So, I studied the history of calculus and where it started... A lot of the time we focus on European mathematicians or figures like Aristotle or people like that... I was able to research a Mexican mathematician. And so that was something cool to tie my identity in my culture back to what I'm learning. And so, I was able to research*
this woman... *She was one of the first females to graduate from the University of Math in Mexico. So that was cool to learn about.*

Another thing that only two students discussed was transferable workplace skills, such as practicing skills they would use in their future career. Jose highlighted the benefits of transferable workplace skills when he reflected on a course assignment:

*We had to come up with an activity and make a curriculum basically for our class and I did mine on different types of plants and that was cool.*

Lastly, only Florencia saw the importance of developing a creative problem-solving orientation, such as having analytical skills and thinking outside the box:

*Analytical skills are one of the most important skills in engineering, kind of having the out of the box kind of mentality to try to resolve a solution to things that doesn't seem to have a solution. Having an open mentality of ‘Hmm... What can I do to solve this, or what do I have to do to invent something that can solve this? Even if it takes time. There has to be a solution for this.' That's very important for the whole engineering world.***

**Faculty Mentors Promoting Skills Development**

While all participants reported skills that they believed were critical in their respective STEM disciplines, only six reported having experience with faculty mentors that promoted the development of those skills. (See Table 26 in Appendix C for a description of each participants’ experience with faculty mentors promoting their skill development) Four students’ experiences highlighted the importance of time with faculty mentors, as they expressed structured time set aside with mentors to review work...
alongside them, get feedback, find solutions, and get tutoring helped them work on the skills they found important. Sara recalled a time that her lab principal investigator (PI) helped her develop skills by giving her time:

…for one of our meetings, we got to pick a [journal] article to summarize it, and then we went over the table and [the PI explained what things meant and] what the numbers meant… how they were applying the study. And so, we actually took the time to go over it.

Two students expressed that when their faculty mentors facilitated opportunities for collaboration, such as whole class activities or group work, it helped their skills. Luna stated:

...she would put us in a lot of group settings just to prepare us for the future... you will have to be in groups, work in teams sometimes in the real world... and learn to interact with others... Plenty of math teachers would put us in groups because... in the future you will be with other people and interacting with other people, learning how to interact with others and working together is a big deal, especially in research.

Two students reported that another way faculty mentors promote their skills is when they help them develop their STEM identity, such as by encouraging them to read articles within their field of interest or learn about STEM professionals that share their cultural identity. Blaire shared that her lab mentors:

...strongly encourage me to read articles within the field that I'm interested in working in.
Another way that two students reported that faculty mentors promoted their skills was by allowing them to practice those skills in their current environment, such as getting experience with software programs or learning how to act in a lab. Catherine demonstrated the importance of practicing skills when she answered:

*The biggest thing that I can translate to what I would want to do is to know how to act in the lab, and how to communicate with people... and that includes being able to read the studies that your PI wants you to read, and summarize them...*

Lastly one student, Jose, mentioned that it is helpful when mentors provide intentional scaffolding, that also considers students’ time:

*Different types of readings... and interesting videos that get right to the point... Some videos, articles, even sometimes if they have really good podcasts... I’ve had good experiences with that. Sometimes they have online books and that’s where you do the homework and the reading, I’ve had a pretty good experience with that too.*

Five students did not believe their faculty mentors promoted the development of the skills they found important. Two students shared what they believed their mentors could have offered to help them promote their skills, and what they shared reflected the same patterns as those students who did receive help. For example, when Karla was asked if she thought her skills would develop if all her professors commented on her assignments like her psychology professor did, she answered:

*Oh yeah! I feel he definitely would. He would see me and be like ‘oh hey let's set up a meeting, let's talk about this, let me help you out’.*
Miguel identified with the others on the importance of transferable skills when he stated:

...Sometimes [teachers] give super complicated spills about different technologies or stuff like that when it shouldn't be that complicated, it could be explained really easily. I feel like that should be part of their job... explaining it in a set of smaller concepts and then try to expand outward.

Miguel also mentioned the need for scaffolds and time when he expressed:

Probably that students have so many classes going on. That we don't have only one class, and we have multiple things at the same time... we could understand this easily how you're saying it if this was our only class. But we just took two other classes, and we sat in two other lectures for 4 hours... and it's like... 'this is my last class of the day”, and it's not like I'm going to be fresh off the crash and be able to understand it, you know. So, if they were able to like, understand we have to warm up to it and not just throw something brand new at the end of the day... at the beginning of the class, but [slowly] build up [to it], or maybe dumb it down at the beginning, and then try to expand outward.

Competence

Nine students felt their faculty mentors believed in them. Two students did not feel like their faculty mentors believed in them. (See table 27 to view participants categorized in these groups)

**Promotion of a sense of competence in classrooms.** There were three overarching clusters within ways professors support feelings of competence in
classrooms, including (1) scaffolding, understanding, and motivation, (2) approachability and accessibility, and (3) student input/autonomy in course structure. See Table 7 below this section, which presents a summary of faculty behaviors and characteristics that the participants listed before categorized into clusters.

Seven students discussed the importance of the first cluster (scaffolding, understanding, and motivation). Examples of this cluster included professors giving words of affirmation, inviting students to participate in class, giving students recognition of their positive qualities, encouragement, reassurance, scaffolding toward correct answers, exposing students to practice exams/quizzes/homework that will reflect upcoming exams, and providing positive feedback on assignments. For example, Jose mentioned:

"Feedback is one of the most important things in class... If the feedback is good, then it's because they took the time to look it over and tell you what things you can improve on... and once [I] do it right, it makes me feel really good. Like I'm gonna be successful."

Four students expressed points within the cluster of approachability and accessibility, including telling students they are there to help, being friendly and chatty, having conversations unrelated to school, and talking about each other's background. Luna highlighted the importance of approachability and accessibility when she stated:

"...every single time I went to office hours... I didn't feel as confident. And so, I would go in [and say] ‘I’m here again, I'm so sorry’ and they're like ‘You're here for a reason... [It] is important for you to ask questions [and it] shows that you're..."
passionate about what you're learning’... They'd always make me feel better about going in for office hours.

Two students discussed the importance of student input/ autonomy in the course structure, including the points of being accommodating, making the course accessible, and acting on the input of students. For instance, Elizabeth expressed:

...he was asking the general public, which was kind of a small class, if it would be more beneficial to open all the modules and keep it weekly ... he took the input of the students. It felt like he did want us to learn from what he was saying and make it more accessible.

Table 7
Ways professors support feelings of competence in class

| Providing positive feedback and scaffolding |
| Having non-school related conversations |
| Their recognition of students’ positive qualities |
| Words of affirmation and encouragement |
| Talking about each other’s backgrounds |
| Being accommodating |
| Being nice |
| Being chatty |
| Taking the input of students |
| Making the course accessible |
| Validating students’ presence in office hours |
| Recognizing students’ abilities |
| Giving practice exams/ quizzes/homework that will reflect upcoming exams |

Note. This table demonstrates ways faculty mentors supported students’ sense of competence in classrooms.
**Promotion of a sense of competence in research labs.** There was one overarching cluster on how faculty mentors can help students feel competent in research labs. This was motivational and emotional support, which all four students involved in undergraduate research identified as important. This included providing positive feedback, giving reassurance, helping without overstepping, giving recognition, giving them leadership responsibilities and management tasks, being compassionate, making them feel respected, being kind, and being supportive. See Table 8 below this section, which presents a summary of faculty behaviors and characteristics that the participants listed, before categorized into clusters.

Sara highlighted the importance of providing reassurance when she stated:

... I sent a document about my current study, and we were going over making changes... After we were done, she [gave] me reassurance that ‘yeah, we may have changed a lot, but that's how it's supposed to be’. It [didn’t] mean I did anything wrong... that's how editing works. You go over and change it as many times until it's good. [She gave] me that reassurance.

Only Jay mentioned some other things outside of motivational and emotional support, and this included giving him the right amount of work, considering other aspects of his schedule, and being accommodating and accepting:

*Part of it is giving you the right guides down a certain rabbit hole. They give you the right amount of work to... that kind of fits your schedule, but they're also just very accommodating or accepting people.*
Table 8

Ways mentors support feelings of competence in research labs

- Positive feedback and scaffolding
- Giving the right amount of work
- Considering other aspects of student’s schedules
- Being accommodating and accepting
- Being compassionate
- Respecting students
- Being kind
- Providing students with leadership responsibilities and management tasks
- Being supportive
- Providing reassurance

Note. This table demonstrates ways faculty mentors supported students’ sense of competence in research labs.

Inhibitors of a sense of competence in classrooms. There were three overarching clusters of ways professors undermine feelings of competence in classrooms, including (1) harshness and failure to provide positive scaffolds, (2) lack of time, and (3) failure to provide resources that strengthen their identity. See Table 9 below, which presents a summary of faculty behaviors and characteristics that the participants listed, before categorized into clusters.

Six students discussed the detriments of the first cluster, harshness, and failure to provide positive scaffolds. Examples of this cluster included when professors do not explain why their answers are wrong on quizzes, tell the class that students tend to perform poorly on exams, lack understanding when health interferes with academic success, give harsh feedback, use unfamiliar language, are dismissive of their questions,
question/ invalidate their need for help, become upset when they do not understand, and when exam questions do not match what students spent time studying. For example, Luna recalled a time with a difficult professor that made her feel incompetent:

> I don't remember his name because I think I was so traumatized. But I did go to office hours one time, and asked a question, and he [was] like, ‘Did you not look back at the notes?’... They were really short with their answers. And so, I was very intimidated to go... they would kind of roll their eyes at me when I didn't understand something. And so that really threw me off and made me not want to come back, because I felt so dumb like I should know this. Um, and so that was a feeling that I do not like to have.

Miguel also experienced difficulties with professors who made him feel incompetent:

> I think professors... by giving exams and telling us that previous classes have done so bad on the exam. That's kind of scary on the exam. Because it's like ‘you don’t expect us to do good’, and it's like ‘and why are you giving this such a hard test that you're like’? I had a professor brag about ‘I've never had a student get an A in my exams’. Like, how is that a good thing? Why, why would you be bragging about bad things?

Five students expressed points within the cluster of lack of time, including the high level of content professors require them to learn in little time, professors going at a fast pace during lecture, giving too many assignments in a week, pressure to meet certain deadlines, when professors don’t acknowledge their other responsibilities outside of class, when professors don’t stop to make sure all students are on the right track during
the lecture, students feeling like they are being left behind during lecture, lecture-style is
the only mode of instruction because of professors’ pressure to get through content, and
lack of time for group work/ opportunities to engage with others. Stephanie described
some of her courses as:

*kind of a race... Where you have to learn a lot, and if you don't learn a lot in the
amount of time that was given to you, you don't pass. I feel like I never got to fully
grasp the concepts because the teacher didn't really have time to answer
questions because they were trying to meet a quota of information that they
needed to teach.*

Two students discussed the negativity of professors failing to provide resources
that strengthen their identity, such as when they do not promote clubs and organizations
that support Latinx students or are not aware of necessary Latinx-specific resources.

For example, Florencia stated professors should:

*...have resources to send students of color.... For example, you know the Society
for Hispanic Engineers. A lot of professors probably didn't [know] that existed.
So, if they were more... ‘Hey, there's this club’... If professionals will just get
more educated [of] the different resources for people of color that would
definitely make a difference for students.*
Table 9
Faculty mentor qualities that make students feel incompetent in class

- Giving too many assignments in a week
- Unclear or harsh feedback
- Only lecture-style courses
- Not allowing time for group work/discussion
- The high level of content professors require students to learn in little time
- Not putting themselves in students’ shoes
- Using big words
- Going at a fast pace
- Questioning/invalidating students’ need for help
- Not promoting clubs and organizations that support Latinx students
- Telling the class that students in past classes tend to perform poorly on exams
- Exams not matching what she spent time studying

Note. This table demonstrates ways faculty mentors inhibited students’ sense of competence in classrooms.

Inhibitors of a sense of competence in research labs. Blaire reported that she did not have any experiences that made her feel incompetent in her lab because of her lab P.I. A response for Sara was not obtained because of interviewer and interview script inconsistencies. Catherine and Jay’s responses were different from each other, in which Jay said he felt incompetent when his P.I. takes a long time to respond to him. See Table 10, which presents a summary of these examples. Jay stated:

*I sent an email to my mentors, and after the response time takes a while... if I'm very burnt out, I start to have second thoughts, ‘Oh, did I not word this right? Am I going down the right path? What do they think?’*
Whereas Catherine said she recently felt incompetent when:

...my lab partner and I weren’t making as much progress coding samples, because it’s a ton of reading to code samples and we were being a little slow and my PI wasn't rude about it, but it was like ‘What’s going on? You guys are logging all these hours [but only coding a certain amount of samples]’. And so... you can’t help but feel some type of way like ‘Oh snap. Maybe she's right... We've been doing this for a while. How am I not doing it faster’? And in a way I felt kind of guilty. ...But I don't know, I [also] feel like she's been doing this for years...

