Board 228: Comprehending the Complex Context of Community Colleges: STEM Student Success at a Hispanic-Serving Institution

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Comprehending the Complex Context of Community Colleges: STEM Student Success at a Hispanic Serving Institution

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Abstract

In the pursuit of enhancing the success of students in science, technology, engineering, and mathematics (STEM) fields, understanding the intricate network of factors influencing their achievements is crucial. This phenomenological study investigates the multifaceted network of factors influencing the success of students in STEM, with a specific focus on a Hispanic Serving Institution (HSI) community college in Southern California. Through faculty interviews and student focus groups, the study uncovers the lived experiences of STEM students, providing valuable insights into the nuances of their educational journey exploring critical aspects such as STEM identity, external support, faculty influence, and internal motivation.

The research highlights the crucial role of community colleges and HSIs in supporting underrepresented groups in STEM fields and underscores the significance of creating inclusive learning environments and opportunities to foster a sense of belonging and empowerment among students. External factors, including family support and access to resources, are identified as fundamental determinants of STEM student success.

Overall, the study's findings reveal the interconnected nature of STEM student achievements, emphasizing the importance of recognizing and addressing the interactions between STEM identity, student-faculty relationships, faculty influence, and external factors. Educators, policymakers, and institutional leaders can utilize the results to provide guidance to enhance STEM student success and promote the dismantling of barriers and the creation of equitable opportunities, particularly for underrepresented groups, to foster an inclusive and thriving STEM community.

Keywords: Hispanic Serving Institution, community college, STEM, student success, STEM identity

Introduction

As the nation's most accessible institutions in higher education, community colleges have historically and continue to enroll students from diverse cultural and socioeconomic backgrounds (Carales & Hooker, 2019). In an increasingly technology-driven world, the demand for professionals skilled in science, technology, engineering, and mathematics (STEM) fields is growing at an unprecedented rate. As technology continues to transform industries and reshape our daily lives, the need for a strong STEM workforce has become paramount. Community colleges play a crucial role in addressing these needs by providing accessible and affordable education. This study will explore the experiences of STEM students at a community college that is a Hispanic Serving Institution (HSI) and examine the context for student success.

The future of the U.S. scientific workforce depends on graduating college students in STEM fields (Griffith, 2010; Sriram & Diaz, 2016) as they are in the forefront of innovation, driving advancements in sectors such as healthcare, energy, manufacturing, and information technology. Employers seek individuals with expertise in fields such as computer science, engineering, data analysis, and biotechnology (U.S. Bureau of Labor Statistics, 2020). Unfortunately, only 37% of students majoring in a STEM field complete their degree (Chen & Weko, 2009). Furthermore, students who entered computer science or engineering had a lower rate of undergraduate degree completion than other STEM majors, and success and completion issues are only intensified when considering students of color in STEM fields (Horwedel, 2006; Le & Gardner, 2010). Colleges interested in the success of STEM students of color should place emphasis on the institutional environment (Museus, Palmer, Davis, & Maramba, 2011).

Community colleges play a pivotal role in addressing the shortage of STEM students by offering accessible and affordable educational opportunities including associate degrees, certificates, and transfer pathways to four-year institutions. By offering flexible schedules, online learning

options, and hands-on training, community colleges create opportunities for students to develop foundational STEM knowledge and skills. Their emphasis on practical applications and industry partnerships also enhances students' employability prospects.

In recent years, due to demographic shifts, many institutions across the United States have become HSIs where a significant portion (25%) of the student population consists of Latinx students. California (where this study is conducted) has the highest number of HSIs among all states, with 176 institutions. In California, HSIs represent about 50% of all institutions but enroll nearly 90% of Latinx undergraduates and nearly 80% of all undergraduates (*Excelencia* in Education, 2022). HSIs play a critical role in meeting the educational needs of the growing Latinx population as they are more likely to provide culturally responsive and inclusive learning environments. When these factors are combined, HSI community colleges create an ecosystem that supports the success of STEM students by providing academic support, fostering a strong sense of community, cultural pride, and social support networks.

Purpose

The purpose of this study is to investigate STEM students' success at an HSI community college. Multiple factors influence the success of students, and we focus on one institution in California interviewing both STEM students and STEM faculty. Student success is critical for the completion of academic degrees and certificates within STEM as the field lacks representation from diverse student groups. Further, STEM degree acquisition is low for students at community colleges and even lower for underrepresented students of color (Varty, 2022).

The study is guided by an overarching research question: What helps STEM students succeed at an HSI community college? In pursuit of that answer, four sub questions were also generated to help focus the research activities: a) How do community college students develop a STEM identity? b) What do students attribute their success to? c) How do faculty members either support or hinder

students in their educational journey? and d) What external factors and resources contribute to student success?

Literature Review

The research team searched for literature on STEM, student success factors, HSIs, and community college contexts. A very brief overview of the most prevalent themes are summarized here and include: engagement, STEM identity, student-faculty relationships, and conditions for underrepresented students in STEM.

Engagement

There is growing interest in educational research on student engagement. Empirical research has shifted from focusing solely on academic student outcomes to wider educational environment research as it pertains to student success. Community college students vary greatly from "traditional" college students centering the experiences of students at four-year institutions. However, there seems to be a prominent shift in what is to be considered a normative college experience (Deil-Amen, 2015). Community college students have various commitments outside of the classroom such as employment, being parents, or supporting other family members (Flores, 2017), therefore engagement shows up primarily in the classroom setting interacting with peers and faculty. Engagement in the wider context of higher education refers to the relational interplay between the student and the institution (Wolf-Wendel, Ward, & Kinzie, 2009).

