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"Contributing to something good": rural Latinx college students' giving back through STEM degrees and careers

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Introduction: The U.S. prioritizes the development of STEM talent, often framing its value through an individualistic and capitalist lens. This approach may not align with rural students' values, ethics, and way of life, particularly for rural Latinx students, who often come from collectivist cultures. Accordingly, this article investigates how rural Latinx students' intersectional identities and geographical backgrounds influence their STEM degree and career pursuits, and desire to give back to their migrant farm worker communities.

Methods: This qualitative research study used Chicana/Latina feminist pláticas (conversations) methodology to examine the chosen STEM majors, experiences, and future career intentions of five rural Latinx third-year undergraduate students from migrant farm worker backgrounds. This methodology fosters open-ended, culturally relevant conversations that allow students to highlight topics that matter most to them. Each plática ranged between 90 and 120 minutes and was audio recorded and transcribed.

Results: Three findings explained how rural Latinx students' intersectional identities and geographical backgrounds influenced their desire to give back to their communities through STEM degrees and careers. These included: (a) helping and leading through STEM extracurricular activities, (b) pursuing socially conscious STEM careers, and (c) addressing place-based inequities in rural communities.

Discussion: Rural Latinx students' desires to "give back" outweighed commonly emphasized factors like job stability, career prestige, and high earnings—factors that, while important, were secondary to the students in this study. Higher education institutions must expand their programs, services, and curricula to better align with rural Latinx students' diverse identities, values, and motivations for STEM.

KEYWORDS

STEMM, rural STEMM, rural Latinx, giving back, asset-based, intersectionality, geography, higher education

Introduction

The United States has a long history of advancing science, technology, engineering, mathematics, and medicine (STEMM) education, from establishing land-grant universities that promoted agricultural science and engineering to recent efforts, such as former President Joe Biden's "YOU Belong in STEM" initiative. While these efforts reflect a national and historical commitment to preparing a skilled and diverse STEMM workforce, the benefits have been unevenly distributed among racial/ethnic groups and geographic areas. For instance, Latinxs are consistently underrepresented among science and engineering degree recipients at the bachelor's level and above (National Science Board, 2024) despite being the country's largest racial/ethnic minoritized group (Jensen et al., 2021). Furthermore, the U.S. West Coast and Northeast have the highest proportion of STEMM workers with a bachelor's degree or higher compared to the South and Midwest (National Science Board, 2024), highlighting spatial differences in higher education, employment, and industry opportunities, particularly in rural areas.

Given the country's national and political interest in developing STEMM talent, persistent inequities across race and space are crucial to address. This motivation often drives discussions and policies regarding improving STEMM education and enhancing the workforce. While analyzing the global position and competitiveness of the U.S. in STEMM are leading considerations for independent science agencies and the federal government, these economic and political indicators of relevance, performance, and power may be less relevant to individual students, families, and communities, particularly those in rural and geographically isolated areas where rural residents often feel left behind by the discourse and aims of a national agenda (NBC News, 2022). There is an evident challenge in advancing national interests around STEMM while responding to the unique needs of rural communities. Given that rural communities in the U.S. are not a monolith and are diverse in population size, density, industry, and demographic composition, alignment between national and rural STEMM agendas is further complicated, necessitating that research on rural STEMM educational advancement is attuned to the unique identities, needs, and complexities of rural people and places.

Rural America is undergoing significant changes, becoming more diverse and experiencing substantial growth in its Latinx population (Lichter and Johnson, 2020). Given the considerable representation of Latinxs in the U.S., independent science agencies, the federal government, and educational researchers are concerned with the systemic underrepresentation of Latinxs in STEMM. The U.S. thus has a vested interest in enhancing the STEMM educational experiences, degree attainment, and workforce pursuits of Latinx students. Yet, just like rural populations, Latinxs are not a monolith, and investigations into the Latinx STEMM experience must also include an analysis of students' rural and geographical identities and backgrounds in addition to intersectional identities (Crenshaw, 1991) already explored within Latinx communities, such as gender (e.g., Rodriguez and Blaney, 2021).