But I'm sure that's not what she was implying.

Table 10
Faculty mentor qualities that make students feel incompetent in lab

<table>
<thead>
<tr>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>When replies take a long time</td>
</tr>
<tr>
<td>Questioning/ doubting students’ work</td>
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<tr>
<td>Not putting themselves in students’ shoes</td>
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</table>

*Note.* This table demonstrates ways faculty mentors inhibited students’ sense of competence in research labs.

**Belonging**

There were more in-depth conversations about feelings of belonging, and the clusters of categories that resulted for students when asked about their experiences of belonging were more complex. First, when asked if students felt like they belonged in their STEM courses, only five students reported that they felt they did, while six stated that their sense of belonging was dependent on other factors. For example, a pattern that was noticed for students in undergraduate research was that if they did not feel like they
belonged in their classes, they mostly felt so in their labs, and this buffered the development of their science identity development, and thus is how their belonging was dependent on environments. However, there were no students who explicitly mentioned they did not feel like they belonged in their STEM courses.

**Promotion of belonging in classrooms.** Students were asked how professors promote their feelings of belonging in classrooms, and the key experiences that were gathered were organized into a total of seven clusters, including (1) professor relatability with students, (2) professors taking a mentorship role and being approachable, (3) providing opportunities for collaboration, (4) providing a safe space to speak Spanish, (5) making class enjoyable, (6) giving students recognition, and (7) understanding the importance of representation. See Table 11 below, which presents a summary of faculty behaviors and characteristics the participants listed, before categorized into clusters.

Three students discussed the importance of the first cluster, relatability with students. Examples of this cluster included when professors shared their nonlinear experiences as past students and their non-linear path in their graduate school years. When these experiences are relatable to students, and when they have similar customs and educational backgrounds as students, students feel comfort and like they would belong. For example, Elizabeth mentioned:

*...knowing that someone from a similar background of you was pursuing the same route that you're taking would be really beneficial or knowing that they’ve done*
Three students expressed points within the cluster of professors taking a mentorship role and being approachable, including when mentors take time to explain difficult concepts, take time to explain things until they understand, being approachable and willing to answer questions, talk to students, care about mentorship, and give reassurance. Stephanie shared that one of her professors:

...would tell me about her research... She was super nice. She would always explain everything to me... I'd be like ‘I don't understand this’... and she'd help me... So, in that sense, I felt really welcome because I felt like I had an equal chance to learn like everyone else.

Three students discussed the importance of opportunities for collaboration, including when professors implement group work, allow for building relationships and communication in the classroom, and allow all students an equal opportunity to learn and participate. This was highlighted when Jose stated:

...I really like activities and I also like working in groups.

Two students discussed the importance of having a safe space to speak Spanish, such as promoting an accepting, non-judgment zone. Catherine shared that:

For two years, I took Spanish heritage. I was with native speakers at least twice a week. I didn't feel too connected to my classmates in other classes... I wouldn't even pay too much attention to it, because I [knew] I'd go to this place where I felt like home. I even told my [two] professors... ‘I'm always so excited to come here’.
Even though I primarily use English, I get sick of it... So, it was really nice to be able to go in an environment where... [there] wasn't judgment. ‘Why are you speaking Spanish?’

Two students expressed points within the fifth cluster, making class enjoyable, such as through implementing enjoyable activities. For example, Karla shared:

Building relationships in the classroom has been really helpful... I feel like it always went really fast just because I felt like it was just a time for friends. And... and it never really felt like class.

Two students expressed points within the sixth cluster, giving students recognition, such as sharing their work to the classroom as a good example. Jay expressed it was helpful to his belonging when he felt:

Achievement or recognition of the work that I've done. It wasn't something that I initially... just felt accepted. But I think the work building towards some contribution... within the range of students, I think has helped me feel in place in my field.

Lastly, two students expressed points within the cluster of understanding the importance of representation, including readings that allow them to read about Latinx people, and having inclusive posters. Elizabeth talked about seeing inclusive posters:

...They do this in high school, but I guess it's kind of different here because they move around in different buildings, but they [usually] have a general little poster that's like ‘Everyone is welcome here. This is a safe space’.
Luna and Miguel expressed that professors are not concerned with students’ feelings of belonging. For example, Luna explained that math teachers do not worry about belonging because:

_They're math teachers. They're there to teach math. And so, they would always make it a point that ‘you’re in the class to learn. You chose this class for a reason’… I don't think I've ever heard anyone say, ‘You belong here’ (laughingly)... But maybe it might be nice to hear that! (Laughs)_

<table>
<thead>
<tr>
<th>Table 11 Ways professors support feelings of belonging in class</th>
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<tbody>
<tr>
<td>Implementing enjoyable activities</td>
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<tr>
<td>Facilitating the creation of groups</td>
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<tr>
<td>Assigning readings about Latinx and communities</td>
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<tr>
<td>Chatting with students</td>
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<tr>
<td>Being relatable</td>
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<td>Taking the time to explain difficult concepts</td>
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<tr>
<td>Allowing all students an equal opportunity to learn and participate</td>
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<tr>
<td>Being approachable and willing to answer questions</td>
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<tr>
<td>Providing recognition</td>
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<tr>
<td>Having inclusive posters</td>
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<tr>
<td>Promoting a non-judgment zone for Spanish-speaking</td>
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<tr>
<td>Giving reassurance</td>
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</table>

*Note. This table demonstrates ways faculty mentors supported students’ belonging in classrooms.*

**Promotion of belonging in research labs.** Students were asked how faculty mentors promote their feelings of belonging in research labs, and the key ideas that were
gathered were organized into two clusters, including (1) developing content knowledge and nature of tasks, and (2) strong relationships. See Table 12 below, which presents a summary of faculty behaviors and characteristics the participants listed, before categorized into clusters.

Blaire, Catherine, and Sara stated that they felt belonging when there were strong relationships, such as building a relationship with the PI, and when the PI was including students, valuing students, and making them feel supported. Sara shared:

\begin{quote}
I do think I belong to my lab. Just like I said, they're really supportive. And it's really only the three of us. We're very communicative [and] supportive of each other. So, I really do think I belong there. Especially since we're working with Latinos.
\end{quote}

Two students discussed the importance of developing content knowledge and the nature of tasks, such as recognition of their work, giving challenging tasks, and allowing them to learn about topics they are interested in. For example, Jay shared:

\begin{quote}
...I feel comfortable... partly because of the work I have done [and] skills I’ve acquired.
\end{quote}
Table 12
Ways mentors support feelings of belonging in research labs

<table>
<thead>
<tr>
<th>Providing recognition</th>
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<tbody>
<tr>
<td>Assigning challenging tasks</td>
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<tr>
<td>Relationship-building</td>
</tr>
<tr>
<td>Allowing students to learn about research topics they are interested in</td>
</tr>
<tr>
<td>Valuing students</td>
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<tr>
<td>Supporting students</td>
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</tbody>
</table>

*Note.* This table demonstrates ways faculty mentors supported students’ belonging in research labs.

**Inhibitors of belonging in classrooms.** Students were asked how professors undermine their feelings of belonging in research labs, and the key ideas that were gathered were organized into five clusters, including (1) ignoring important aspects of students’ identities, (2) unresponsive teaching, (3) alienation via competence messages, (4) lack of engagement in classrooms, and (5) lack of representation. See Table 13 below, which presents a summary of faculty behaviors and characteristics the participants listed, before categorized into clusters.

Four students discussed the first cluster, ignoring important aspects of students’ identities. Examples of this cluster included when professors do not acknowledge cultural perspectives, assign readings that students do not find relatable, make ignorant comments related to others’ culture, make discouraging comments about student success based on students' demographics, are unaccepting of bilingualism and accents, and do not care about who students are and only how they perform. For example, sometimes, Jose sometimes felt his professors:
from a cultural perspective... they don't acknowledge certain things that should be acknowledged... Like they'll say something that may be... it's not what they intended... Sometimes the readings are not really it... I can’t relate to [them].

Four students expressed points within the cluster of unresponsive teaching, including when professors are not understanding of students’ work pace, when they do not take students’ skill sets into account, when they do not consider different work styles, creating time-consuming homework that does not reflect the difficult tests, teaching in a manner that makes it difficult for students to comprehend the material, and giving unclear feedback on how to improve their work. Stephanie highlighted the detriments of unreflective homework assignments when she said:

*Exam points... are not the same as your homework. You have to learn from the lectures... but you still have to do the homework and the homework takes me at least six hours sometimes or more...*

Three students discussed alienation via competence messages, including making students feel like they do not know what they are doing, not giving words of affirmation and encouragement to students, and devaluing their hard work on assignments. Florencia shared that her most uncomfortable moment was when she wrote a paper while already feeling insecure about her writing. After attending the writing center:

*I felt confident, and the person was really nice. But then I turned in my paper. When I got my paper back, I received all these marks. I was like, ‘okay, maybe I did it wrong, or it was probably bad’. But then, when I saw... a lot of the comments were like ‘This is awkward’. And... I just I... when I read ‘This is*
awkward’, I got really confused because I don’t really get what that means with ‘awkward’. How can I fix this paper if… I don’t get it. What? What does this mean? ‘This is awkward’. I was really confused by those comments because I [didn’t know where] I went wrong.

Two students discussed ideas that fit under the fourth cluster, lack of engagement in classrooms. This included using a traditional classroom style where it is purely lecture without talking to peers and teaching designs that encourage passive learning or memorization for tests. Catherine shared:

... I took my psych as a natural science and psych of social science, which are the 200 level classes. And I did feel really intimidated in that class. I was a freshman, but I was still... I got a good idea to know who this old guy is, like... ‘this is the first time I hear about this guy’. I would be like, ‘should I even study psychology? Is this a huge thing to know’? But then I [I realized] they're very broad, [entry-level] classes, and it's not so much like ‘Let's dive into why you're thinking this way’. [It was more] like those memorizing passive tests on what this guy did.

Finally, two students expressed points within the fifth cluster, lack of representation, including only seeing white male professors, and faculty mentors not having posters that welcome diversity or demonstrate allyship. For example, Miguel mentioned he did not feel he belonged when he did not see:

...representation of the classroom... If all your professors are white males... Why is there even a point in this?
Table 13

Faculty mentor qualities making students feel lack of belonging in class

- Not acknowledging important cultural perspectives
- Making ignorant comments about others’ cultures
- Assigning unrelatable readings
- Using purely lecture class organization
- Creating time-consuming homework that do not reflect tests
- Not considering students work-pace or work-style
- Questioning students’ abilities
- Not giving words of affirmation and encouragement to students
- Lack of similarity and relatability
- Using a teaching design that encourages passive learning/ memorization for tests
- Giving unclear feedback
- Being unaccepting of bilingualism and accents

Note. This table demonstrates ways faculty mentors inhibited students’ belonging in classrooms.

Inhibitors of belonging in research labs. Students were asked how faculty mentors inhibit their feelings of belonging in research labs. Three out of the four students in undergraduate research, Blaire, Catherine, and Sara, did not believe their faculty mentors had done anything specific to make them feel like they don’t belong in their lab. Jay’s points of what made him feel like he didn’t belong in a classroom were still relevant in his lab settings, including when his work pace is not understood, when his work style is not considered, when his skill sets are not considered, and being made to feel like he doesn't know what he is doing:

*I think it was in the very beginning when I was barely trying to get any information in my lab and so because I didn't have any context I was just like*
[laughs] making a lot of claims that weren’t really supported... when I got some feedback on it... Not that I didn't know what I was doing, but I just missed the mark, and so that was a time I felt I needed to... have more experience.

Table 14 below presents a summary of Jay’s points.

Table 14
Faculty mentor qualities making students feel lack of belonging in labs

| Not considering students work-pace or work-style |
| Questioning students’ abilities |

*Note.* This table demonstrates ways faculty mentors inhibited students’ belonging in research labs.

**Participation as People in STEM**

Students were asked if their classrooms welcomed their participation as STEM people and their responses were categorized into students who felt their classrooms did and students who felt their classrooms did not, with the latter category having the greatest number of students in it. Four students reported that their classroom did welcome their participation as students in STEM, and students’ responses were organized into two clusters: (1) being provided support to make individual progress and (2) the structure of the course and curriculum. See Table 15 below, which presents a summary of faculty behaviors and characteristics the participants listed, before categorized into clusters.

Three students discussed the importance of the first cluster, being provided support to make individual progress. Examples of this cluster include having nice and approachable professors, professors that want their students to understand and ask questions, professors promoting the resource and learning center, professors that ask...
students what questions they have, and professors who go around tables checking in with students. Elizabeth stated:

I keep hearing about the learning center and tutoring... I keep passing by the library and I keep seeing those things.