The multi-dimensionality of engagement is often understood to fall within three core concepts which span the literature in various forms. The three dimensions of student engagement from this lens are academic, relational, and cognitive (Alicea et al., 2016). Academic engagement involves taking part in tasks like attending classes and completing assignments. Relational engagement is about the connection and support a student feels towards peers and faculty. Cognitive engagement relates to a student's inherent interest in learning. While not comprehensive, these dimensions provide a well-defined basis for applying theoretical frameworks on student and

institutional engagement. This foundational relationship is a precursor to the development of a STEM identity.

STEM Identity

When considering a formal definition to ascribe to, we found Carlone and Johnson's (2007) development of a science identity most apt as a starting point. They posit a triad relationship between performance, recognition, and competence encapsulating a science identity that interacts with an individual student's racial, ethnic, and gender identifies. Subsequent scholars have extrapolated this presentation of a science identity (Carlone & Johnson, 2007) to a STEM identity. We then operationalize a STEM identity to refer to an individual's sense of belonging, engagement, and identification within STEM. It encompasses how people perceive themselves regarding their potential for success and contribution in STEM disciplines.

The scholarship highlights the importance of creating inclusive environments, providing supportive role models and mentors, and addressing barriers to cultivate a strong STEM identity among diverse student populations. STEM identity is a broad and evolving concept, and researchers continue to explore new aspects, interventions, and strategies to foster a positive STEM identity among individuals. These endeavors seek to be inclusive of individuals with a variety of identities and past experiences, who can bring a diverse range of thought to STEM disciplines in order to create better outcomes and creative solutions (Rodriguez et al., 2019). Research on the transfer pathways of community college students to four-year universities within STEM fields is crucial to ensure successful transition (Blaney, 2022). STEM identity becomes more crucial for students belonging to marginalized groups as they may experience increased feelings of alienation and other barriers that can negatively impact their progression in STEM fields (Santiago et al., 2022). It is however important to approach this work with an asset viewpoint rather than a deficit perspective as educators must recognize the various forms of capital (Yosso, 2005) that students bring into their

educational journeys are invaluable to developing their STEM identities. The nature of a STEM identity is not one which can subordinate the various other social identities of a student, but instead one which further helps to cement the role of the student within their educational and social communities (Ortiz et al., 2019). The formation of a STEM identity arises from the internal conceptualization of belonging within STEM, and thus is fueled by the accumulation of human interactions and educational experiences within the student's pursuit of a STEM education. Underrepresented students especially convey the importance of support received from family (Holland Zahner, 2023; Jaime-Diaz & Ramos, 2023), community, and the classroom itself as being integral to overcoming various barriers (Dounebaine, 2020). A vital component to the development of a STEM identity also includes the development of student-faculty relationships.

Student-Faculty Relationships

Student-faculty relationships play a vital role in STEM retention. The scholarship in the field has extensively documented the significance of student-faculty interactions as an important predictor for success; however, we possess limited knowledge of the nature of student-faculty engagement for Latinx students in community colleges (Rodriguez et al., 2016). In fact, community colleges have been attributed as the most important avenue to transferring to 4-year institutions (Jackson et al., 2013). An important way to encourage the development of student-faculty relationships could be through mentoring. Student-faculty relationships aid students in different ways such as self-development, work ethic, and mentorship (Gandhi-Lee et al., 2015). Pedraza and Chen (2022), emphasize the importance of mentorship on persistence when pursuing baccalaureate level education. Mentoring can promote students' motivation, increase determination, and allow for self-discipline in students (Christe, 2013). Mentorship can also help create a sense of belonging which in turn has been attributed to the success of students (Christe, 2013). Although all types of interactions with educators are essential to the success of students, those relationships that are more fully developed provide

greater levels of support and guidance from educators (Pedraza & Chen, 2022). Relationships where students can relate and identify the most to their mentor provide the ultimate support (Gandhi-Lee et al., 2015).

Another way to foster student and faculty relationships could be through undergraduate research (Christe, 2013). This opportunity allows them to envelope themselves in learning opportunities such as analyzing data and applying the knowledge from their classroom to situational practices (Christe, 2013). A study focused on engagement between faculty and students in engineering also found that it facilitated further engagement with their peers and ultimately benefitted the student through the development of self-efficacy and improved academic performance resulting in an increase in persistence within the STEM field (Palmer et al., 2011). Opportunities that employ active learning techniques have a positive correlation between student content and retention (Christe, 2013). Faculty can also be proactive and take the initiative to notify student services, tutoring, or other types of academic assistance centers early on to help students be retained in their courses (Piland & Piland, 2020). While these are all important practices to employ with all students, specific attention must be given to marginalized groups.

Underrepresented Students in STEM

The literature on underrepresented students highlights barriers and challenges, and is framed from a deficit perspective. Underrepresented students in STEM are more likely to not receive a degree in STEM and more likely to change their degree to a non-STEM major (Tsui, 2007). Flynn (2016) found that Black STEM students have a higher probability of not continuing their education in STEM compared to their White counterparts. Underrepresented racial and ethnic groups, such as Black, Hispanic/Latinx, Native American, and Indigenous communities, face unique challenges in accessing and succeeding in STEM education and careers. Structural barriers, lack of resources, limited role models, and systemic racism contribute to lower representation and retention rates for

these groups in STEM fields (Corbett & Hill, 2015). Overcoming these challenges requires concerted efforts to provide equitable opportunities, support systems, and inclusive environments that empower underrepresented racial and ethnic groups to thrive in STEM.

