It's a Vibe: Student Experiences with STEM Inclusivity at a Hispanic-Serving Institution

2024 ASHE Proposal

There are disagreements about what constitutes STEM (science, technology, engineering, and mathematics) inclusivity, especially from an organizational perspective (Palid, et al., 2023). Much of what the field of higher education understands about STEM inclusivity is derived from the theories of sense of belonging (Strayhorn, 2012), self-efficacy (Bandura, 1977), and identity development (Vincent-Ruz & Schunn, 2018) in STEM that is based on how students *feel* within a STEM environment. When conceptualized this way, STEM inclusivity becomes synonymous with asking students whether they feel they belong in STEM or can reach their full STEM potential. This leads to debates, designs, and measures of STEM inclusion with primary regard to individuals, which blinds us to how institutional systems function in these perceptions (Nunn, 2021). This can contribute to deficit frames about underrepresented STEM students as the sole determiners of their educational experiences and outcomes (McGee, 2020). Therefore, in this study, we suggest a need to consider organizational actions leading to one's feelings of belonging in STEM.

Given the need for continued scientific innovation and a diverse skilled STEM workforce in the United States (U.S.), increasing the representation of women, Latino, Black, first-generation, and other underrepresented groups in STEM is vital (National Science Board [NSB], 2022). Hispanic-Serving Institutions (HSIs) are recognized for enrolling large proportions of students from lower-income, first-generation, and racially marginalized backgrounds (Núñez et al., 2015). Additionally, Latino students earn STEM degrees at high rates at HSIs (National Science Foundation [NSF], 2019); in 2016, 46% of Latino students who earned STEM bachelor's degrees graduated from HSIs. As such, HSIs can play an important role in closing national gaps in STEM degree attainment and workforce needs through intentional policies, practices, and institutional commitment (Crisp et al., 2009).

Despite the opportunities HSIs afford diversifying the STEM workforce, public policy in the U.S. often overlooks these institutions (National Academies of Sciences, Engineering, and Medicine [NASEM], 2019). Instead, research focus is often given to STEM student experiences at Predominantly White Institutions (PWI) whose organizational structures give norm reference to White men (McGee, 2016). At the same time, recent research, despite having flawed designs, portrays HSIs as exclusionary places (e.g., Mejia et al., 2024). Thus, this study enlists the call for HSI research to consider institutional structures in research designs (Garcia et al., 2019), and aims to contribute knowledge about structured STEM inclusion at HSIs. We use an asset-based approach (Wofard & Gutzwa, 2022) to understand students' perceptions of how their institution structures STEM inclusivity. The research question is:

How do STEM students describe how their regional-serving R1 public 4-year HSI serves as a place for STEM inclusivity?

The study site is a public R1 HSI in the southern U.S. Nearly 35,000 students are enrolled, 59% are Latino (Institutional Research and Analysis, 2023). The university has embraced its role as an HSI and its responsibility to build institutional capacity and structures to serve its students. However, this movement is ongoing and shifts with time in relation to institutional decisions and actions.

Literature Review

The STEM workforce comprises nearly one quarter of the total workforce in the U.S. and serves as a vital economic asset (NSB, 2024). With a global and growing competitive job market, STEM workers need to be highly educated and trained. Having a STEM degree is both the surest pathway to legitimacy and preparation in tight-knit STEM industries and a source of financial benefit and social mobility. Those with STEM occupations have a higher median income than those with non-STEM careers (NSB, 2024). Having a STEM degree also is associated with greater earning potential; in 2021, the median salary of those with a STEM bachelor's degree was $81,955, compared to $49,837 for those without a STEM degree (NCSES, 2023).

Diversity in the workforce is viewed as a critical way to increase innovation and productivity, yet, for far too long, women, Black, Latino, and other historically marginalized groups continue to experience underrepresentation in STEM fields and the workforce (NSB, 2024). For example, in 2021, Black and Latino individuals represented 23% of the overall STEM workforce, whereas White individuals made up 63%. Additionally, White students earn the greatest proportion of science and engineering bachelor's degrees (56%), compared with Black (9%) and Latino students (18%) (NSB, 2024).

STEM inclusivity is not a monolith for all students (Reinholz et al., 2019). Whereas White, straight men without disabilities are privileged in STEM institutions and careers (University of Michigan, 2022), the same cannot be said about non-White students. STEM non-White students consistently experience disparities, especially within PWIs (McGee, 2021). Some would argue that PWIs act as gatekeepers of STEM degree attainment for non-White students, given that "race and racism are the cornerstones which these institutions were built and currently operate" (Bourke, 2016, p.13; Hughes, 2014).

Adding to an already uneven STEM playing field, the STEM culture at higher education institutions is often isolated and built on the false premise that not everyone is 'cut out' to make it (Weston et al., 2019). For example, 'weed' out courses purposefully aim to remove students from their STEM major. A report by the President's Council of Advisors on Science and Technology (PCAST) shows that students tend to leave STEM majors after taking an introductory STEM course, and states that a main reason for leaving is being uninspired and poor performance (PCAST, 2012), placing blame on the student, instead of institutional failure.