This article explores the STEMM higher education and career pursuits of rural Latinx students from California's San Joaquin Valley agricultural region and migrant farm worker backgrounds, specifically asking: (1) How do the intersectional identities and geographical backgrounds of rural Latinx college students influence

their STEMM degree and career pursuits? (2) How do these identities and backgrounds influence their desire to give back to their communities through STEMM? In investigating the unique influences of STEMM pursuits and commitments on these students, educational researchers, agencies, and government entities can universally explore the relevance of framings regarding the importance of STEMM beyond global influence, competitiveness, work, and income-related outcomes. They can also consider the role of giving back in influencing STEMM interests, pursuits, and educational and career success, especially for institutionally marginalized students and communities.

Literature review

Latinx students in STEMM

While job security and earning potential remain relevant factors, recent studies reveal a range of motivations for Latinx students pursuing STEMM degrees and careers that extend beyond economic considerations and are rooted in cultural values, identity, and altruistic goals (Carlone and Johnson, 2007; Garibay, 2015, 2024; McGee and Bentley, 2017; Garcia et al., 2024). For instance, Garibay's (2015) study found that Latinx students reported higher aspirations for working toward social change than their white and Asian counterparts. Findings suggest that Latinx students in STEMM may be more drawn to health-related careers that align with their higher reported social agency, which enables them to directly help others and promote social change. Similarly, Garcia et al. (2024) explored how Latinx students' perceptions of cultural congruity between their cultural values and STEMM environments modeled the STEMM professionals they aspired to be. The participants reported aspiring to professions where they could directly impact their communities, such as becoming primary care physicians in underserved areas or professors who could mentor future generations of STEMM scholars.

Studies have also found that Latinx students are less attracted to the individualistic and capitalistic values typically associated with STEMM professions, which may be due to their collectivist approach to life (Arevalo et al., 2016). For example, McGee and Bentley (2017) found that high-achieving Latinx STEMM students expressed an *equity ethic*, defined as a strong desire to utilize their STEMM knowledge, skills, and careers to benefit their communities and address social inequities. Students reported intentions to become educators, start non-profit organizations, or apply their STEMM knowledge to address global issues. The scholars found that students' altruistic and community-oriented aspirations sometimes conflicted with the traditional framing of STEMM careers (McGee and Bentley, 2017). Furthermore, Rodriguez et al. (2020) highlighted how Latina STEMM undergraduates critiqued STEMM disciplines for their emphasis on the capitalist nature of STEMM at the expense of addressing social concerns or giving back to their communities. For instance, students expressed frustration with the focus on developing products for private industries rather than using technology to empower women or create solutions for developing countries. Through their active resistance, Latina women students sought to transform STEMM fields to better serve marginalized communities (Rodriguez et al., 2020), underscoring the mismatch between traditional STEMM

values and the community-oriented aspirations of many Latinx STEM students. Research has found that not finding “meaning” in STEM coursework and majors can lead to the pushout of Latinx college students from STEM fields (Fematt et al., 2024, p. 15).

Recent Latinx STEM research highlights students’ cultural assets to illuminate further their motivations for pursuing STEM majors and careers. In addition to collectivism, research has found that familismo, the tendency to hold the wants and needs of the family unit in higher regard than those of the individual, is a common trait of Latinxs (Martinez, 2013). While previous research has taken a deficit view of Latinx families and cultures, family is an integral factor in shaping the decisions of Latinx students to pursue STEM majors and careers. Latinx students report pursuing STEM degrees to fulfill parents’ expectations, achieve financial security for themselves and their families, and address health issues affecting family members (Rincón et al., 2020). Similarly, Mein et al. (2020) found that Mexican-origin students viewed their pursuit of STEM careers as a means to achieve social mobility and repay their parents for their sacrifices. While economic motivations are present, they were often relationally framed to benefit their families rather than for individual gain or status. In addition, Mein et al. (2020) found that students’ STEM career decisions were influenced by their personal experiences with family health-related circumstances. Students expressed a desire to pursue medical professions, such as research careers or become medical doctors, to help address their family’s health issues, particularly those of their parents (Mein et al., 2020). Findings offer a nuanced understanding of Latinx students’ STEM aspirations, suggesting a potential mismatch between the need for increased Latinx representation in STEM, grounded in economic perspectives, and the actual motivations of many Latinx students pursuing STEM fields.