According to Nimmesgern (2016), the lack of representation of women in STEM fields can be attributed to the intimidation factor from a male dominated field along with the importance of family formations in adulthood. Societal biases, stereotypes, and systemic barriers have historically discouraged girls and women from pursuing careers in STEM. These disparities not only limit opportunities for women but also hinder the overall progress and potential of the STEM workforce. Community college plays a vital role for women in STEM (Jackson et al., 2013). For women and underrepresented minorities, community college can allow for more peer support and ease a transition to a 4-year institution (Jackson et al., 2013). In 2008, 49% of female recipients of bachelor's and master's degrees had attended community college (Jackson et al., 2013).

To provide a varying perspective, Burt et al. (2023) focused on 20 participants across 8 different colleges in the Louis Stokes Alliance for Minority Participation (LSAMP) program that serves underrepresented students in STEM. Their study found that those students of color who engage with different diversity programs within the field of STEM, lack a feeling of underrepresentation and instead view STEM in a positive manner. We look forward to hearing more about these empowering spaces in the literature soon. We now move to the conceptual framework.

Conceptual Framework

The conceptual framework illustrated in Figure 1 titled "Integrated Action and Perception Model for STEM Students" emerges from the analysis of the interviews with students and faculty from this study. The model lends itself to a student centric viewpoint of collegiate environmental factors, STEM identity, motivation, external pressures, and how they mediate the objects of the student's educational journey with their respective outcomes. Rather than attempting to simplify a

student's collegiate experience into a linear trajectory, this framework aims to illustrate the relational and iterative processes of students' experiential pathways within their educational venture. Instead of overlaying factors as other models have done (Lawson & Lawson, 2013), this model identifies them as directly applicable to college experiences (College Environment) and those outside of a campus (External Environment).

The conceptual framework encapsulates the environmental influences shared by the participants which play various roles within a student's educational career (Dounebaine, 2020). The community college environment was described in a multitude of ways by the participants and determined to have two major subcategories: faculty and non-faculty. The other dimension of the environment for college students was identified as the external environment and best encapsulated by the subcategories: familial and socio-economic. They represent a linked situational experience, particularly for first generation college students and low-income students. Both college and external environmental phenomena were shown to have a dramatic impact on the development of characteristics of self-reported STEM identity as well as internal motivation.

The diagram's center represents the internalized self-conceptualization of students as they navigate college. Chosen specifically here is STEM identity as all students in this study were STEM majors. Also lying in the middle of the diagram is internal motivation. Rather than singling out an individual aspect of motivation such as persistence or self-efficacy as many prior studies have done, the category of internal motivation is the encapsulation of all these aspects within the student's frame (National Academies of Sciences, Engineering, and Medicine, 2019; Sithole et al., 2017). Internal motivation was found to be inextricably linked to STEM identity, and thus strengthening one would predictably strengthen the latter, and as such is represented as being in equilibrium with one another.

Finally, above the internal self-conceptualization of the student is that of the object and the outcome. The object in this model is defined as the student's immediate objectives and goals for any given moment in their educational careers, while the outcome represents the end goal which is

achieved via the accumulation or completion of objects. The object therefore is the major mediating factor, in which the building blocks to the eventual outcome of the student's educational journey are found. To illustrate this point, if the desired outcome of the student is to successfully pass a class, then the object could represent completing homework assignments, attending lectures, and engaging with supplemental class activities or materials. As the student progresses through these intermediate tasks, they are working towards the larger outcome which necessitates the objects completion (Hatch, 2017).

Objects are interchanged, replaced, or updated as one continually aims to reach their specified outcome. This model lends itself to this mode of iterative pursuit by establishing connections between the object and the environmental elements. These connections are either an action impact which represents direct and actionable connections, or a perception impact. Action impact elements affect the object directly and can dictate educational outcomes. Perceptual impact refers to the relationship in which the student perceives their environment and how it affects the object a student aims to complete as they attempt to achieve their outcomes. To conceptualize this relationship, consider a situation where a student is taking an extremely challenging class and their perception throughout the course can shift from one of negativity to that of positivity as they progress through their objects (e.g. course assignments). This is crucial as a negative perception can halt their advancement as they perceive the class as an impediment to their educational progress. This perceptual shift to a positive outlook can serve to bolster both their STEM identity and internal motivation as they now view themselves as competent for successfully completing the course. Their heightened internal motivation (which can also be interpreted as motivational capital) can now influence additional objects. This allows the framework to be seen as a regenerative and sustainable model by which STEM students can use various external factors, which in and of themselves have the ability to be perceived as positive or negative experiences, to further extrapolate multiple forms

of “capital” (Yosso, 2005) in the pursuit of objects which will eventually lead to finalized outcomes. Next, we turn to the methods followed to complete the study.

Methodology

This study is guided by a phenomenological approach (Moustakas, 1994; Polkinghome, 1989), to investigate STEM student success at an HSI community college. The case study campus is one of the largest public community colleges in California. The intention of this study is to examine and understand what facilitates the success of STEM students on this specific campus. Due to the inherent characteristics of the phenomenological case study research design, this study was conducted exclusively at a single institution (pseudonym: Santiago Vista College). The purposeful use of this approach was to gain a comprehensive understanding of the experiences of students within that specific case (Sriram & Diaz, 2016). By focusing on a single institution, the study aimed to capture the unique context, dynamics, and nuances that influence participants' experiences, success, and perceptions within that setting.

This phenomenological examination occurred in two separate steps. Step one included interviews with Santiago Vista College (SVC) STEM faculty members, with specific emphasis placed on how they articulated their support in helping students achieve success. In the second step, students participated in focus groups to share their educational experiences, challenges, and expectations. By employing this approach, the study allows for the analysis of both the faculty perspective regarding how they support students (evaluate their success) and the student perspective derived from their experiences with professors, engagement, and their perception about STEM identity. This methodology has been utilized by other researchers studying the college experiences of students of color (Museus & Quaye, 2009).