Two students discussed points that fell within the second cluster, the structure of the course and curriculum. Examples include that STEM is embedded in their curriculum, STEM is everywhere and over time it influences the identity one develops, and professors who structure classroom activities as interactive problem solving with other students.

Florencia shared that many of her professors:

...have these types of lectures... and we all work first, and solve problems... and then from there, [before sharing answers, the professor asks] ‘What question do you have?’ Or they stop by every table, and they [ask] ‘What do you think about this? Why did you do that?... Show me more.’ ...They just go personally asking you first to see if you’re confident about it, and so that helps a lot.

Five students reported their classrooms did not welcome their participation. Their responses were organized into two clusters, (1) unengaging class structure and (2) not enough support from professors.

Three students discussed the drawbacks of unengaging class structures, such as large classes not allowing students to ask questions or comments, zoom classes being less engaging, and environments that do not welcome participation. For example, Miguel said that:
...Sometimes I feel like professors are just there to teach. They don't really give any career advice. It's just 'Okay, have a good one. See you next lecture', and that's it. Mentors I've had... those have been probably the key pieces into that.

Two students discussed the drawbacks of the second cluster, not enough support from professors. Examples included being the youngest, intimidation, and low confidence. Students feeling intimidated and unable to voice their opinions could suggest that there needed to be more support from the professor to lower that barrier. It is possible that students did not realize that professors could have done something to support their confidence. When asked if she participated in her classes, Karla expressed:

*To be completely honest, no. Just cuz I've been the youngest one there and it's intimidating and you don't know the students there.*

<table>
<thead>
<tr>
<th>Table 15</th>
<th>Classroom atmosphere that welcomes their participation as STEM people</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>STEM is embedded in their curriculum, and STEM is everywhere and over time it influences the identity one develops.</td>
<td>Class sizes are too big for questions/ comments.</td>
</tr>
<tr>
<td>Hearing about the learning center and the tutoring center is a resource of support for her identity development.</td>
<td>Zoom and lecture-based classes are less engaging.</td>
</tr>
<tr>
<td>Classroom activities are interactive problem solving with other students, followed by sharing thoughts to the class, and then professor giving feedback to their solution.</td>
<td>Students feel intimidation.</td>
</tr>
<tr>
<td>Professors ask students what questions they have.</td>
<td>Some professors do not like participation</td>
</tr>
<tr>
<td>Professors go around to check in</td>
<td></td>
</tr>
<tr>
<td>Professors are approachable</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* This table categorizes students based on whether they felt like their classroom atmosphere welcomed their participation as people in STEM.
The four students involved in undergraduate research were further asked if their labs welcomed their participation as STEM people. All students with a lab placement felt their lab atmosphere welcomed their participation, and their reasons as to why were organized into three clusters, (1) scaffolding, (2) appropriate and adequate challenges, and (3) empowerment. See Table 16 below, which presents a summary of faculty behaviors and characteristics the participants listed, before categorized into clusters.

Three students discussed the importance of scaffolding, including PIs being supportive, learning independently but obtaining mentors’ support when needed, research mentor being accommodating, mentors letting them choose their own topics for their projects, PIs walking them through things step by step, and research mentors introducing them to official lab members. For example, Blaire mentioned:

...In my research lab, my PI has given me the autonomy to find... well, to use the data in her lab and to ask questions that I am genuinely interested in. [I’m] the person who chooses a topic to do an independent project on... I’ve heard that other students or peers are given specific questions to research on that don’t necessarily fit with their research interests. But with me... [that] has been very helpful in terms of enforcing that identity.

Two students discussed having appropriate and adequate challenges, such as being exposed to new people, environments, and tasks, mentors giving them autonomy to ask their own research questions that they are interested in, and PIs putting responsibilities on them to use their knowledge and backgrounds in STEM. Jay shared:
They're very helpful in the work that I do. I work in a speech and hearing lab and I come from a STEM background. They put responsibility on me to use my knowledge from STEM and my background from STEM.

Lastly, two students discussed empowerment, such as obtaining reassurance that they belong in STEM, career mentors pointing out that when they don’t give themselves enough credit for the important work they do with their research program, and their PIs making them realize that their research contributions in STEM are valuable. Catherine shared a conversation she had with her PI:

…When I was working on my resume I was like, ‘I have my research listed, the lab that I work in right now’ and she was like… ‘Girl, you’re minimizing and belittling what you do… Put it like you’re a Research Assistant!’ I think I had it labeled like I was just like… I was just part of BUILD EXITO, part of the cohort. She’s like, ‘Girl, you’re a whole research assistant! You do these tasks in the lab’. She helped me word it, and it was so empowering… I was like ‘Oh, my gosh! It is so cool! What I do’.
Students were asked about specific experiences that make it difficult for them to participate, consequently inhibiting their opportunity to solidify their STEM identity. Within the context of classrooms, student responses were organized into five clusters, (1) threats to competence, (2) unwelcoming atmosphere, (3) failure to integrate students’ perspectives, (4) lack of authenticity and relevance, and (5) lack of recognition in STEM. See Table 17 below, which presents a summary of faculty behaviors and characteristics the participants listed, before categorized into clusters.

Five students discussed points that fell within the first cluster, threats to competence. Examples include not having reassurance that it is okay to not have the right answer, not wanting to embarrass themselves, public discussion posts because they invite comparative aspects, feeling intimidated, and when professors push students to answer
questions instead of inviting them to if they feel comfortable. For example, Jose described an intimidating task:

*I would say discussion posts. Sometimes it could feel like some discussion posts are better than others... I don’t know. It could be intimidating.*

Four students discussed the second cluster, being in unwelcoming environments, and the drawbacks that experiences in this cluster resulted in for their participation, including not helping students be comfortable to be there, acting cold and uninterested, not wanting to help, being unwelcoming of students’ questions, being closed to their own experiences and not understanding diverse students, and not facilitating a space where students who are similar to each other can converse. For example, Catherine talked about professors contributing to unwelcoming environments:

*I want to think they don't purposely do it... It's never happened to me personally... but I've witnessed... people will [indirectly] be like... ‘Did you seriously just ask that?’", or something like. You kinda are made to feel like ‘I should have known this already’ and it's a reality... you do go into some environments or some courses where the professor expects you to know certain things. and you're like ‘Oh, snap. Like, I don't’.*

Four students discussed the importance of the third cluster, failure to integrate students’ perspectives. Examples include professors having unrealistic expectations for students to be highly knowledgeable about class content, there being too many concepts taught at a fast pace because it is hard for students to understand, when professors are not understanding of students schedules and responsibilities, lack of flexibility, strict
environments and guidelines, and professors not giving students autonomy to learn about
their interests. Elizabeth had recently experienced high expectations from faculty in a
summer program she participated in:

For the GANAS program … I understand the requirements but some of them are a
little hard time wise, cause they require you to go to events and they have a whole
week that you’re required to go to and it was from nine to 9 to 4 with an hour
break”.

One student, Jay, discussed the fourth cluster, lack of authenticity and relevance,
such as when professors provide inapplicable practice tasks such as workbooks to
practice for a job interview, and when they do not share applicable skills that are critical
to have when on the job market:

Being closed to their own experiences. In computer science, there's a lot of job
opportunities. So, you'll see professors going back and forth between jobs...
[they] kind of push their own experiences, or the skills that they [found] helpful to
their students. One class, specifically… looked at skills that would help in a job
interview, like math. [So, they gave] math workbook pages. And it's like, that's not
helpful. I'm trying to learn about this field and this person is just giving me
workbooks. Very closed mindset and mentality.

One student, Blaire, discussed the final cluster, lack of recognition as a person in
STEM, such as when a professor failed to recognize Psychology as part of STEM:

... [professor’s name] is my career mentor. We talk about psychology as STEM...
and helped me shift that mentality of psychology. ‘You are part of the STEM
community’. That has been very helpful and encouraging overall… Like I mentioned before, hearing all these little comments from past mentors [that psychology is not STEM] looks a little discouraging. But the exposure that I have had with certain environments… and the conversations I've had with mentors have helped me with the idea of… me being part of that STEM field.

A response for Miguel on what made it difficult for him to participate in class was not collected because of interviewer and interview script inconsistencies.

Table 17
Ways professors make it difficult for students to participate in class

<table>
<thead>
<tr>
<th>Way</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public discussion posts because they invite a comparative aspect within students</td>
</tr>
<tr>
<td>Not facilitating a space where students who are similar can converse</td>
</tr>
<tr>
<td>Too many class concepts are taught at a fast pace</td>
</tr>
<tr>
<td>Failing to recognize psychology as STEM</td>
</tr>
<tr>
<td>Not giving students autonomy to learn about her interests</td>
</tr>
<tr>
<td>Not sharing applicable skills that would be critical to have when on the job market</td>
</tr>
<tr>
<td>Not being understanding of students' schedules, time, and other responsibilities</td>
</tr>
<tr>
<td>Being strict and lacking flexibility</td>
</tr>
<tr>
<td>Not providing reassurance that it's okay not to have the right answer</td>
</tr>
<tr>
<td>Being unwelcoming of students' questions</td>
</tr>
<tr>
<td>Unrealistic expectation for students to be highly knowledgeable of class content</td>
</tr>
<tr>
<td>Pushing students to answer questions, instead of inviting them to share if they feel confident</td>
</tr>
<tr>
<td>Acting cold and uninterested</td>
</tr>
</tbody>
</table>

Note. This table lists ways that professors make it difficult for students to participate in their STEM classes.

The students with lab placements were also asked about specific experiences that make it difficult for them to participate, consequently inhibiting their opportunity to
solidify their STEM identity. Students’ responses were not organized into particular clusters. See Table 18 below, which presents a list of participants’ responses. First, Jay had mostly talked about experiences relevant to his classroom for this question. Second, Blaire and Sara stated that their mentors did not explicitly do things that inhibited their participation. Lastly, Catherine’s points were all relevant to lack of scaffolding, such as when her PI used unfamiliar acronyms, not clarifying their lab mates’ discussions they may not understand, and expectations that she should have prior knowledge:

I had some of my BUILD EXITO peers say they have a lot of people in their lab using acronyms (Laughs). They're like ‘Dude, I have no idea what you just said.’ So, then it just shows the expectation that ‘You should know this’ They're all using it back and forth, they all know what it means, that, you just feel silly, even though there's no way you would have known that word... it's new to you, right? But I think professors and mentors... need to keep in mind that there's people in different parts in their journey that are getting exposed to things for the first time.

Table 18
Ways mentors make it difficult for students to participate in labs

<table>
<thead>
<tr>
<th>Way</th>
</tr>
</thead>
<tbody>
<tr>
<td>Being closed to their own experiences</td>
</tr>
<tr>
<td>Using unfamiliar acronyms</td>
</tr>
<tr>
<td>Not clarifying lab mates’ discussions students may not understand</td>
</tr>
<tr>
<td>Expecting that students should have prior knowledge of the class content</td>
</tr>
</tbody>
</table>

Note. This table lists ways that mentors make it difficult for students to participate in their research labs.
Non-natural science and outside of STEM faculty with positive mentorship qualities

While many of the students expressed trouble with their competence and belonging, 10/11 students (See Table 28 on Appendix C) mentioned the feeling that non-natural science mentors, or outside of STEM mentors, embody qualities that do make them feel competent or like they belong. For example, Blair stated:

...I do feel like I belong more in psychology than the [inaudible] labs, like the hard science and STEM courses for sure. Because I do take into account the diversity of the population and students in those courses. Because in hard STEM classes they don't really care about who you are. They just care about how you perform.

Stephanie shared that it was hard to find STEM mentors that checked in with her:

...I want to see more check-ins... because it really means a lot, at least to me, when someone checks-in and they're like ‘hey, how are you doing this term’. I have had a few mentors that weren't STEM mentors that have done that with me but they're hard to find sometimes.

Florencia, who was the only one who did not mention an outside STEM mentor, made it sound like the level of support in her department was high. She came from a community college where she was discouraged to pursue engineering because she is a woman, and this could be the culture of that specific institution. She expressed that compared to her past institution, she felt like she was “in heaven” at PSU. So maybe she did experience other faculty members that weren't STEM encouraging her, but it was just
that her engineering department, based on her past experiences, were good enough for the competence and belonging she needed.

**Student Recommendations**

Upon ending our discussions on competence, belonging, and participation, students summarized their thoughts at the end of each section by providing bullet points of recommendations they would provide faculty mentors to do/ do better so Latinx students feel a sense of competence, belonging, and encouragement to participate.