Research on Latinx students in STEM paints a clear picture of the importance of giving back to their families and communities through problem-solving, career paths, and social mobility. This line of research offers a more nuanced understanding of the motivations and aspirations of Latinx students in STEM, taking into account their cultural and familial values and upbringings. Still, this research overlooks the unique identities and experiences of rural Latinx students, as well as the role that rurality and geographical backgrounds may play in their pursuit of STEM.

Rural students in STEM

The literature on rural students’ pursuit of STEM primarily focuses on the barriers that impact their STEM pursuits. Saw and Agger’s (2021) quantitative study, which drew on a sample of 20,242 first-time ninth-grade students from the 2009 High School Longitudinal Study, documented the challenges that rural and small-town students face in pursuing STEM. Students faced limited access to advanced STEM coursework and extracurricular STEM programs, as well as lower levels of teaching capacity, including math and science teacher shortages, teacher self-efficacy, and inadequate professional development. In effect, they under-enrolled in postsecondary STEM degree programs. Henley and Roberts’ (2016) case study on the impact of a STEM scholarship program on second-year scholarship recipients at Southwest Virginia Community College qualitatively found that students

perceived various economic, geographic, social, and educational barriers to success in STEM education and careers. Some of the most common factors included a lack of familial support, mentorship, career guidance, access to advanced STEM courses in high school, and STEM jobs in the region. Students felt confident about obtaining a job in STEM, given the influential role of the scholarship program. Still, they acknowledged that such employment would likely not be local, which caused conflict for rural students with strong family and community ties.

Despite persistent academic and geographic barriers to STEM pursuits, rural students remain highly interested in STEM. Cain et al.’s (2022) qualitative study of 11 rural college students’ STEM-related interests found that internal factors, such as personal traits and personal attraction, and external factors, including family and high school context, influenced their STEM interests. While taking advanced STEM coursework continues to be a recurring theme in the rural STEM literature, Cain et al.’s (2024) study found that collegiate environments and experiences also have the potential to nurture STEM interests, with 10 of the 11 students developing their STEM interests while in college. Another study by Cain et al. (2024) employed a non-deficit approach to qualitatively explore the role of rural schools and communities in supporting rural college students’ STEM pursuits. By leveraging rural cultural wealth (Crumb et al., 2023), Cain et al. (2024) found that 11 rural college students in STEM majors were influenced by their schools and communities, with rural teachers playing a key role in supporting students’ higher education and STEM pursuits. When resources were unavailable in their schools or communities, students sought them out, demonstrating their resourcefulness and resilience (i.e., cultural wealth) in pursuing their STEM aspirations despite facing inequities in accessing these majors and career paths.

The emerging research on rural students’ STEM pursuits is widely concerned with the academic underpreparedness of rural students for STEM degrees and the lack of available STEM jobs in rural communities and regions. Importantly, research is beginning to consider the positive influences of rural communities on students’ STEM pursuits (e.g., Cain et al., 2024). This article contributes to emerging asset-based perspectives on rural students’ STEM pursuits and further nuances the rural STEM education literature by considering the intersections between rurality and Latinx identity in shaping STEM paths and opportunities.