Santiago Vista College

Santiago Vista College is an HSI community college in California. The college has an approximate total enrollment of 20,000 students with about 80% identifying as Latinx. The majority of students (around 75%) attend college on a part-time basis. Additionally, about 90% of students receive financial aid, and over half of them qualify for a Pell Grant. Regarding the faculty composition, the racial and ethnic breakdown is as follows: 43% are White, 35% are Latinx, 11% are Asian, 3% are African American, and less than 1% are Native American (National Center for Education Statistics, 2021). It is worth noting that full-time faculty members represent only 33% of the instructional staff at the college.

Faculty Interviews

The Dean of the STEM Division emailed all STEM faculty members, seeking volunteers interested in participating in discussions with an external educational researcher (interviewer). These discussions were to explore how faculty members support students to succeed in STEM fields at SVC. Also, faculty members were requested to complete an online Qualtrics survey to provide their demographic information, aiming to ensure a diverse pool of participants. As an incentive for their participation, each faculty member received compensation of $100 at the completion of the data-collection process. Ultimately, 9 faculty members participated in one-on-one interviews conducted virtually via Zoom. The interviews were video recorded and transcribed verbatim. The duration of each interview ranged between 55 and 70 minutes.

Student Focus Groups

Students were screened based on criteria such as their intended STEM major, the number of completed units at SVC, and participation in the Math Engineering Science Achievement (MESA) program. Working in collaboration with the institutional researcher, the principal investigator gathered the email addresses of students who met the criteria. Six targeted sample focus groups were

created to keep similarly experienced students with their peers. Invitations were sent to the selected STEM students, inviting them to participate in one of six virtual Zoom meetings. Students were asked to confirm their availability using Calendly, an online scheduling tool. In total, 34 students agreed to take part in the focus groups. As an incentive for their participation, each student was offered a $20 gift card. The focus groups lasted between 58 and 67 minutes. They were video recorded and transcribed verbatim.

Analysis

After completion of the data collection phase, the transcripts were carefully read and re-read to identify the prominent themes that related to STEM student success, the support they received in pursuing their goal, engagement on campus, challenges they encountered, and the student's relationships with faculty members. According to Braun and Clarke (2006), thematic analysis is a qualitative data analysis method that involves reading a data set (such as transcripts from in-depth interviews or focus groups) and identifying patterns in meaning across the data to derive themes. Thematic analysis involves an active process of reflexivity where a researcher's subjective experience plays a leading role in meaning-making from data. The themes from the student focus groups were then compared with those from the faculty interviews. Independent development of themes, comparison and integration of codes and themes, and cross-checking each transcript with the newly developed themes were all vital steps conducted by the researchers (Patton, 1990). By triangulating the data, the aim was to enhance the credibility and reliability of the findings by identifying points of convergence or divergence between the perspectives of the students and faculty members. This overall approach helps to ensure a more comprehensive and well-rounded understanding of the phenomenon being studied. Case study research, as noted by Flyvbjerg (2006), contributes to scientific development by testing hypotheses and building theories while acknowledging the value of practical knowledge. Next, we turn to the findings of the study.

Findings

The findings from the qualitative data yielded five overarching themes. They were: community college resources; faculty influence; STEM identity; student motivation; and external factors that include familial influence and socio-economic status.

Community College Resources

Engagement of community college students with other professors or peers can be imperative to the success of a student. In this section, the focus is on community college resources from the faculty perspective. A faculty member, Rene, recounts engaging with a student outside of the classroom that later transferred to a 4-year university and was able to use the relationships and networks created from engagement at Santiago Vista College to guide her through medical school.

> I see the friendships, because we're still Facebook friends, to see that she's still very much interconnected with the students that she went through MESA with. So, it was very important for getting through SVC. It was very important for [the student's university] you know, when she transferred, because a lot of that group stayed interconnected and while some relationships broke, other stayed there for her maintaining relationships in med school. (Rene)

There are different ways to engage on community college campuses. Some of these engagements can be via faculty, getting involved in student organizations, or engaging with peers. From a faculty's perspective, Jackie shares that teaching students is something that they are passionate about and take pride in aiding their students to the best of their ability. They briefly share some of the resources Santiago Vista College provides for the students to become involved.

> Especially in the math department, the faculty are... they just love their students. So, a lot of them [faculty] are just like me. They're just very passionate about what they do. They're invested into what is best for their students. As you walk around campus, there are clubs and it's surprising the amount of ways to plug into the campus. There's events on campus all the time. (Jackie)

Another faculty member recounts a time when the college provided food for the students during finals. This activity with the student can provide nourishment and motivate students to

succeed in their final exams. SVC provides unique clubs for those who desire more knowledge in a specific field that may not be related to their studies. Faculty member Jacob states:

> A student that wanted to learn more about history, there's a club that they can go and learn more about ancient history and things like that. I've never been a student here, but it seems quite welcoming to me... Oh, you know what they do, that's really cool for real? Around finals time, they will buy a ton of pizzas, and just feed any student who wants pizza. Like, the faculty they're out there just handing out pizzas. It's beautiful. They don't do that at [another local college campus]. (Jacob)

Rene describes the positive effects of MESA on students. They stress how important the relationships that are developed within MESA have been, not only for the students but for the faculty as well. Even after several years, the established relationships endure over time. Community college resources are imperative for the success of both students and faculty. Rene shares,

> On the one hand we have MESA which has done an outstanding job of cultivating student support networks between the students and between students and faculty. To establish, you know, to make us as faculty, a lot more human. For the students, to help cultivate good study skills, to help them to cultivate strong relationships. And these are relationships that I'm seeing seven, eight years later that are still in existence. (Rene)

In an interview with Keiko (faculty), they detail how SVC supports their students. Keiko refers to a scholarship provided to the students and how the scholarship is just a perk to the support the students are able to receive: "I can say there is I think STEM [support]. I mean, they support students a lot. It's 100% support plus scholarship. It's a really really great program we have at Santiago Vista."