**Competence.** Students summarized their thoughts of what would help Latinx students feel a high sense of competence. (See Table 19 below to view a table summary. See Table 29 in Appendix C to view individual answers) Seven students reported that their sense of competence benefitted from faculty mentors’ responsiveness, such as (1) helping when students are stuck, (2) giving them tutoring, (3) holding office hours, (4) having one-on-one time with students, (5) dedicating time to students, (6) helping students with their non-school related stressors, (7) restructuring coursework if a lot of students are struggling, (8) being accommodating, and (9) being understanding that students have many responsibilities.

Another faculty mentor quality that helped five students feel a sense of competence was when they acknowledged the role of structural influences, such as (1) acknowledging that society makes some students feel inferior, (2) acknowledging their own privilege, (3) being understanding of the gap of education that some people might have, (4) understanding first generation students' experiences, struggles, and environments, (5) being aware of and educating students on systemic injustices, (6) not
being prejudiced or expressing stereotypes towards students with different backgrounds, (7) taking opportunities with students with different background, and (8) bringing in Latino engineers to outside events.

It also helped students’ sense of competence when faculty mentors shared resources, such as (1) knowing where student services are, (2) bringing awareness about clubs, programs, and organizations that support Latinx math students, (4) and connecting their students with applicable resources and clubs/organizations.

Four students’ sense of competence benefited from felt encouragement from faculty, such as (1) giving student uplifting words, (2) providing support, (3) giving validation, (4) letting students know they want to help, (5) reassuring students they are smart, and (6) encouraging students to get involved.

The next faulty mentor behavior that was recommended by four participants for students to feel a sense of competence was high communication, including (1) reaching out, (2) checking in, and (3) giving them reminders. Finally, three students recommended that faculty prepare students in their career pathway by (1) allowing students to have pathway-specific mentors that guide their development, (2) assigning tasks that prepare them for their future careers or graduate school, and (3) telling their own stories to their students.
Table 19
Summary of recommendations for faculty mentors to help students’ sense of competence

<table>
<thead>
<tr>
<th>Clusters</th>
<th>Examples within Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsiveness</td>
<td>(1) Help students when they’re stuck, (2) giving them tutoring, (3) holding office hours, (4) having one-on-one time with students, (5) dedicating time to students, (6) helping students with their non-school related stressors, (7) restructuring coursework if a lot of students are struggling, (8) being accommodating, and (9) being understanding that students have many responsibilities.</td>
</tr>
<tr>
<td>Acknowledging the role of Structural Influences</td>
<td>(1) acknowledging that society makes some students feel inferior, (2) acknowledging their privilege, (3) understanding education gaps, (4) understanding first generation students’ experiences, (5) being aware of and educate students on systemic injustices, (6) not being prejudiced or make stereotypes towards students with different backgrounds, (7) taking opportunities with students with different background, and (8) bringing in Latino engineers to outside events.</td>
</tr>
<tr>
<td>Sharing Resources</td>
<td>(1) Knowing where student services are, (2) bringing awareness about clubs, programs, and organizations that support Latinx math students, (4) and connecting their students with resources.</td>
</tr>
<tr>
<td>Encouragement</td>
<td>(1) Giving them uplifting words, (2) words of encouragement, (3) support, (4) validation, letting students know they want to help, reassuring students they are smart, and encouraging students to get involved.</td>
</tr>
<tr>
<td>High Communication</td>
<td>(1) reaching out, (2) checking in, and (3) giving them reminders.</td>
</tr>
<tr>
<td>Preparing them in their Career Pathway</td>
<td>(1) Having pathway-specific mentors that guide their development, (2) assigning tasks that prepare them for their future careers or graduate school, and (3) professors telling their own stories to their students.</td>
</tr>
</tbody>
</table>

Note. This table includes students’ recommendations to faculty mentors, so they help students’ sense of competence.

**Belonging.** Eight clusters arose from students’ recommendations for faculty mentors to help Latinx students feel like they belong. (See Table 20 below to view a table summary. See Table 30 in Appendix C to view individual answers) Five students recommended faculty to invest in good mentorship by (1) checking-in frequently with students, (2) making students feel like they truly care about students and are not just getting paid, (3) guiding them through academic hardships, (4) asking students about their goals, (5) and listening.
Four students recommended that faculty mentors provide culturally specific supports by (1) having posters that welcome all identities and that demonstrate they are allies, (2) understanding that everyone comes from different backgrounds, (3) being understanding and accepting of the impact bilingualism makes on communication in higher education, (4) promoting STEM clubs for Latinos, (5) incorporating readings on the Latinx community or other minority communities, and (6) providing readings and videos that represent their culture and people of color.

Four students shared that when faculty mentors were similar to students, such as similar backgrounds, it made them feel more belonging.

Another faculty mentor quality that four students thought would promote belonging was when they provided motivational scaffolding such as: (1) giving words of affirmation and encouragement, (2) having a positive outlook and purpose for students, (3) making an effort to motivate students, (4) sharing their academic experiences, sharing their triumphs and successes, (5) talking about their jobs and previous experiences, (6) sharing their stories and struggles as students in the past before they had the title of professor, (7) recognizing that there are many skills, and (8) that progress can look many different ways.

A fifth characteristic that three students recommended was structure and scaffolding understanding, such as (1) providing students with feedback, (2) holding students accountable, and (3) being accommodating. Three students recommended that faculty help students build connections to help their belonging by (1) sharing resources, (2) connecting students with other people, researchers, and professors, (3) connecting
students with events or programs, and (4) structuring classrooms so students can talk to each other.

Two students recommended faculty to provide students with opportunities to build their skills by (1) having workshops, (2) providing students with lab experiences so they can observe conversations and learn how the dynamic works, (3) giving students information they can apply to their careers, and (4) helping students become comfortable in public settings and with communication.

Lastly, two students expressed the need for field-specific mentors to feel belonging.
Table 20
Summary of recommendations for faculty mentors to help students’ sense of belonging

<table>
<thead>
<tr>
<th>Clusters</th>
<th>Examples within Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment in good mentorship</td>
<td>(1) Checking-in frequently, (2) making students feel like they care about students, (3) guiding them through academic hardships, (4) asking students about their goals, (5) and listening.</td>
</tr>
<tr>
<td>Culturally Specific Supports</td>
<td>(1) Having posters that welcome all identities, (2) understanding that everyone comes from different backgrounds, (3) being understanding and accepting of bilingualism, (4) promoting STEM clubs for Latinos, (5) incorporating readings on the Latinx community or other minority communities, and (6) providing readings that represent their culture and people of color.</td>
</tr>
<tr>
<td>Similarity with Students</td>
<td>(1) Having similar backgrounds as students.</td>
</tr>
<tr>
<td>Motivational Scaffolding</td>
<td>(1) Giving words of affirmation and encouragement, (2) having a positive outlook and purpose for students, (3) motivating students, (4) sharing academic experiences, (5) talking about their previous experiences, (6) recognizing that there are many skills, and (7) that progress can look many ways.</td>
</tr>
<tr>
<td>Structure and scaffolding understanding</td>
<td>(1) Providing feedback, (2) holding students accountable, and (3) being accommodating.</td>
</tr>
<tr>
<td>Building connections</td>
<td>(1) Sharing resources, (2) connecting students with others, (3) connecting students with events or programs, and (4) structuring classrooms so students can talk to each other.</td>
</tr>
<tr>
<td>Providing opportunities to build skills</td>
<td>(1) Having workshops, (2) providing students with lab experiences, (3) giving students information to apply to their careers, and (4) helping students become comfortable in public settings and with communication.</td>
</tr>
<tr>
<td>Pathway specific supports</td>
<td>(1) Pathway specific mentors</td>
</tr>
</tbody>
</table>

Note. This table includes students’ recommendations to faculty mentors, so they help students’ sense of belonging.

**Participation.** Students summarized their thoughts of what would help Latinx students participate in their STEM environments. (See Table 21 below to view a table summary of student’s recommendations. See Table 31 in Appendix C to view individual answers) The first recommendation provided by six students was for faculty mentors to create a welcoming environment by (1) verbally telling students they can reach out for
help, (2) pauses during lecture so students don't feel like they are interrupting, (3) providing enough time for students to complete tasks while they work on developing expertise, (4) asking students what questions they have, (5) getting to know students more personally to help reduce traditional formalities, (6) help students feel comfortable, (7) be approachable, (8) give reassurance that it's okay not to have the right answer to encourage participation, (9) normalizing mistakes and that you learn from them, and (10) structuring the class so students can expect their participation is welcome.

Next, four students recommended faculty mentors to facilitate collaboration by (1) facilitating the creation of groups, (2) grouping students who are interested in similar topics, (3) allowing students to interact about their assignments with each other, and (4) incorporating teamwork.

The next faulty mentor behavior that was recommended four students to help participation was providing direct support, such as (1) when they provide personalized or one-on-one study time, (2) create time in class to ask students if they have questions, (3) are willing to help, (4) walk students step by step, (5) are willing to take questions, (6) go around each table to check in, and (7) hear students’ ideas in class and give feedback to their solution.

Three students expressed it benefited their participation when faculty mentors provide a safe way to develop competence, such as (1) when professors not only ask difficult questions that require a correct answer, (2) provide tasks that get them out of their comfort zone, and (3) have patience.
Lastly, two students recommended faculty to provide opportunities that pique students’ interests, such as (1) being engaging, (2) being open to student engagement, and (3) providing tasks relevant to their interests.

Table 21
Summary of recommendations for faculty mentors to help students’ participation

<table>
<thead>
<tr>
<th>Clusters</th>
<th>Examples within Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creating a welcoming environment</td>
<td>(1) Verbally telling students they can reach out for help, (2) pauses during lecture so students don’t feel like they are interrupting, (3) providing enough time for students to complete tasks while they work on developing expertise, (4) asking students what questions they have, (5) getting to know students more personally to help reduce traditional formalities, (6) help students feel comfortable, (7) be approachable, (8) give reassurance that it’s okay not to have the right answer to encourage participation, (9) normalizing mistakes and that you learn from them, and (10) structuring the class so students can expect their participation is welcome.</td>
</tr>
<tr>
<td>Facilitating collaboration</td>
<td>(1) Facilitating the creation of groups, (2) grouping students who are interested in similar topics, (3) allowing students to interact about their assignments with each other, and (4) incorporating teamwork.</td>
</tr>
<tr>
<td>Providing direct support</td>
<td>(1) When they provide personalized or one-on-one study time, (2) create time in class to ask students if they have questions, (3) are willing to help, (4) walk students step by step, (5) are willing to take questions, (6) go around each table to check in, and (7) hear students ideas in class and give feedback to their solution.</td>
</tr>
<tr>
<td>Providing a safe way to develop competence</td>
<td>(1) When professors not only ask difficult questions that require a correct answer, (2) provide tasks that get them out of their comfort zone, and (3) have patience.</td>
</tr>
<tr>
<td>Providing opportunities that pique students’ interests</td>
<td>(1) Being engaging, (2) being open to student engagement, and (3) providing tasks relevant to their interests.</td>
</tr>
</tbody>
</table>

Note. This table includes students’ recommendations to faculty mentors, so they help students’ participation.
Chapter 6: Discussion

This study aimed to answer two questions: First, what are the faculty mentor qualities that promote Latino/a/x undergraduates’ STEM identity development? Second, what are the faculty mentor qualities that undermine Latino/a/x undergraduates’ STEM identity development? In this chapter, I will discuss the four key findings of the study in the context of the broader literature on Latinx undergraduate student experiences in STEM: (1) specific STEM-skill attainment, or lack thereof, (2) relational support, or lack of closeness, (3) autonomy support, or lack thereof, and (4) cultural supports or inhibitors.

The first major finding is related to the STEM skills the students desired in the current study, which aligned with Estepp and colleagues’ (2017) scientific skills that are increased with access to successful faculty mentors. For example, the participants in the current study cared about skills for (1) scientific reading and writing, (2) effective communication, (3) data analysis, and (4) other skills, such as math, workplace skills, and creative problem-solving. However, only six out of 11 students reported that their faculty mentors had helped them gain critical skills, allowing them a sense of confidence. These six included the four that were part of UGR programs. This aligns with recent research showing that STEM students participating in a research mentor program report higher confidence in their research skills and understanding of the research process (Chelberg et al., 2019; Haeger & Fresquez, 2016).

The six students described the processes that their faculty mentors engaged in to help them gain skills. However, students that did not obtain help from their faculty
mentors in obtaining important STEM skills in turn experienced inhibitors to their STEM identity. Students who had not obtained scaffolding from faculty mentors provided recommendations on what faculty mentors can do to help build their skills, which closely reflected the positive behaviors the other six students described. The behaviors and recommendations aligned with Ceyhan and Tillotson’s (2020) findings that described the benefits of intellectual support, such as mentor scaffolding, on students’ scientific process. More specifically, students described multiple kinds of scaffolding that they found to be helpful, including (1) providing mentees with hands-on practice in applying suggested and effective methods to feel confident about concepts they are learning, (2) understanding the next steps they should be taking in their academic career, and (3) being familiar with important terminology and tools that are important in a lab. Similarly, professional support, such as academic advising, allowed students to feel they had guidance, increasing their engagement and socialization skills within their scientific community.