Minority-serving institutions (MSIs) have the potential to change this narrative, as many are exemplars of STEM degree production for non-White students (Perna et al., 2010).

Institutional agents, such as faculty and staff, STEM programs, engaging and flexible pedagogy, and institutional culture are factors that promote student inclusivity on campus (Crisp et al., 2009). Compared to PWIs, some MSIs prioritize hiring and retaining STEM faculty that reflect the student demographics (Gomez et al., 2018). This intentionality fosters inclusivity and nurtures faculty-student mentorship. For example, non-White students at HBCUs (Historically Black Colleges and Universities), in contrast to those at PWIs, experience higher levels of support from faculty (McCoy et al., 2017; Hirt et al., 2006). Moreover, non-White students were more willing to approach diverse STEM faculty at HSIs where diverse faculty hiring was prioritized (Gomez et al., 2018).

Our literature review suggests STEM students can experience a unique form of inclusion at HSIs. Past work about STEM at HSIs is inconclusive due to methodological procedures and does not fully capture nuances within the HSI population. We learn from the perceptions of HSI STEM students.

Conceptual Framework

This study provides deeper insights into using the HSI Servingness Framework to comprehend STEM inclusivity (Garcia et al., 2019). The development of the current research conceptualizes STEM inclusivity as a form of servingness. This framework includes several tenants, consisting of structural and cultural perspectives, external policy, and representations of equitable academic and non-academic results. Structural perspectives in institutions encompass policies, degree completion, the importance of transfer rates, and programs or services for students. Cultural perspectives entail validating experiences that positively contribute to students' campus experience. External policy involves state or federal legislation that impacts the institution's capability to support minoritized students efficiently. For this reason, we pinpoint using HSI Servingness to understand STEM inclusivity because it promotes institutions' active engagement in creating new approaches to help attain STEM students' full capabilities.

Methods

Semi-structured individual interviews were conducted in-person with 41 STEM undergraduates, during summer and fall of 2023. Ensuring confidentiality and responding to Spanish language preferences, the researchers navigated diverse backgrounds adeptly (see Table 1). Despite these comprehensive efforts, certain demographic groups, such as Black STEM students and White female STEM students, were underrepresented in the sample. Continued recruitment endeavors will aim to address these gaps, alongside a commitment to inclusivity and broader representation in future research initiatives.

The interview protocol encompassed a spectrum of topics, from STEM academic experiences to perceptions of campus resources, policies, and career opportunities. Interviews lasted 31 to 112 minutes and notes were typed after each interview. Data analysis included transcription and de-identification of audio-recorded interviews,

followed by codebook development, guided by an exemplar interview. Utilizing Dedoose software for coding and analysis, the team iteratively refined codes and themes, ensuring consistency via intercoder reliability checks. Member checks will further bolster credibility, reinforcing the research's trustworthiness and fostering participant engagement in the institutional change process.

Findings

Four themes emerged from the narratives. Due to proposal word limit constraints, we highlight four students as exemplary representations of each theme, below.

Owning Where Students Are – Pushing Back on Exceptionalism

The HSI in our study promoted the idea that any student regardless of background could pursue a STEM degree. Students talked about noticing the diverse identities enrolled in STEM and felt their HSI's democratic approach towards who could be a STEM major was a strength. STEM students described how they felt the institution facilitated this through broad access admissions policies, along with STEM departmental structures that allowed for students to arrive with their level of knowledge, skills, abilities, and gain competency. For example, one White male mechanical engineering student explained why he chose to transfer from a PWI. He stated, "I think being around a, a wide range of, um, all types of people in every way can only make everyone better. I don't think that anyone should be discriminated against for any reason. You know?"

Addressing Local STEM Needs – Resisting Individualism

Several participants stated their departments valued STEM for public good. Students talked about the opportunity to learn about local STEM workforces. Students also noted enjoyment for learning STEM through local needs helping move beyond theoretical to practical. This approach encouraged students who were bound/committed to the region. For instance, one White woman majoring in mathematics stated how she was employed in a STEM-based position with a local employer, liked the job, but pursued a STEM degree to learn how to do the job better. She felt doing so could lead to personal and professional advancements, especially for women in STEM. She stated, "My endgame I guess was trying to come up with new stuff. Like I said, the [local] textile industry is very antiquated. And there's just so much stuff that we could make better."

Sustaining Positive Experiences with STEM Staff & Faculty – Disrupting Hierarchy

The STEM students described positive experiences with STEM faculty and opportunities to create and sustain meaningful relationships with them. Many students expressed that STEM faculty went out of their way to help students. They felt comfortable around faculty

and perceived that faculty genuinely cared about them. Students built relationships by attending office hours and talking to their professors about a range of topics, including course material. In the following quote, Diego, a Latino chemistry major, shared about the strong connections he has with faculty at the university:

> I became friends with the faculty here. I became friends with the Associate Dean. … The Dean knows my name. … I have met other supporting staff and faculty. … All these people have helped me and … given me more resources than I would have ever gotten.