Another faculty member (Alexis) mentions how Santiago Vista College is good at providing resources such as tutoring and workshops. Alexis also mentions the MESA program for STEM students and how it has been beneficial. From a faculty's perspective, the resources provided by the college are copious.

> As far as the [STEM] division for students, I think that they do a really good job of providing opportunities to help students be successful. I know that they really do a lot of pushing and advertising to get students to come to the [math science center] to get tutoring. They provide workshops, there's flyers in every classroom, there's emails that go out to instructors, encouraging them to have students come to these. Then we've got MESA for all of the STEM majors and what a great support that is for them. I've just never seen a school with so many

> opportunities for students and free opportunities that I think are really great, you know? There may even be more that I'm not seeing, not having been here all that long. (Alexis)

In sum, from the faculty perspective, Santiago Vista College provides its students with multiple opportunities to access resources curricularly and co-curricularly. STEM-focused programs such as MESA provide tailored resources that this student demographic can benefit from. Other opportunities for engagement exist throughout campus irrespective of the student's major.

Faculty Influence

Student-faculty relationships are important to the success of students and their future STEM careers. One avenue to help establish student-faculty relationships is through creating the space to have open conversations and engage with each other. A faculty member describes the importance of an inclusive classroom where student voices are heard and the role of the educator is to facilitate open conversations that allow for the development of student-faculty relationships. When asked to describe what an inclusive classroom looks like, Rene shares,

> Something where everyone has a right to have a voice and those voices are valued. Not necessarily that every student is taking advantage of it, but they're all being encouraged and being made aware that they have that right to be heard, and to share their opinions, and to be valued. I think some students just don't take advantage of that for whatever reason, even though we try to be as approachable as we can be. I think that's another thing that's incumbent on instructors. When you talk about inclusive classrooms, I think students look to you as the instructor, as the person who's maintaining that kind of environment. And so, you have to model what it means to be inclusive. (Rene)

An example of open conversations can be seen within this students' perspective at a time when they experienced a positive student-faculty relationship. In this next passage, student Cyril shares their experience of when they truly felt welcomed in a classroom:

> A time where I felt like I belonged and welcomed... it was a Calculus or Pre-calculus class, but the professor was a little bit on the younger side. And with all the stuff that we're dealing with (like owning a house and real-world problems)… he kind of made us all feel like... helped us all out. We're all going to be owning a home someday, [starting a] family. So he would talk to us about life and be understanding of our circumstances. Not everybody's brought up the same and he just made everybody feels so, so welcomed. And I didn't want to

> leave his class ever... but great, great professor. I've never felt more, I guess, at home, in a classroom than I did with that professor. (Cyril)

For some students, it is the little things that professors do to make them feel validated and seen. Student Carlos recalls a time when they felt valued so much so that they vividly remember the class and professor. Moments like these have an impact on the student's motivation and STEM identity development. The student mentions how this kind of comfortability and ease changed the way they experienced the learning environment.

> At the time I felt like I really belonged. When I took the introductory chemistry when the pandemic first started, I understood the material very well. And I was answering [the professor] every single time he would ask a question. And people would message me asking me, "Hey, do you know how to do this? How to do that?" It made me feel important and like a leader somehow. And I really liked that. I like people to ask me questions and feel like what I say is valid and what I say is right. And they can trust me. And the instructor, yes, they create a very good space. (Carlos)

Carlos describes how they excelled in chemistry class so much so that their peers were asking for advice on how to improve themselves. This made them feel important in the classroom and helped to bring a feeling of leadership. They describe how professors instilled a sense of trust in them. Professors in previous courses developed a safe space within their classrooms and the students were able to excel in those courses and translate those skills into other subsequent courses.

Another example of a positive student-faculty interaction occurred when an instructor was able to analyze a situation in which a student was struggling and provide them with assistance. An engaged professor can help guide students to available resources. In this instance, the instructor was able to offer a solution to the student Juliana so that she could address a situation that was distracting her from her studies, thus allowing for an increased opportunity for success.

> For me, a time I felt validated was when one of my professors noticed I got distracted really easily. And I would tell him like, "Oh, I don't like going to the library, 'cause the sounds of everyone clicking on their keyboards, and the whispering, and like the chairs drove me crazy. I wouldn't be able to get any work done." And then just like... it was so many people. I would get really overwhelmed. And he [the professor] was like, "Well, why don't you try... um, I think it's the Transfer ... the Transfer Center has computers in like this small little

> room." He was like, "You should try to go in there." And I did, and it was like the holy grail. It was quiet. No one was in there. It was super... the ladies that work there are super nice. So that's where I started doing my homework. (Juliana)

Kris, a professor at SVC, tries to instill in their students core skills for learning. This perspective allows us to view ways that student-faculty relationships foster engagement that ultimately aid in the students' learning goals. Kris shares their learning engagement strategies utilizing various modalities to involve students in active learning.