The second major finding, relational support, also aligns to Estepp and colleagues (2017) findings about the influence of relational support characteristics (i.e., scheduling regular meetings, frequent contact, etc.) that would promote or inhibit competence, belonging, and participation. A new theme that emerged from participants’ responses concerned autonomy support, a motivational provision described in self-determination theory (Ryan & Deci, 2016) as practices that encourage student to discover, express, and act according to their authentic values and selves. Examples of teachers’ autonomy support in classrooms include combining structure with perspective-taking or allowing
students to work independently but providing help when needed (Ryan & Deci, 2016). It was also anticipated that students would find culturally relevant support especially critical, and this prediction was supported and represents the fourth major finding of the current study; calling attention to cultural aspects that the students addressed as promoting or inhibiting their STEM identity, that were not highlighted in Estepp and colleagues’ (2017) findings. Positive characteristics included the importance of mentors’ racial/ethnic relatability with students, providing a safe space for Spanish speaking, understanding the importance of representation, acknowledging cultural identities and structural influences, and being aware of culturally specific supports. This reflects past work suggesting that faculty should learn more about theories that shape the outcomes and identity development of minority students, such as critical race theory (Ladson-Billing & Tate, 1995; Dixson & Rousseau Anderson, 2018; Taylor et al., 2009). This also aligns with Fries-Britt’s (2000) notion that when faculty have and share knowledge about resources useful to students, it contributes to positive outcomes for students, and this is true regardless of whether the faculty’s racial/ethnic background is like their students.

**Faculty Mentor Qualities that Promote STEM Identity Development**

The students shared answers about how faculty, both professors in classrooms, and PIs in research labs, promote their STEM identity development through conversations about their sense of competence, sense of belonging, and experiences of participation in their STEM environments.

**Skill-building support.** Faculty mentor characteristics and behaviors relevant to the first major finding, skill-building support, that promoted students’ STEM identity
development were divided into classroom professor characteristics and behaviors, Lab PI characteristics and behaviors, and similarities between these two social partners. To promote students’ skill-building, it was helpful when classroom professors provided practice quizzes/homework, provided major-specific mentorship, had in-class workshops, and promoted the resource and learning center. To promote students’ skill-building, it was helpful when Lab PIs gave students leadership roles, assigned challenging tasks, shared information that could be applicable to their future careers, and provided constructive feedback. They were also similar behaviors and characteristics that students described needed from both social partners in these separate communities of practice to promote their skill-building, including, providing constructive feedback, scaffolding appropriately, sending out reminders, assigning tasks that prepare students for their future, and providing step-by-step instruction. See Figure 3 below for a visual representation of the skill-building supports that promoted STEM identity development.
Figure 3
Skill building supports that promoted Latinx undergraduates’ STEM identity development

Note. This figure demonstrates the ways that faculty mentor characteristics and behaviors promoted students’ STEM identity development, relevant to the first major finding, skill-building support.

This skill-building support theme reflects past research showing that college students with mentors on similar academic or career tracks also experience improved academics and other hands-on skills because they can apply suggested and effective methods to feel confident about concepts they are learning or understand the next steps they should be taking in their academic career (Ahmed et al., 2021; Ceyhan & Tillotson, 2020; Chelberg & Bosman, 2019). This also aligns with suggestions of the importance of providing mentees with appropriate guidance and resources, sharing skills and knowledge, and teaching practical studying skills (Ceyhan & Tillotson, 2020; Gordon et al., 2013; Freedman, 1993).
Relational support. Faculty mentor characteristics and behaviors relevant to the second major finding, relational support, that promote students’ STEM identity development were divided into classroom professor characteristics and behaviors, Lab PI characteristics and behaviors, and similarities between these two social partners. To provide students’ relational support, it was helpful when classroom professors dedicated one-on-one time with students, helped students with non-school stressors, shared their own stories, were approachable, and gave reassurance. To provide students’ relational support, it was helpful when Lab PIs provided uplifting words, were compassionate, supportive, inclusive, patient, and respectful, built relationships with students, and connected students with other professionals. They were also similar behaviors and characteristics that students described needing from both social partners in these separate communities of practice, including, scheduling frequent check-ins with their students, and getting to know them more personally. See Figure 4 below for a visual representation of the relational supports that promoted STEM identity development.
Note. This table lists the ways that faculty mentor characteristics and behaviors promoted students’ STEM identity development, relevant to the second major finding, relational support.

These characteristics and behaviors are supported by past evidence that good mentors offer personal support and work with mentees on their tasks (Ceyhan & Tillotson, 2020; Gordon et al., 2013; Freedman, 1993). Additionally, they align with suggestions about the importance of interacting with, listening to, and understanding students’ interests (Estepp et al., 2017).

**Autonomy support.** Faculty mentor characteristics and behaviors relevant to the third major finding, autonomy support, that promote students’ STEM identity development were divided into classroom professor characteristics and behaviors, Lab PI characteristics and behaviors, and similarities between these two social partners. To provide students’ autonomy, it was helpful when classroom professors structured classrooms as interactive, implemented enjoyable activities, and were engaging. To
provide students’ autonomy, it was helpful when Lab PIs provided the right amount of work, allowed students to learn about their own interests, and letting students ask their own research questions for projects. They were also similar behaviors and characteristics that students described needed from both social partners in these separate communities of practice to promote their autonomy, including providing recognition, being accommodating and accessible, understanding students’ several responsibilities, and normalizing mistakes. See Figure 5 below for a visual representation of the autonomy supports that promoted STEM identity development.

Figure 5
Autonomy supports that promoted Latinx undergraduates’ STEM identity development

Note. This table lists the ways that faculty mentor characteristics and behaviors promoted students’ STEM identity development, relevant to the third major finding, autonomy support.

This autonomy support theme reflects Ryan and Deci’s (2016) recommendations to parents and teachers of young children to promote autonomy-supportive environments,
which emphasize structure over control, paying attention to students’ interests, listening, and being responsive.

**Cultural support.** Lastly, faculty mentor characteristics and behaviors relevant to the fourth major finding, cultural support, that promote students’ STEM identity development were divided into classroom professor characteristics and behaviors, Lab PI characteristics and behaviors, and similarities between these two social partners. To satisfy students’ cultural support needs, it was helpful when classroom professors understood their own privilege, conversed about each other’s backgrounds, shared information about Latinx-specific clubs, educated others on systemic injustices, brought in Latino professionals, had inclusive posters, and promoted an accepting space for Spanish. There were no specific cultural support needs behaviors listed for lab PIs specifically, but there were similar behaviors and characteristics that students described needing from both professors and PIs in these separate communities of practice to promote their cultural needs, including being unprejudiced/ non-stereotypical, understanding first-generation students’ experiences, providing work that represent people of color, and having a similar background as students. See Figure 6 below for a visual representation of the autonomy supports that promoted STEM identity development.
This highlights Dueñas and Gloria’s (2020) recommendations for advisors and faculty mentors to be aware of different ways Latino/a/x students can be involved on campus. This also reflects Rose and colleagues’ (2005) work about the importance of mentors referring their mentees to the correct resources, especially when a situation is beyond the mentor’s scope of expertise.

**Faculty Mentor Qualities that Undermine STEM Identity Development**

The students shared how they believed faculty, both professors in classrooms, and PIs in research labs, inhibited students’ STEM identity development through conversations about their sense of competence, sense of belonging, and experiences of participation in their STEM environments.
**Lack of skill-building.** Relevant to the first theme, classroom professor characteristics that interfered with students’ skill-building needs include creating exams that do not match homework, devaluing students’ hard work, and providing unclear or harsh feedback. Lab PI characteristics that undercut students’ skill-building were the use of unfamiliar language/ acronyms. There was one behavior students described that was similar from both professors and PIs in these separate communities of practice that inhibited their skill-building needs, which was not sharing applicable skills for students’ futures. See Figure 7 below for a visual representation of lack of skill-building supporting behaviors that inhibited students’ STEM identity development.

*Note.* This figure demonstrates the ways that faculty mentor characteristics and behaviors inhibited students’ STEM identity development, relevant to the first major finding, skill-building supports.
This is related to past work about how the culture associated with STEM makes Latino/a/x students have trouble with a sense of belonging and identification (Hurtado et al., 2009; Landivar, 2013; Riegle-Crumb & King, 2010; Saw et al., 2018). This aligns with past work about the hindrances Latino/a/x students experience when they frequently receive messages from their instructors that they were unprepared for the class if there were concepts that the students did not understand (Hurtado et al., 2009).

**Lack of relational support.** Classroom professor characteristics and behaviors relevant to the second major finding, that interfered with students’ relational needs include acting cold and uninterested, not wanting to help, and not giving reassurance. Lab PI characteristics and behaviors that undercut relational support needs included taking too long to reply to emails and making students feel incompetent. There were no similar behaviors that students described both professors and PIs doing in these separate communities of practice that inhibited their relational support. See Figure 8 below for a visual representation of lack of relational supporting behaviors that inhibited students’ STEM identity development.
Note. This figure demonstrates the ways that faculty mentor characteristics and behaviors inhibited students’ STEM identity development, relevant to the second major finding, relational supports.

**Lack of autonomy support.** Relevant to the third theme, classroom professor characteristics that denied students’ autonomy support needs include not accommodating to students, being dismissive of needs, not giving opportunities to engage with others, too many assignments in a week, only employing lecture-style classes, assigning unrelatable readings, un-engaging large classes/zoom classes, too many concepts taught at a fast pace, lack flexibility, and not allowing students to learn according to their interests. Lab PI characteristics that denied students’ autonomy support needs were questioning students’ work pace and not considering work-style differences. There was one similar behavior that professors and PIs in these separate communities of practice did that undermined their autonomy supportive needs, which was having unrealistic expectations.
See Figure 9 below for a visual representation of the lack of autonomy supportive behaviors that inhibited students’ STEM identity development.

Figure 9
_Behaviors and characteristics that undercut Latinx undergraduates’ autonomy supports_

Lack of cultural support. Finally, relevant to the fourth theme, classroom professor characteristics that denied students cultural needs included not promoting Latinx clubs and organizations, not being aware of Latinx-specific resources, lack of cultural representation, not acknowledging cultural perspectives, making ignorant comments about others’ culture, and being unaccepting of bilingualism and accents. Students did not state lab PI behaviors or characteristics that inhibited their need for cultural support or that were like any of those behaviors professors engaged in. See
Figure 10 below for a visual representation of the lack of culturally supportive behaviors that inhibited students’ STEM identity development.

Figure 10
Behaviors and characteristics that denied Latinx undergraduates’ cultural supports

Note. This figure demonstrates the ways that faculty mentor characteristics and behaviors inhibited students’ STEM identity development, relevant to the fourth major finding, cultural supports.

**Students in UGR versus those not in UGR.** In addition to the creation of these themes, the current study was able to identify the different experiences that students in UGR versus those not in UGR had. First, most students needed more communication with their professors. Those in undergraduate research, however, experienced hands-on mentorship and skill-building from other faculty. Thus, despite not having a close relationship with their professors in classrooms, they still experienced the positive benefits of scaffolding from a professional. On the other hand, students who were not involved in UGR programs either had no close relationships with STEM faculty, obtained
mentorship from faculty outside of STEM, or were one of the few who did communicate highlights with professors in their class. This reflects past work that shows that URG students experience more direct interactions with faculty mentors outside of the classroom. The patterns of whether students felt acknowledgment in their STEM environments are like the patterns of communication levels. Many students felt their perspectives and ideas were not acknowledged in their STEM environments. However, for those in UGR programs, if they were not acknowledged in their classrooms, all expressed feeling like their ideas and perspectives were acknowledged in their labs, contributing to positive experiences. This finding supports Ceyhan and Tillotson’s (2020) work that professors’ support may not be enough to give the necessary guidance, assistance, and hands-on experiences to engage undergraduates in STEM fields and research.

Additionally, UGR programs seemed to be a positive source of skill obtainment, providing students the chance for close mentorship and relationship building with professionals in their field and allowing them to feel like their ideas are acknowledged, highlighting past findings about the benefits of UGR (Chelberg et al., 2019; Haeger & Fresquez, 2016). However, while UGR programs provided students with skill development, they were not alone responsible for a strong STEM identity. Students were highly impacted by faculty mentors’ messages, whether uplifting or discouraging, on who belonged in STEM and was competent enough to be there. The current study contributed to knowledge not only about UGR programs, in which access to research opportunities alone does not make a strong identity, but also about how positive interactions with
faculty combined with skill development opportunities made the most impact in identity strengthening.