Theoretical framework

This article draws on Page-Reeves et al.’s (2019) five domains of giving back to understand the role that rural Latinx students’ intersectional identities and geographical backgrounds play in their desire to pursue STEM fields and give back to their communities through their degrees and careers. Page-Reeves et al. (2019) argued that giving back is a culturally sanctioned concept for Native American students, emphasizing the need to utilize their education to benefit community members and achieve self-determination and nation-building. In their study, Page-Reeves et al. (2019) proposed five domains of giving back for Native American students in STEM, including (a) duty, expectation, and reciprocity; (b) defining success in STEM in relation to giving back; (c) translating and bridging functions of giving back

in STEM; (d) being a role model and blazing a trail in STEM; and (5) giving back as a challenge in STEM. The scholars suggested that if higher education institutions focused on these domains and values of giving back, Native American participation in STEM would increase, alluding to the disconnect between institutionally marginalized students and communities and the individualistic culture and orientation of STEM classes and careers.

Jaumot-Pascual et al. (2023) applied Page-Reeves et al.'s (2019) framework of giving back to analyze the experiences of Native students' desires to give back to their communities through computing. The scholars conducted photo elicitation interviews with eight Native computing undergraduates, finding that giving back is a cultural value central to tribal and Native ways of being and doing. The scholars identified specific ways that students aimed to give back to their culture and communities using their computer science skills, such as achieving technological sovereignty and cultural preservation, and creating apps to preserve tribal languages. Similarly, Garcia (2024) drew on Rendón et al.'s (2019) cultural assets and ways of knowing framework to theorize giving back as a cultural asset and value shared by first-generation Latinx premedical students. For the 24 students in Garcia's qualitative study, they desired to give back to their communities by (a) addressing language barriers, (b) volunteering in Latinx communities, (c) creating infrastructure to support Latinx premedical students, and (d) working in underserved communities as physicians. Garcia's final finding included a narrative of a rural Latina student who aspired to return to her hometown to address health inequities in her community; however, the overall study did not explore the role of rurality or geography on STEM pursuits.

The literature and theoretical framework offered by Page-Reeves et al. (2019) on giving back have universal implications for enhancing STEM education and career participation, particularly for institutionally marginalized students. While rural Latinxs are also likely to express giving back as a cultural value rooted in their racial/ethnic backgrounds, as in Garcia's study, rural Latinxs are unique in that they live in underinvested communities that lack infrastructure, resources, and STEM job opportunities. The role of rurality and geography was also not explored in Page-Reeves et al.'s (2019) theorization, in which they noted that the Native American students came from diverse geographical backgrounds, including urban, suburban, rural, and reservation settings. This article extends the framework of Page-Reeves et al. (2019) and the literature that have primarily framed giving back as a cultural value by investigating how the unique intersectional, marginalized, racial/ethnic identities and geographic backgrounds of rural Latinx students influence their pursuit of STEM degrees and careers.

Materials and methods

The qualitative data for this study were derived from a larger mixed methods research study on rural Latinx high school seniors' college (in)opportunities and how their paths were structured by the sociopolitical and geographic context of California's San Joaquin Valley agricultural region (Puente, 2022). As the first author maintained relationships with the students, the study expanded to include a longitudinal analysis of their college and career paths, tracking their trajectories from their high school senior year in 2021 until 2024, in which the majority of students

were third-year undergraduates, with some experiencing non-linear college choice plans (Puente et al., 2025). The University of California, Santa Barbara's Institutional Review Board (IRB) approved the follow-up study. Of the 16 students included in the larger study, six pursued STEM majors at the time of their college applications in 2021. In reconnecting with all 16 students in 2024, four remained in STEM, two switched out of STEM, and one switched into STEM. This article examines the STEM pursuits of five rural Latinx students who were pursuing STEM in 2024.