> You don't walk in the door and talk for an hour and a half straight and then say, "Okay, see you next week." You talk for 5 to 10 minutes and then ask them a question or have them work with each other and do a think-pair-share. This is where my K-12 background shows through... And they use their devices in class to do a little Kahoot quiz really quick to check and make sure that they're learning. I have little packets when we do cell structures where I have literally put together little pieces of paper that have cell structure names on them, and then cell functions, the functions of those structures. And they're all mixed up in the bag and I give them to pairs or groups of three in the really big classes, during class time. And I say, "Okay, you know, work with your partner and spend some time." And I walk around the classroom, even if it's rows, in one of the stadium classrooms. I walk around in there and check and look at their progress and say, "Okay, you got one more, you know, these couple are kind of wrong, go back and check those." And then we go through them together. So, I think doing things that engage them more and make them more responsible that they have more impact on their learning process than just being passive and sitting in the classroom, listening to someone drone for an hour and a half. (Kris)

This section illustrates the importance of faculty connecting with students and building long-lasting relationships. Providing environments where students can speak openly and where instructors share their humanity are a few examples shared by the participants in this study. Faculty also note the power of networking opportunities created by engagement in STEM programs at SVC that transcend into continuing educational spaces.

STEM Identity

The concept of a "STEM identity" refers to an individual's perception of their experiences in STEM and how those experiences shape their self-identification as a STEM learner. Specifically, the concept stems from the triadic relationship between performance, recognition, and competence (Carlone & Johnson, 2007). Asking students where their STEM identity emerged, Eduardo mentions,

"My identity developed from having that curiosity of always wanting to find the reason for something. Then I would apply it to my field of study with problem solving and all that."

Performance refers to how a student's classroom accomplishments impact the perception of their abilities in STEM subjects. It involves the relationship between their academic achievements and their self-perception as a STEM learner. Marcus mentioned during the interview,

> I don't think I only have a STEM identity 'cause I also have a creative identity. My own projects, whatever I'm into. Personally, I'm really into music, so as of now I'm a math and music major, so I find it difficult to balance those things 'cause on one hand, STEM takes a really long time to do. Music also, in its own sense, takes a long time to do with having to practice every day, and going to concerts and rehearsals and stuff like that. I think they balance out each other nicely though since one is very analytical and one is very theatrical. I think it's important to not just study, study, study. You have to do other things that make you happy. (Marcus)

Competence, on the other hand, focuses on how students understand STEM concepts and knowledge beyond their performance in class. It considers their comprehension of STEM material outside of formal assessments. Elisa mentions,

> I would say that I do have a STEM identity, just because I have a very strong motivation to enter that field. And it kind of feels like, to me, that my whole life has led me on this path, not from anything special, but it just feels like it's the best fit for me and the way I want to go about life. So it's a very challenging and very time-consuming path, for sure. But I think it offers a lot in return for putting in all that effort. And it's a field that only keeps on improving and keeps innovating. I think that it has a lot of potential, and it has a lot of freedom involved in it too, once you get past the more difficult parts, which is kinda like the entire thing. But I'm sure it's there eventually. And so that kinda pushes me to continue going forward. (Elisa)

Marcus, reflects on their STEM identity and offers a different perspective.

> The strongest my STEM identity occurs is Monday through Thursday. That is when I am all STEM, the whole group, we meet up, we talk about homework, we talk about lecture, lab, and it's also more... it's not just an in-the-classroom bond. It's outside the classroom too. We also hang out outside the classroom. So, the STEM identity kinda blends into our normal life. How your classmates in college become your friends. So, STEM identity makes a bond that's already strong, even stronger. (Marcus)

Cecilia illustrates the concept of recognition, and it describes how peers perceive and recognize students as individuals with an affinity for science. It emphasizes the social aspect of STEM identity

and the influence of peer interactions on shaping a student's perception of themselves as a "science person." Cecilia mentioned that:

> But with SVC, I did feel like they did challenge me to acknowledge my identity as a mechanical engineer and to acknowledge the sacrifices and the hard work that I have put into, you know, be at certain spots, or get certain internships. I think my identity is evolving but overall, I do feel like I take pride in being a mechanical engineering major. Overall, I just take pride in helping my community when it comes to tutoring and things like that as well. (Cecilia)

It is important to note here that the students interviewed view the pursuit of STEM as a collective endeavor. Adam asserts that he takes pride in helping his community (of peers within STEM studies). The pursuit of STEM also includes the academic and professional endeavors aimed at advancing knowledge and innovation in these fields. STEM fields are essential for addressing complex challenges, driving technological advancements, and shaping the future. Adam mentioned,

> If you really want to become a STEM major and be a really good person in STEM, then you need to just really focus on yourself and keep your eye on the goal and just stay with that. And sacrifice, like it may be sacrificing some of your youth. But if you finish as fast as possible, you could still be young and have a really good life and have your degree and all that. (Adam)

Overall, the development of STEM identity is crucial for STEM students, and addressing the unique needs and experiences of this population is essential for diversifying the STEM workforce. Creating a supportive community, involving faculty members, and implementing institutional strategies can contribute to the development of a strong STEM identity among STEM students and increase their chances of success in STEM career fields.

Student Motivation

Motivating and ensuring the success of STEM students at an HSI community college is crucial for fostering a diverse and talented STEM workforce. Oftentimes, this motivation is self-actualized. Motivated students are more likely to pursue advanced degrees, contribute to scientific research, and excel in their STEM careers, making motivation a critical factor in their success.

Instructors also play a key role to motivation in how they structure their classroom practices and course content. Penelope shares about the connection students felt with their instructor,

> The first time I ever felt like my perspective was valued was when I first took my first physics course during summer. The professor was very welcoming to every one of us, ‘cause he [was as all of us are] college students. So, he knows that not only does a STEM major require so much work, so much time, but he also knew that we have to take care of our mental health. (Penelope)

Motivation plays a key role in the broader educational landscape, but it can also have a detrimental effect when students experience racism, sexism, or xenophobia. Natalia mentioned,

> I’m Mexican and I usually get criticized for being a different race. But I don’t really let that get in my way, but at first it did start getting in my way. For me, being a woman and actually being in the STEM field, that’s one of the hardest things that up to now has really challenged me because I never thought it would, but it does. (Natalia)

Natalia articulates the challenges she faces in the intersectionality of her identities as a woman, as a STEM student, and as a Mexican. The coming together of these demographics changes the context of any one of them alone.