**Limitations and Strengths of the Current Study**

There are noteworthy limitations to the current study. First, the members of the thesis committee recommended I aim for 11-15 participants, and thus I perceived 15 would have been the most ideal. The data collection and recruitment were exhaustive, however, as was mentioned in the methods section, the efforts only granted 11 participants in the study. A possible reason for this was that the interviews were 60-90 minutes long. This time commitment may have needed to be more attractive to interest students busy with their academic endeavors. However, this sample size can be defended as it was guided by and implements the suggestions of the five dimensions of Information Power by Malterud and colleagues (2015) who suggest the more information a sample holds, the fewer participants they will need in the sample.

Second, the sample was unrepresentative of other gender identities. There were, unfortunately, no participants who identified as gender nonbinary or transgender, and this prevented me from learning valuable information about how these students experience their STEM identity development and, more specifically, how faculty mentors influence it.

Third, I alone analyzed participants' responses, my interpretations could have been influenced by my own biases and identification (Talbert, 2018), so while it was vital for me to engage in reflexivity and take measures to establish rapport with the students
when I had conversations with, in terms of how our conversations are analyzed, I am the person with the most power.

Fourth, while not discussed within the current study’s analysis and results, many students shared interactions with peers, despite interviewers asking explicitly about faculty mentors, and it was difficult to steer the conversation back to the social partner of interest. As a result, a significant chunk of the data discusses interactions with peers, not granting the researchers the opportunity to obtain fuller data that was exclusively about mentors. There are a few questions that this pattern raises as noteworthy to analyze in depth in a new, future study about peers’ influence on Latinx undergraduates’ STEM identity: First, is there a norm of respecting the professors' authority in a way that makes it more challenging to raise awareness of their limitations when they should be made? Particularly in the case of Latinx students, they have been socialized by their families to embody the valued trait of respeto (Lopez et al., 2022), and thus may have trouble highlighting the weaknesses of an authority figure and instead emphasize experiences with peers they do not perceive as authority. Second, could it instead result in students’ self-criticism when it should have been a critique of the mentor? It could be that because respeto is instilled in many Latinx students, they default in perceiving themselves as ones who need to better their abilities and engage in comparisons with those who are not authority, classmates. Third, is it possible that female-identifying students are less willing to raise criticisms of their advisors and mentors than male students would be? Another cultural value in Latinx families that stems from a traditional point of view is marianismo; families’ desired gender role for women as embodying gentle, passive, and
self-sacrificing behaviors (Morales & Perez, 2020), which could inhibit them from speaking up and thus instead leading them to refer to social partners of equal status.

Lastly, as demonstrated at the end of each paragraph of every relevant cluster in the results section, there were inconsistencies in the information gathered across participants; information was not gathered for some students in several sections. However, while the lack of fully structured interview format made it so some important pieces of information were missing to better analyze and form the results of the current study, semi-structured interviews allowed for more personable conversation, and a higher likelihood that the interviewer could establish rapport with their participants. Thus, I believe the quality of our engaging conversations may outweigh this drawback.

**Strengths.** There are also noteworthy strengths of this study. The current study had all Mexican-identifying participants although one participant, Karla, identified as Mexican and Guatemalan. Garcia and Bayer (2005) revealed that Mexican Americans as a subgroup experienced disparities within the broader Latinx group, so the current study benefited from the focus on this group to understand their needs more strongly. Second, all participants in the study were first-generation college students. Dueñas and Gloria (2020) discuss that first-generation students have the most difficulties navigating campus resources, report a lower sense of belonging, and have lower feelings of mattering within their universities when compared to continuing-generation students. Thus, a focus on this subgroup may be beneficial.

**Future Directions**
The results of the current study also provided several suggestions for additional research on how to support the development of Latinx students’ identities in STEM. First, it is advised not to be overly optimistic about participant sample goals in qualitative studies with highly specific samples, and to award them with more appropriate compensation, especially for long interviews. Second, to lower biases, a future direction for this project, such as if this becomes a journal publication or for other researchers engaging in interviews, would be to implement member check-ins (i.e., "Would you say this is accurate?"). For this study, it would involve sharing the results with five or so participants to verify that their statements were interpreted correctly. This direction is consistent with one of Lincoln and Guba's (1986) guidelines for enhancing the credibility of findings.

Lastly, considering that a hierarchy is at play when students are asked to talk about their professors and faculty mentors, if the protocol asked questions without the need to identify specific mentors, it could be that students would answer more wholly. Alternative, future qualitative studies could benefit from wording protocols such as how they would mentor in the future or what feedback they would give their future self. This could be more anonymous and avoid fear of retaliation. On the same note, with hierarchies in place, students knew that the interviewers were students and that interviews were confidential; however, we were more senior students. Nevertheless, the observed patterns create a rationale for a second study focusing on peers' influence on Latinx students' STEM identity.
Chapter 7: Conclusion

While attendance among Latino/a/x college students has risen substantially over past decades, significant disparities with their white counterparts in graduation rates as well as underrepresentation in STEM fields (American Psychological Association, 2019; McFarland et al., 2018, Saw et al., 2018; Estrada et al., 2016; Krogstad, 2015; Landivar, 2013; Riegle-Crumb & King, 2010; National Center for Education Statistics, 2005). Understanding and addressing educational differences with appropriate resources can diminish disparities in STEM achievement (Dueñas & Gloria, 2017). Thus, the study aimed to understand the changes needed from the perspectives of Latino/a/x students. Employing a critical paradigm guided by Wenger’s (1998) Communities of Practice framework, it was proposed to shift attention to communities of practice rather than students; the current project solicited Latino/a/x STEM student perspectives through interviews about their experiences with faculty mentors, providing information about STEM communities of practice at the undergraduate level.

There were differences in students’ communication level with faculty, felt acknowledgment in their STEM environments, and strength levels in STEM identity. The processes were related to whether students were part of UGR or only obtained skill-building opportunities in classrooms, year in school, and STEM discipline. Additionally, students described STEM skills they found meaningful, including scientific reading and writing, effective communication, skills for data analysis, and others. While all students reported several STEM skills they considered critical, only a few felt that they had obtained them with the help of faculty.
Students shared their reflections about how faculty promoted their STEM identity development through conversations about their sense of competence, sense of belonging, and experiences of participation in their STEM environments. Faculty mentor characteristics and behaviors relevant to skill-building support that promoted students’ STEM identity development include scaffolding, helping students build connections, providing them opportunities to build skills within their environments, facilitating collaboration through peer activities, and being part of students’ desired discipline to share recommendations for success.

Faculty mentor characteristics and behaviors relevant to relational support that promote students’ STEM identity development include being understanding, providing motivational and emotional support, being approachable and accessible, making environments enjoyable, implementing students’ input in the structure of the environment, giving students their time, allowing students to have autonomy, and empowering students.

Faculty mentor characteristics and behaviors relevant to cultural support that promote students’ STEM identity development includes sharing resources, having a relatable background to students, providing a safe space to speak Spanish, understanding the importance of representation, and acknowledging the role of structural influences.

Students also shared answers about how faculty mentors inhibited their STEM identity development through conversations about students’ sense of competence, sense of belonging, and experiences of participation in their STEM environments. Faculty mentor characteristics and behaviors relevant to relational support that inhibited students’
STEM identity development include unengaging class structure, insufficient support from professors, threats to competence, and lack of authenticity and relevance.

Faculty mentor characteristics and behaviors relevant to relational support that inhibited students’ STEM identity development include failure to integrate students’ perspectives, unresponsive teaching, lack of classroom engagement, harshness, failure to provide positive scaffolds, lack of time, and lack of recognition in STEM. Faculty mentor characteristics and behaviors relevant to cultural support that inhibited students’ STEM identity development include failure to provide resources that strengthen their identity, ignoring essential aspects of students’ identities, alienation via competence messages, lack of representation, and unwelcoming atmospheres. This reflects work that Latino/a/x students struggle with, consequently being unable to find faculty with backgrounds and experiences like theirs (Castellanos & Gloria, 2007; Gloria & Rodriguez, 2000). UGR programs seemed to be a positive source of skill obtainment, providing students the chance for close mentorship and relationship building with professionals in their field and allowing them to feel like their ideas are acknowledged. However, while UGR programs provided students with skill development, they were not responsible for a strong STEM identity. Students were highly influenced by stereotypical messages on who would be considered a STEM person and if they met the culture of STEM’s criteria of rigor, even if they were in a UGR program. Students were also highly impacted by faculty mentors’ messages, whether uplifting or discouraging, on who belonged in STEM. The results section concluded with tables identifying students’ explicit recommendations for faculty
mentors to better promote a sense of competence, belonging, and participation for Latino/a/x STEM undergraduate students.

Qualitative methodologies enabled the current study's participants to expand in detail and provide helpful examples, not limiting them to only a set of possible responses, as do only quantitative methods (Queirós et al., 2017). Along with contributing to the development of programs through their excerpts describing their experiences, these students felt empowered through their participation (Maton, 2008). The conclusions drawn from this study highlight rich, in-depth qualitative recommendations for the mentors and faculty of Latino/a/x STEM undergraduates from the students themselves, who are the experts in the issues they face as underrepresented minorities in scientific fields.
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Appendix A : Study Instruments
**MENTORING LATINO/A/X STEM UNDERGRADUATES**

**143**

Recruitment Flyer

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**ARE YOU A LATINO/A/X STUDENT WHO WANTS TO SHARE YOUR EXPERIENCES AS A STEM MAJOR AT PORTLAND STATE UNIVERSITY? JOIN THIS STUDY!**

**PARTICIPATION INVOLVES:**

- Completion of brief intake questionnaires
- Partaking in a semi-structured interview that will be 60-90 minutes in length

**You May Qualify If You Are:**

- Latino/a/x/e
- Between 18-29 years old
- An undergraduate in one of the following majors at PSU:
  - Science, social science, technology, engineering, computer engineering, or math

**All interviews will be held through the use of the video call application, Zoom**

**POTENTIAL BENEFITS:**

- You will receive a $20 Amazon gift card as an incentive
- Feeling empowered from sharing your experiences as a Latino/a/x in STEM
- Potentially contributing to the implementation of action within the institution

**USE YOUR PSU EMAIL TO APPLY WITH THIS CODE**

**For More Information Please Contact Sandy Cerda-Lezama at scerdel2@pdx.edu**

**Portland State University**
Involvement Questionnaire

Please check all the following programs or organizations that you are a member of:

**Undergraduate Research Experiences**
☐ BUILD EXITO
☐ McNair Scholars Program
☐ Honors College
☐ For-credit research or independent study
☐ Volunteer research assistantship

**Culturally Specific Programs and Organizations**
☐ Diversity Scholars Program
☐ Dream PSU
☐ Gaining Awareness & Networking for Academic Success (GANAS)
☐ Kappa Delta Chi Sorority Inc.
☐ La Casa Latina
☐ Las Mujeres PSU
☐ LSAMP Program
☐ Movimiento Estudiantil Chicano de Aztlán (MEChA)
☐ Multicultural Student Center
☐ Omega Delta Phi
☐ Society of Hispanic Professional Engineers
☐ TRiO/ Student Support Services (SSS)
☐ Uplift: Students in STEM
☐ Other, Please Specify: ______________________

**STEM Specific Programs and Organizations**
☐ American Medical Women's Association
☐ Future Leaders in Industrial and Organizational Psychology
☐ Neuroscience Club at PSU
☐ Portland State Women in STEM
☐ Pre-Physician Assistant Association
☐ Pre-Dental Student Association
☐ Pre-Medicine Student Association
☐ Pre-Pharmacy Student Association
☐ Statistics Journal Club
☐ Student Chapter of the Society for Industrial and Applied Mathematics (SIAM) at Portland State University
☐ The Chemistry Society
☐ Other, Please Specify: _______________________

**Discipline-Specific**

Are you part of any discipline-specific honors societies (i.e., Psi Chi, Sigma Xi, etc.)?

☐ Yes

☐ No

If yes, which one(s)?: _________________________
Demographic Survey

1. What is your age? ________________

2. What is your major? ________________

3. What is your minor? ________________

4. What is your class standing?
   ○ Freshman
   ○ Sophomore
   ○ Junior
   ○ Senior
   ○ Other: ________________

5. What is your nationality? (check all that apply):
   ○ Mexican
   ○ Guatemalan
   ○ Honduran
   ○ Nicaraguan
   ○ Salvadorian
   ○ Costa Rican
   ○ Puerto Rican/ Boricua
   ○ Others(s): ________________

6. I best identify as:
   ○ Latino
   ○ Latina
   ○ Latine
   ○ Latinx

7. What is your gender identity? ________________

8. Do your parent(s)/guardian(s) have a 4-year college degree?
☐ Yes, both or one of them.

☐ No, none of them.

9. Do your parent(s)/guardian(s) have a graduate degree?

☐ Yes, both or one of them.

☐ No, none of them.