Facilitating STEM Student Engagement with Diverse Peers – Opposing Superiority

The university structures facilitated STEM students to engage with and learn from diverse STEM peers, in and out of the classroom. Catherine identified as Latina mechanical engineering major. She and several STEM students discussed the important role of in-class peer and group learning opportunities, study groups with classmates from diverse backgrounds, and student organization involvement. When talking about her classes, Catherine described a tight-knit community of students within STEM, stating that, "You kinda go through the same … classes together … and we're always, like, helping each other out. … We're all pretty close … we're like a family essentially."

Discussion

Through a servingness framework, STEM inclusivity at this HSI meant more than enrolling Latino students. Students described how their HSI intentionally included them in STEM. This challenges past work that claims underrepresented STEM students are not served well at HSIs. Instead, the HSI in our study demonstrated commitment to creating a vibe that celebrates and works toward diversity in STEM, challenging assumptions about who deserves to learn STEM.

Table 1

Demographic and Academic Information of Students in the Study

Pseudonym	Gender	Major	Classification	Undergraduate Type	Ethnicity
Diamond Alamos	Female	Civil Engineering	Senior	FTIC	Latino/a
Trina Garza	Female	Biology	Senior	Transfer	Latino/a
Paloma Velasquez	Female	Biomedical Engineering	Senior	Transfer	Asian American/Mixed
Sebastian Garcia	Male	Math of Data and Computing	Senior	FTIC	Latino/a
Catherine Castro	Female	Mechanical Engineering	Junior	FTIC	Latino/a
Mateo González Cruz	Male	Mechanical Engineering	Senior	Transfer	Latino/a
Ella Acherley	Female	Mechanical Engineering	Junior	Transfer	White/Caucasian
Andrew Taylor	Male	Mechanical Engineering	Senior	Transfer	White/Caucasian
Lexi (Lex) Eden	Female	Mechanical Engineering	Senior	Transfer	White/Caucasian
Nate Strong	Male	Mechanical Engineering	Post Baccalaureate	Transfer	White/Caucasian
Alexander Gomez	Male	Mathematics	Senior	Transfer	Hispanic
Isabel Herrera-Montes	Female	Chemical Engineering	Senior	FTIC	Latino/a; White/Caucasian
Rosa Huarez	Female	Biology	Senior	Transfer	Latino/a
Diego Garcia	Male	Chemistry	Senior	FTIC	Latino/a
Eric Bennett	Male	Mechanical Engineering	Senior	Transfer	White/Caucasian
Mohammed Nasser	Male	Mechanical Engineering	Junior	Transfer	Middle Eastern
Christopher Lawne	Male	Physics	Senior	FTIC	Latino/a
Jesus Casas	Male	Chemical Engineering	Senior	Transfer	Latino/a
Adriana Vasquez	Female	Chemical Engineering	Junior	Transfer	Latino/a

Araceli Hernandez	Female	Civil Engineering	Junior	FTIC	Latino/a
Alicia McCarthy	Female	Microbiology and Immunology	Junior	FTIC	Asian American
Erika Marquez	Female	Biology	Senior	FTIC	Latino/a
Hannah Cruz	Female	Mechanical Engineering	Senior	Transfer	White/Caucasian
Lucia Delgado	Female	Chemical Engineering	Junior	FTIC	Latino/a
Fernie Olivarez	Male	Mechanical Engineering	Senior	Transfer	Latino/a
Michael Roberts	Male	Mechanical Engineering	Senior	Transfer	White/Caucasian
Greg Simmons	Male	Civil Engineering	Senior	Transfer	White/Caucasian
Emilio Aguilar	Male	Civil Engineering	Senior	FTIC	Latino/a
Paola Gaitan	Female	Civil Engineering	Senior	FTIC	Latino/a
Salvador Cruz	Male	Mechanical Engineering	Senior	Transfer	Latino/a
Jasmine Romero	Female	Mechanical Engineering	Senior	FTIC	Latino/a
Jonas Rivers	Male	Computer Engineering	Junior	Transfer	Latino/a
Antonio Ruiz	Male	Computer Engineering	Junior	Transfer	Latino/a
Brian Martin	Male	Mechanical Engineering	Senior	FTIC	White/Caucasian
Mike Castillo	Male	Computer Engineering	Senior	Transfer	Latino/a
Felix Ramirez	Male	Civil Engineering	Sophomore	FTIC	Latino/a; White/Caucasian
Carlos Perez	Male	Mechanical Engineering	Junior	FTIC	Latino/a
Zachary Davis	Male	Mechanical Engineering	Senior	Transfer	White/Caucasian
Andrew Justin Smith	Male	Microbiology and Immunology	Senior	FTIC	Latino/a; White/Caucasian
Huy Huynh	Male	Mechanical Engineering	Senior	Transfer	Asian American

Jenna Ortega	Female	Geosciences	Senior	FTIC	Latino/a; White/Caucasian

Note. FTIC stands for First-Time-In-College.

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