Motivation also comes from different sources. Adam shares how they are supported by their parents. “You can get up to wherever you wanna get. You can meet your goal and you can work as hard as you want, and that's the type of mentality I have. My parents encourage me and I'm so thankful for that.”

Alejandro also finds resiliency when challenging themselves. Considering a major change, he shared,

> When I first transitioned into a STEM major, as a bio major, I tested myself out by taking a[n introductory] chemistry class. And I failed it for the first time. But when I decided to not give up and come back to that class and then pass it, that kind of told me that this is what I want to do. (Alejandro)

Faculty recognize the motivation that students expend when enrolled in STEM classes. Because SVC is an HSI, it is crucial to create an inclusive and supportive environment that fosters student success. A faculty member, named Michael mentioned,

> What are the biggest strengths of the students? My SVC students work really hard. They have jobs, taking care of their kids or their little brother, little sister. They still come to class and most of them are still passing or doing well in their STEM classes. I say that STEM students need a different attitude of, like, being able to challenge... or work with something challenging. But a lot of my students don't have that problem. They're like, "Didn't do so well this time. Let's do it again." But yeah, the work ethic at SVC, I think, is pretty impressive. (Michael)

By addressing the unique challenges faced by these students, implementing strategies to enhance their motivation and success, and providing a supportive and inclusive environment, HSI community colleges can empower STEM students to excel in their educational pursuits. Sebastian also connected with a faculty member and shared,

> One thing that comes to mind is when I took [a chemistry course] with professor Leon, which he's a really nice professor. He would always be like... he was kind of happy go lucky. So he made all the students feel welcome because he was just that cool teacher that was really nice. He seemed like he really cared for us, and like he cared for his job.

The impact of motivated STEM faculty carries over to the motivation of STEM students extending beyond the individual level, and potentially impacting all students in a classroom fostering a more inclusive and validating educational environment.

External Factors

When examining the lives of STEM students at community colleges, several elements emerged outside of the purview of campus. This lent itself to a separation between the college environment and the external environment—defined as the collection of responsibilities and roles which govern the non-academic lives of the students. Throughout the interviews, a majority of students identified elements of familial influence, in both positive and negative ways, which impacted the student's identity and motivation. A student, Eduardo shared their experience of the evolving support they received from their parents:

> I think the biggest support my family gives me is, uh, they just leave me alone. I think they help me. They tried to support me the first time in college, and it was just like detrimental to my like mental health and my academics. And now they just kinda… just hands off. And that's the best support they give me. (Eduardo)

Family members often did not understand the time commitment of the educational pursuits of being a student as many were first-generation and their parents were unaware of the requirements of pursuing a STEM degree. These same students reported increased feelings of stress and strife as they attempted to balance classwork and family life.

Beyond this friction, some community college students have even encountered outright doubt from family members upon disclosure of their STEM aspirations. Female students shared more of these challenges than male students. Natalia described her experiences talking to her family about her career aspirations.

> I'm Mexican. I have family that's Mexican. I have an uncle who, anytime I talk about my career, really, he acts like I don't know what I'm doing. And I'm like, but I've been studying. I don't let it get to me personally because I know where I'm at and I'm confident with what I study and what I know. But I just let him blurb, and I'm just like, okay. To me, that's one of the things in my family, at least with the men, some of the men, that they act like I don't know what I'm doing... like they know more of the field than I do. I'm like, okay. And so that happens a bit. Maybe just being a woman that has to deal with that, and if I was man, maybe he wouldn't question me so much.

Despite the questioning that Natalia felt from her family, particularly from her uncle, she has the fortitude to continue her studies and pursue the STEM degree. Her confidence allows her to brush off the comments made.

While some of the students have encountered doubt, others have unequivocally received the exact opposite result with many participants claiming they have received support from their family. Nina, a student, talks about the support she receives from her parents, and how they encourage not only her academic development but also her interpersonal development.

> Personally, for me, what my parents always tell me is, "Nina, we just wanna see you strive in school and be someone. Not because we wanna say, hey, she went to school. She has a degree. But to know that you're able to defend yourself. And you're in a position where not everybody can step on you." (Nina)

Themes relating to socioeconomic status were also identified as impacting both motivation as well as identity. It is of importance to note that socioeconomic status (SES) and familial support are

intricately linked as family history and culture are factors of SES. The majority of students interviewed were of Latinx background, first-generation college students, and had working class parents, all of which shape how a student perceives themselves and enters college. Juliana spoke very openly about the impact that her parents had on her drive to educate herself.

> I think, at least for me, developing motivation and basically dedicating my life to doing good in school and stuff just basically stems from how hardworking I see my parents. And it means a lot to me because my... neither of my parents graduated from college. And I see how much they struggle. And I know they don't want me to struggle. And it means a lot to me that my parents always have my back. (Juliana)

External factors such as SES and familial expectations can indirectly influence the perception and motivation of the student but can also have a direct impact on their ability to perform in school. SES is directly linked to the cost of education, and a lack of financial resources. Faculty report the complex balancing act of being a student, working for pay, and managing familial responsibilities. One such faculty member, Jackie, spoke on the subject:

> The biggest challenge for my students... A lot of the students at SVC are working students. They have jobs and they just don't have the time. I've only taught at night at SVC, and they get there to those classes and they are exhausted. I mean, they're following along and everything, but you can see this is the end of their day in a lot of cases. I mean, in some cases they have night jobs. And so, my class was the beginning of their day. Actually, they would go straight from there to a job or something like that. (Jackie)

Another challenge at the intersection of family and the impact of SES comes when students are expected to be caregivers as well responsible for their own children or other family members due to necessity, as many families cannot afford the alternative of outsourcing care. One such student, Rosalyn, shares the very hard time she has with balancing her education, her job, and her caretaker role within her family.