10. Do any of your grandparents have a 4-year college degree?

☐ Yes

☐ No

11. Are you a transfer student?

☐ Yes        ☐ No

If so, what institution did you transfer from? ___________________________

12. What area of STEM are you in? (check all that apply):

☐ Science        ☐ Technology

☐ Social Science ☐ Engineering

☐ Math

13. What are your plans after graduation? (Check all that apply)

☐ Work full-time

☐ Work part-time

☐ Continue to Graduate or Professional School

☐ Mission/Service Trip
☐ Traveling

☐ Military

☐ Other: _______________

☐ Unsure/ I don’t know yet

14. How would you rate your overall experience at this institution?

<table>
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<th>Poor</th>
<th>Below Average</th>
<th>Average</th>
<th>Good</th>
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Interview Protocol

Welcome
Hi! It is great to see you! How are you doing today?
Thank you so much for taking some time to chat with me.

Introduction
The purpose of this interview is to get a deeper understanding of what mentors, advisors, and professors can do to support Latino students’ success in science and their development as scientists. I want to learn from students’ experiences so we can give mentors and advisors advice about what to do and what not to do if they want to have a positive impact on minority students’ development as scientists.

More Latino/a/x students than ever are entering college, showing that they have what it takes to go up against the system. However, they are not graduating at the same rates. So, along with many other researchers, I am trying to figure out what universities can do to support Latino/s/x students’ success more effectively. I’m looking at the role of faculty mentors, but I’m open to any other advice you have for me about what PSU and other universities could do to improve the situation.

So, I’m going to be asking some questions about your experiences with faculty mentors as a Latino/a in S.T.E.M at this institution. Your genuine answers and feelings are very beneficial to me because I want to learn more about what Latino/s need from their mentors to succeed. This could also help me share information about what students find helpful and harmful in their experiences with mentors and faculty.

Please answer as wholly and openly as possible. Your answers will remain confidential. I know it might be hard to talk about negative experiences with your mentor or advisor, but if we can identify these kinds of things, we can work hard to make sure they don’t happen to others. Is this all making sense?

I am thinking that we could talk for about 60 to 90 minutes. Will that work for you?

Feel free to stop and ask me questions at any time if anything is unclear.

Logistics
I would like to record this video to capture all of the helpful information I will learn from you, so I am able to go back to it as I am pulling out the important messages. I would love it if you continued to keep your camera and mic unmuted. If it’s okay with you, I’ll be recording, but your identity will remain completely confidential. To protect your identity, the audio-files and videos themselves will be destroyed after we make a written record of our conversation. Does this all sound okay to you?

My plan is to ask you this list of questions, but there will be room to explore anything else you want during the conversation.
If you come to any question that you do not feel comfortable answering, we’ll just skip it, okay?

Do you have any questions before beginning?

Before we start our conversation, I have two forms for you to fill out.

The first one has questions about your background, and the second one asks about the clubs and organizations you belong to at Portland State University.

(Students will complete the forms)

Before we get on with the interview, could you please restate your major, your minor if you have one, age, what year you are in college.

- Could you also give me a brief explanation of your family background?
- Can you tell me a little bit about yourself? What is important to you?

Thank you so much. Let’s get started.

**Full Protocol**

Could you please state your name and consent to participating in this recorded interview?

**Let’s start very generally:**

Would you say you have any mentors at Portland State University?
- If yes- have them name their mentors and what department/program/office they’re mentors are in.
- If no – ask them to explain why they said no.
- Could you tell me a bit about them?
  - How did you get to know them?
  - How long have you worked with them?
  - What are they like?

In the big picture:
- Has/have your mentor(s) done things that are helpful to you as a Latina/o/x in the STEM field? If you had to pick the top three most important things, what would they be?
  - Can you tell me about a time?
Can you give me an example?

Why was that so helpful?

How about things that are not so helpful? Like you even wish they hadn’t done them? Like they made things harder for you? Or maybe have hurt your feelings or made you feel frustrated? Would you have some examples of that?

Can you tell me about a time?

Can you give me an example?

Why was that so hard?

Here’s a funny question. What about things they DIDN’T do that you wish they had? That you thought would be helpful, but they didn’t do? Know what I mean? Did that ever happen?

Can you tell me about a time?

Can you give me an example?

Why was that a problem for you?

Now let me ask you some more specific things, okay?

My first question is about gaining science and research skills.

Some science and research skills include searching for articles related to one’s area of interest, summarizing research articles and completing literature reviews, writing research papers, and analyzing data.

Are there any particular research skills or knowledge areas you think are important to you in your STEM field?

1. Have your mentor(s) and faculty helped you get those scientific/research skills?

   How have they done that?

   Can you tell me about a time your mentor helped you work on those research skills that are important to you?

The next questions have to do with feelings of competence.

“Feelings of competence” are like when you feel smart enough or you have enough skills and abilities to do well. Like you have what it takes to succeed.

2. Do you feel that faculty mentors believe in you?

   Have your mentor(s) and faculty done things to support your feelings of competence in your labs, classrooms, etc.?

   Can you think of a time your mentors did something that made you feel competent in your research team/lab?

   Tell me about a time you did NOT feel competent in your research team/lab. What happened? What did your faculty or mentor do? How did that make you feel?
Do you ever or did you ever have to prove yourself to be seen as competent? How does that make you feel?
What can mentor(s) and faculty do to support Latino/a/x students’ feelings of competence in their labs, classrooms, etc.?
What can they do better?

The next questions have to do with feelings of belonging.

“Belonging” means a person feels accepted as a member of a lab or part of a team. Like an insider. Like you belong in a lab or in science.

3. Do/did you feel like you belong in your lab/classrooms? What makes you feel that way?
   - Have your mentor(s) and faculty done things to support your feelings of belonging in your labs/classrooms?
   - Tell me about a time you felt like you belonged in your research team/lab.
   - Do you feel like you belong in your lab? What kinds of tasks are given to you as a lab member?
     - FOR CLASSROOMS:
       - During groupwork, are you treated as a full-fledged member? What kinds of assignment do you end up doing?
       - How do professors interact with you in the class, when you participate, or go to office hours?
   - Tell me about a time you felt like you did NOT belong in your research lab/classrooms. What did your mentor do? How did that make you feel?
   - What experiences might make you feel like you don’t belong? Feel devalued?
   - Can you think of a time your mentors did something that made you feel like an outsider in your research team/lab?
   - What can mentor(s) and faculty do to support Latino/a/x students’ feelings of belonging in their labs, classrooms, etc.?
   - What can they do better?

4. Do your mentors and faculty make you feel supported and cared about?
   - How do they do that? Can you give me an example?
   - In your opinion, what are supportive mentors like? What kinds of traits or characteristics to they have? How do they act?
   - Have you ever needed more of something from your mentor? Like what? What did you need?
   - In your experience, have your mentors had what it takes to mentor you well? What would they need more of? Less of?

Now I want to ask you about your identity as a scientist.
To start off, let me tell you what I mean by “science identity.” By identity, I mean the way you see yourself. And there are different parts of yourself. Of your identity.
Like your Latin identity. I might say “I strongly identify as Latina.” So, I have a strong Latin identity. So, science identity is about seeing yourself as a scientist or as on the way to becoming a scientist. Like you would say, “I strongly identify with science.” Or “I am the kind of person who can succeed in science, who belongs in science-- that’s just who I am.” Or “I have a strong science identity.”

Does that make sense?

(If yes, proceed). Great, thank you so much for listening!

(If no, clarify as needed).

How would you describe your STEM Identity?

5. Do your mentor(s) and faculty create an atmosphere in your classes and lab that feels welcoming for you to participate and also helpful in fostering your science identity?

- What are some things your mentors do that make you feel comfortable participating and learning?
- What are some things your mentors do that make you feel uncomfortable in participating and learning?

6. One thing I want to learn more about is what mentors do that can make it easier or harder for students to stay in school and graduate in a STEM major.

- Are there things your mentor did that encouraged you to staying school? To stick with it?
  - What would they be?
  - Can you give an example? Can you tell me about a time?
  - Why was that so important?
- How about things your mentor did that discouraged you from staying school? That made you think about quitting?
  - What would they be?
  - Can you give an example? Can you tell me about a time?
  - Why was that so important?

Intellectual Ownership

- Do you feel like your ideas and perspective are being acknowledged in your classes? Explain.
- Do you feel like your ideas and perspective are being acknowledged in your lab? Explain.

Gender

- Do you believe gender has played a role in what you have experienced in your lab, whether positive or negative?
Do you believe gender has played a role in what you have experienced in classroom settings, whether positive or negative?

SES/ Income
Do you believe that SES/ income has played a role in what you experienced in your lab/ classroom? How?

END: If you were going to write an instructor/ mentor manual for best practices for Latino/a/x students, what would it look like?

- What would be the three most important things to do?
- What would be the three most important things NOT to do?

Is there anything else you would like to share with me?

Anything that you wished I had asked?

Conclusion
Those are all of the questions I have for you.

I’m going to stop the recording now.

I really appreciate your answers. One of the most important goals for me in my study are providing and sharing participant quotes from these interviews. Like I had mentioned, your identity will remain confidential, so any quote I share from you will not include your true identity. I was wondering if you would be interested in assigning yourself a pseudonym that best reflects your own identities?

- In that case, thank you so much!
Appendix B: Reflexivity Paragraph

This section includes the research assistant’s reflexivity paragraph.
Gabriela

I am a first-generation Latina undergraduate college student majoring in social work. I was born and raised in Oregon, where my parents immigrated from Mexico. Growing up in a predominantly white city, I often felt like I did not belong, especially at school. I was enrolled in English Language Learners and other “catch-up” courses until middle school. I had mentors throughout my K-12 grade education that demonstrated support and care for myself and my family. It was not until university that I had an instructor of color and was no longer the only student of color in a classroom. At university, I became involved in multiple mentorship-oriented programs for nontraditional students and culture-specific programs because I wanted to support other students with similar experiences as mine and build a sense of community to support each other. Within my role as a research assistant, I understand that I hold multiple privileges in being able to continue my education and pursue my goals in life. I want to continue to support my community to better the experiences of all students from nontraditional backgrounds.
Appendix C: Additional Tables
Table 22

*Communication with Faculty*

<table>
<thead>
<tr>
<th>High Communication</th>
<th>Middle Communication</th>
<th>Low Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jose</td>
<td>Blaire</td>
<td>Stephanie</td>
</tr>
<tr>
<td>Thinks that if students have communication with faculty, you can be on their good side.</td>
<td>Does not go to office hours or send a lot of emails to professors unless she has questions.</td>
<td>Due to the high volume of students waiting in line at office hours, she stopped going. Most professors were not welcoming to questions during lecture time because there is a quota of information that needs to be met.</td>
</tr>
<tr>
<td>Karla</td>
<td>Jay</td>
<td>Miguel</td>
</tr>
<tr>
<td>Started to feel more comfortable conversing with faculty by the end of her first year, and her professors would reply to her emails quickly and were kind.</td>
<td>Professors do not constantly check-up, but if he has a question, they are there for him and are accommodating. However, they don't answer his questions in-depth.</td>
<td>Some of his professors were passive-aggressive during interactions, and so he tried not to rely on professors and instead went to his teammates.</td>
</tr>
<tr>
<td></td>
<td>Luna</td>
<td>Sara</td>
</tr>
<tr>
<td></td>
<td>Had both encouraging and intimidating interactions with professors. Encouraging professors validated her need for help. Intimidating professors made her feel incompetent, but she went for the sake of her grades and scholarship.</td>
<td>Does not go to office hours or have many interactions with professors, although she says she should.</td>
</tr>
</tbody>
</table>

*Note.* This table includes information pertaining to students’ level of communication with their faculty mentors in classrooms.
### Table 23

*Acknowledgement in STEM Environments*

<table>
<thead>
<tr>
<th>Perspectives are acknowledged</th>
<th>Perspectives are not acknowledged</th>
<th>Acknowledgment of perspectives is dependent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jose receives encouraging feedback when he shares his perspective.</td>
<td>Karla does not talk or raise her hand much.</td>
<td>Blaire tends to not vocalize in zoom classes. In labs, her ideas and perspectives are acknowledged, more so in one lab than in the other though, because there are not a lot of undergraduates, and she does not vocalize as much because she is scared to or people say what she was going to. She feels like she would be acknowledged if she shared more.</td>
</tr>
<tr>
<td>Catherine’s ideas are heard and valued. If her ideas don’t align, they respectfully explain why, and she learns from it</td>
<td>Many of Stephanie’s groups during group work were large, her classmates took over and there was inequality in learning opportunities- but had better experiences in small groups. Class sizes were excessively big.</td>
<td></td>
</tr>
<tr>
<td>Florencia’s faculty mentors let her know when she is correct, and her environments are positive</td>
<td>Elizabeth does not have too much experience with this yet.</td>
<td>Jay does not feel like his perspectives and ideas are acknowledged in his classroom because he thinks people might look at him weirdly. Jay does feel like his perspectives and ideas are acknowledged in his lab because it’s a more creative process and feels more understood in his train of thought.</td>
</tr>
<tr>
<td></td>
<td>Luna has not had the chance to share her perspectives or ideas</td>
<td>Miguel’s ideas and perspectives are not acknowledged because he does not think he can give an idea to a professor because they are the ones teaching. His ideas are more heard in teamwork.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sara’s ideas are acknowledged in the lab because she makes contributions, but not in class because does not think her own opinion would affect the material being taught.</td>
</tr>
</tbody>
</table>