> I feel like my family doesn't give me that much support. I have to work. I have to take care of my younger siblings. And I also have to do school. So, I have a hard time balancing that out and finding the hours to do everything. And it's just a real struggle for me. (Rosalyn)

A counter example can also be found however as some students report the effort of their family to support their educational ventures, rising above so called "stereotypes" of unsupportive

families which value immediate financial income over the longer term educational and career aspirations with delayed revenue-generating support for the family. Stephanie speaks about the experience she had with her family as she pursued her education.

> I know traditionally, or maybe as like a stereotype, Hispanic families don't necessarily want you to be a college student. They would more likely want you to just get work as soon as possible, and you know, that kind of story. That narrative. I know my family maybe is a special kind of Hispanic family, but they especially support me in my studies. Almost like the polar opposite of the traditional Hispanic family. They always tell me, "Go to school." and "Don't get a job yet, until you get your degree." (Stephanie)

Similar to Stephanie, Yaelis also acknowledges that they are among the "lucky ones" that do not have to work while going to college. They recognize that they are the exception and not the rule.

> I recognize that I'm super, super lucky that my parents don't say like, "You have to go to work while you're going to school." They give me the option, "You could go to school. You could go to work." And during summer vacations, I'll work. But generally, when I have a full schedule, they're not forcing me to have to pay for certain things that I can't. (Yaelis)

While there are certainly a variety of levels of support from families as well as a wide financial spectrum from which community college students hail from, it is clear that these factors play directly into their educational experience. These factors also influence the identity development, motivation, and ability by which to strive for STEM academic success.

Conclusion

Both STEM students and STEM faculty at Santiago Vista College provide insight into the overarching research question "What helps STEM students succeed at an HSI community college?" Faculty point to the importance of continuing relationships beyond their years at SVC that extend into the 4-year transfer universities. They also strive to share places of engagement on campus that students can take advantage of, beyond their classrooms. Students recognize the efforts made by faculty to create inclusive learning environments that make them feel welcomed and provide an avenue to make connections. The students then feel validated and seen which in turn affects both motivation and the development of a STEM identity ultimately positively influencing student success.

The STEM students at SVC shared examples of how they develop their STEM identity by helping each other out in community during study sessions or working alongside each other in the classroom. This notion of leadership entangled with being considered a content expert facilitated the self-awareness and recognition of being a STEM scholar. Invoking the conceptual framework, the increased student's STEM identity then increases the student's motivation to work towards their goals. For students, welcoming faculty members also increased their motivation to work hard. Faculty also recognized their student's multiples roles and responsibilities and made allowances for them, again motivating students when that respect was given.

Finally, when considering the success of STEM community college students, the role of external factors must be recognized. For students at SVC, these primarily showed up as familial support (and doubt). The multiple roles they all hold including working full-time, caregivers, parents, and other responsibilities also have to be juggled. Another factor tied to the previous two is their socioeconomic status and its impact on their availability of time. In conclusion, a few recommendations are presented for future research, and considerations for practice.

Recommendations

Research

Even though there is research pertaining to the importance of student-faculty relationships overall, there is a lack of literature investigating student-faculty interaction amongst students and faculty of color (Berhane et al., 2023; Rodriguez et al., 2016). At Santiago Vista College, there were instances where Latinx students were talking specifically about their Latinx faculty, but there were only a handful of instances and not enough to focus a manuscript on exclusively. Therefore, future research should consider this relationship specifically as it can illuminate future practices at HSI community colleges that can best serve Latinx students. This by extension will also be of benefit to all STEM students as providing validation (Rendon, 1994), inclusive classroom spaces, and mentorship have a documented history of impacting student success.

Future research must also investigate the role of community colleges as racialized, structured organizations. Historically, inequitable outcomes have been attributed to individual student shortcomings or cultural deficits rather than considering the contextual organizational policies and practices that reify structural inequities (McCambly et al., 2023).

Practice

There are clear practices that faculty can enact that will lead to increased STEM student success. The findings illustrate that providing a welcoming learning environment where professors genuinely care about the well-being of their students makes the students feel validated and seen which in turn affects student motivation and the development of a STEM identity impacting retention and persistence. Another practice that should be enacted as a result of this study is to provide faculty with the tools, skills, and training to be able to connect with their students and build those important student-faculty relationships. Recognizing that their role is more than just imparting content knowledge is imperative for the long-term success of developing STEM professionals.

A thriving STEM pipeline is vital not only for individual students but also for the community at large. Achievement gaps among student groups reflect structural inequities that are often the result of historic and systemic social injustices (Hund, 2020). By increasing the number of STEM students and graduates, community colleges contribute to the growth and prosperity of local economies. Moreover, a diverse and inclusive STEM workforce ensures that different perspectives and experiences are brought to the table, leading to more creative solutions and a broader range of applications for scientific and technological breakthroughs. In addition to the need for more STEM students and evaluating their success in community colleges, it is imperative to recognize the broader impact of gender, race, and ethnicity on STEM education and careers. Achieving diversity and inclusion in STEM fields is not only a matter of social justice but also crucial for fostering innovation, enhancing problem-solving capabilities, and addressing the unique challenges faced by different communities.

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Figure 1. *Integrated Action and Perception Model for STEM Students*