*Note.* This table provides information about students’ felt acknowledgement.
## Table 24

### STEM Identity

<table>
<thead>
<tr>
<th>Participant</th>
<th>Low Reason</th>
<th>Strong Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karla</td>
<td>Feels like social science is not recognized as STEM</td>
<td>Jay [Understands scientific models but is still able to be creative]</td>
</tr>
</tbody>
</table>
| Stephanie   | 1. Crams for tests  
2. Does not have support  
3. Does not have research experience | Luna \[Has pride and a passion for math, and others know that about her\]       |
| Blaire      | Feels like social science is not recognized as STEM and has heard professors say psychology is not science | Miguel \[Identifies strengths he has in his field that are rare and feels he can give back with his future career\] |
| Elizabeth   | She has not taken many STEM-specific courses but thinks more challenging courses will help her develop a strong STEM identity | Catherine \[She feels and valuable, however, she feels more confident labeling herself as a researcher than she as someone in STEM\] |
| Sara        | Has been made to believe that public health doesn't sound like it is STEM    | Florencia \[1. She feels confident and proud of being in engineering  
2. Tries to encourage and help other family members to choose an engineering field  
3. Takes pride in being an indigenous Mexican woman in engineering\] |

*Note.* This table contains information about participants’ level of STEM identity.
Table 25

*Important STEM skills for students*

<table>
<thead>
<tr>
<th>Participant</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jose</td>
<td>Understanding the math relevant to his coursework</td>
<td>Skill-building for his future career through assignments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Karla</td>
<td>Social skills</td>
<td>Paraphrasing</td>
<td>Citing</td>
<td>Knowledge of APA and MLA formatting</td>
</tr>
<tr>
<td>Stephanie</td>
<td>Understanding scientific articles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blaire</td>
<td>Development of research questions</td>
<td>Writing papers</td>
<td>Analyzing data with software programs</td>
<td></td>
</tr>
<tr>
<td>Jay</td>
<td>Applying theory and tools to understand data</td>
<td>Extracting information from data</td>
<td>Being able to parse articles</td>
<td></td>
</tr>
<tr>
<td>Elizabeth</td>
<td>Analyzing data</td>
<td>Literature reviews</td>
<td>Summarizing research articles</td>
<td></td>
</tr>
<tr>
<td>Luna</td>
<td>Practice researching topics that are of interest to her</td>
<td>Understanding the fundamental of math and that everything builds off them and each other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miguel</td>
<td>Summarizing mechanical engineering ideas in simple language</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catherine</td>
<td>Summarizing research articles</td>
<td>Understanding how a study is written</td>
<td>Knowing how to act in a research lab</td>
<td></td>
</tr>
<tr>
<td>Florencia</td>
<td>Analytical skills</td>
<td>Thinking outside the box</td>
<td>Problem solving</td>
<td></td>
</tr>
<tr>
<td>Sara</td>
<td>Recruitment skills</td>
<td>Communication skills</td>
<td>Literature reviews</td>
<td>Understanding academic articles</td>
</tr>
</tbody>
</table>

*Note.* This table includes the STEM skills participants listed as important to them and their field of study.
## Table 26

*Faculty Mentors helping with skills*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Experience with faculty mentors promoting skills development</th>
<th>Expected faculty-mentor promoters of skill development</th>
</tr>
</thead>
</table>
| Jose        | 1. Readings, videos, and podcasts that get to the point  
              2. One-on-one time                                      | 1. Information not gathered                          |
| Karla       | 1. Information not gathered                                 | 2. Commenting on discussion posts  
              3. Setting up meetings                                 |
| Blaire      | 1. Encouraging her to learn about her interest  
              2. Guiding her in using software programs for analyses | 1. Information not gathered                          |
| Luna        | 1. Allowing her to research her topic of interest  
              2. Making sure students understand the concepts       | 1. Information not gathered                          |
| Miguel      | 1. Not applicable                                           | 1. Teaching how to simplify technical language  
              2. Providing tasks that reflect the future work settings |
| Catherine   | 1. Providing opportunities to practice skills she will use in her career | 1. Not applicable                                   |
| Florencia   | 1. Whole class activities that foster creative problem solving skills | 1. Not applicable                                   |
| Sara        | 1. Setting time aside to walk through things step-by-step    | 1. Not applicable                                   |

*Note.* This table includes information pertaining to whether students’ faculty mentors helped them obtain the STEM skills they listed as important to them and their field of study, or how they expect their faculty mentors could help.
**Table 27**

*Competence*

<table>
<thead>
<tr>
<th>STEM faculty mentors make the student feel that they believe in them</th>
<th>STEM faculty mentors do not make the student feel that they believe in them</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jose</td>
<td>Stephanie</td>
</tr>
<tr>
<td>Karla</td>
<td>Miguel</td>
</tr>
<tr>
<td>Blaire</td>
<td></td>
</tr>
<tr>
<td>Jay</td>
<td></td>
</tr>
<tr>
<td>Elizabeth</td>
<td></td>
</tr>
<tr>
<td>Luna</td>
<td></td>
</tr>
<tr>
<td>Catherine</td>
<td></td>
</tr>
<tr>
<td>Florencia</td>
<td></td>
</tr>
<tr>
<td>Sara</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* This table categorizes whether students felt like their faculty mentors believed in them.
Table 28

*Students that mention non-natural science mentors that make them feel competence/belonging*

<table>
<thead>
<tr>
<th>Jose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karla</td>
</tr>
<tr>
<td>Stephanie</td>
</tr>
<tr>
<td>Blaire</td>
</tr>
<tr>
<td>Jay</td>
</tr>
<tr>
<td>Elizabeth</td>
</tr>
<tr>
<td>Luna</td>
</tr>
<tr>
<td>Catherine</td>
</tr>
<tr>
<td>Sara</td>
</tr>
<tr>
<td>Florencia</td>
</tr>
</tbody>
</table>

*Note.* This table lists the students that mentioned non-natural science or outside of STEM mentors embodying qualities that do make them feel competent or like they belong.
Table 29

*Participant recommendations to help Latinx students’ sense of competence*

<table>
<thead>
<tr>
<th>Name</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jose</td>
<td>1. Reaching out and checking in</td>
</tr>
<tr>
<td></td>
<td>2. Be understanding that students have many responsibilities</td>
</tr>
<tr>
<td>Karla</td>
<td>1. One-on-one time with students</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Karla</td>
<td>1. One-on-one time with students</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Stephanie</td>
<td>1. More check-ins</td>
</tr>
<tr>
<td></td>
<td>2. Major/pathway-specific mentorship</td>
</tr>
<tr>
<td>Blaire</td>
<td>1. Acknowledging systemic barriers</td>
</tr>
<tr>
<td></td>
<td>2. Providing students with resources</td>
</tr>
<tr>
<td></td>
<td>3. Assigning tasks that prepare them for their future</td>
</tr>
<tr>
<td>Jay</td>
<td>1. Not being prejudiced or making stereotypes</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Elizabeth</td>
<td>1. Giving uplifting words</td>
</tr>
<tr>
<td></td>
<td>2. Providing tutoring</td>
</tr>
<tr>
<td></td>
<td>3. Knowing where student services are</td>
</tr>
<tr>
<td></td>
<td>4. Working through assignments step-by-step when students are stuck</td>
</tr>
<tr>
<td>Luna</td>
<td>1. Bringing awareness about Latinx-specific clubs and organizations</td>
</tr>
<tr>
<td></td>
<td>2. Promoting resources on canvas</td>
</tr>
<tr>
<td>Miguel</td>
<td>1. Restructuring coursework if a lot of students are struggling</td>
</tr>
<tr>
<td></td>
<td>2. Bringing in Latino engineers to outside events</td>
</tr>
<tr>
<td></td>
<td>3. Telling their stories</td>
</tr>
<tr>
<td>Catherine</td>
<td>1. Understanding first gen students' experiences, struggles, and environments</td>
</tr>
<tr>
<td></td>
<td>2. Being accommodating</td>
</tr>
<tr>
<td></td>
<td>3. Giving reminders</td>
</tr>
<tr>
<td></td>
<td>4. Checking-in</td>
</tr>
<tr>
<td>Florencia</td>
<td>1. Checking in with students</td>
</tr>
<tr>
<td></td>
<td>2. Letting students know they want to help</td>
</tr>
<tr>
<td></td>
<td>4. Being aware of injustices in education</td>
</tr>
<tr>
<td></td>
<td>5. Providing words of encouragement</td>
</tr>
<tr>
<td></td>
<td>6. Connecting their students with applicable resources and clubs/ organizations</td>
</tr>
<tr>
<td>Sara</td>
<td>1. Being supportive</td>
</tr>
<tr>
<td></td>
<td>2. Giving students validation</td>
</tr>
<tr>
<td></td>
<td>3. Reassuring students that they are smart</td>
</tr>
</tbody>
</table>

*Note.* This table lists students’ recommendations they would give to faculty, so Latinx students feel a sense of competence.
Table 30

*Participant recommendations to help Latinx students’ sense of belonging*

<table>
<thead>
<tr>
<th>Mentor</th>
<th>Recommendations</th>
</tr>
</thead>
</table>
| Jose    | 1. Having in-class workshops  
|         | 2. Providing feedback  
|         | 3. Providing readings and videos that represent people of color                   |
| Karla   | 1. Checking-in with students  
|         | 2. Structuring the classrooms so students can talk to each other                 |
| Stephanie | 1. Having pathway-specific mentorship  
|         | 2. Checking in frequently                                                        |
| Blaire  | 1. Giving students skill-building they can apply to their careers                |
|         | 2. Connect students with other researchers and professors                         |
| Jay     | 1. Being accommodating  
|         | 2. Recognizing that there are many skills                                        |
|         | 3. Understanding that progress can look many different ways                       |
|         | 4. Having a positive outlook and purpose for students                             |
| Elizabeth | 1. Having posters that welcome all identities                                 |
|         | 2. Having a similar background as students                                       |
|         | 3. Sharing their academic experiences                                            |
|         | 4. Promoting Latinx-specific clubs                                               |
| Luna    | 1. Giving words of affirmation and encouragement                                 |
|         | 2. Listening                                                                    |
|         | 3. Asking about goals                                                            |
| Miguel  | 1. Sharing their stories/struggles as students in the past                        |
|         | 2. Trying to motivate them                                                       |
|         | 3. Talking about their jobs and previous experiences                             |
| Catherine | 1. Checking-in with students                                              |
|         | 2. Holding students accountable                                                 |
|         | 3. Guiding them through academic hardships                                      |
| Florencia | 1. Understanding that everyone comes from different backgrounds                |
|         | 2. Understanding and being accepting of bilingualism                             |
| Sara    | 1. Connecting them with other people, events, and programs                      |
|         | 2. Sharing resources                                                            |

*Note.* This table lists students’ recommendations they would give to faculty, so Latinx students feel like they belong in their STEM environments.
**Table 31**

*Participant recommendations to help Latinx students’ participation*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Recommendations</th>
</tr>
</thead>
</table>
| Karla       | 1. Facilitating the creation of groups  
2. Allowing students to talk about their assignments with each other |
| Stephanie   | 1. Facilitate the formation of small groups so for study time |
| Blaire      | 1. Being engaging  
2. Providing challenging tasks  
3. Providing tasks that are relevant to their interests |
| Jay         | 1. Being open to student engagement  
2. Not only asking difficult questions that require a correct response |
| Elizabeth   | 1. Encouraging students to ask questions |
| Luna        | 1. Give reassurance that it’s okay not to have the right answer |
| Miguel      | 1. Incorporating teamwork |
| Catherine   | 1. Incorporating breaks because students don’t feel like they are interrupting  
2. Getting to know students more personally to help reduce formalities  
3. Verbally telling students they can reach out for help  
4. Keeping in mind that they have more expertise than their mentees |
| Florencia   | 1. Having interactive classroom activities with peers  
2. Hearing students’ ideas in class and give feedback to their solution  
3. Going around each table to check in  
4. Helping students feel comfortable |
| Sara        | 1. Having patience  
2. Being willing to explain things  
3. Walking students step by step  
4. Being approachable |

*Note.* This table lists students’ recommendations they would give to faculty, so Latinx students feel more encouragement to participate in their STEM environments.