Research collaborators

The five rural Latinx college students whose experiences are the focus of this article came from three different communities in the San Joaquin Valley agricultural region, with at least one parent who was a migrant farm worker. In describing their communities, students used various language, such as "rural," "agricultural," "small," "tight-knit," and "poor," among others. While rurality is often defined by population count or density, it is also important to consider "one's life or family history" and the role of "economic and social conditions" in rural areas (Hallmark et al., 2023, p. 4). In this article, I consider California's San Joaquin Valley's agricultural-based economy, students' migrant farm worker families and backgrounds, and Latinx immigrants' connections with the land and rural areas in the U.S. and Latin America as indicative of rurality.

Table 1 presents demographic information on the five rural Latinx third-year undergraduate students. Pseudonyms chosen by the students were used to protect their identities and ensure confidentiality in reporting the study's findings. Mariana and Wendy maintained the same STEM interests and degree types as they had in their college applications in 2021, while Michelle and Violet changed from one STEM major to another, and Xavier was the only student to switch into STEM from a sociology associate's degree upon transferring to a public 4-year university. Only Xavier was a transfer student who attended a higher education institution in the San Joaquin Valley agricultural region. Three of the four women pursued their STEM degrees at a University of California (UC) campus outside their local community and the San Joaquin Valley region. Wendy enrolled at a California State University (CSU), away from her hometown and region.

Data collection

Toward the end of the 2023–2024 academic year, the five rural Latinx third-year undergraduate students were invited to participate in a follow-up *plática* with the first author. *Pláticas*, which translate to conversations, were initially used in sociological and mental health work with Latinx populations in the late 1970s and 1980s (Fierros and Delgado Bernal, 2016). During this time, the *plática* was "viewed as an initial nicety" (Fierros and Delgado Bernal, 2016, p. 105) that facilitated the setup of the formal interview process, which took place after the informal conversation. González (2001) then transformed the initial nicety approach of *pláticas* into a method in her dissertation study with young Mexican students, arguing that *pláticas* are "a way to gather family and cultural knowledge through communication

TABLE 1 Demographic characteristics of research collaborators.

| Pseudonym | Race/ethnicity | Gender | Institution | STEMM degree in 2024 | First-generation college student | Career interest in 2024 |
|-----------|-----------------------------|--------|---|--|----------------------------------|-------------------------------------|
| Mariana | Mexican American | Woman | University of California (UC) campus | Software Engineering BS | Yes | Software Engineer |
| Michelle | Mexican Panamanian American | Woman | University of California (UC) campus | Conservation & Resource Studies BS & Geography BA | No | Community Activist |
| Violet | Mexican American | Woman | University of California (UC) campus | Biology BS & Global Health minor | Yes | Physician |
| Wendy | Mexican American | Woman | California State University (CSU) campus | Agricultural Science BS & Agricultural Education minor | No | Agricultural Science Teacher |
| Xavier | Mexican American | Man | California State University (CSU) campus transfer student | Biology BS | Yes | Biology Community College Professor |

of thoughts, memories, ambiguities, and new interpretations” (p. 647). Unlike earlier work, González’s theorization of pláticas positioned conversations with youth about their identities and lived experiences as the actual data from which to theorize about schooling, education, and the world.

Building on González’s foundational work, [Fierros and Delgado Bernal \(2016\)](#) then theorized pláticas as a methodology, arguing that pláticas are not only a way to collect data but an embodied way of doing research that practices five principles, including:

1. Draws upon Chicana/Latina feminist theory and other critical theories that center the experiences of marginalized identities and draw attention to systems of oppression
2. Honors participants as co-constructors of knowledge
3. Makes connections between everyday lived experiences and the research inquiry
4. Provides a potential space for healing
5. Relies on relations of reciprocity, vulnerability, and researcher reflexivity

Research employing pláticas tends to focus on the cultural relevance of this tool when conducting research with Latinx populations. [Morales et al. \(2023\)](#) argued that pláticas are also a methodological disruption in the field of educational research in that traditional qualitative research approaches “rooted in whiteness, colonial logics, and white supremacy” (p. 1633) are de-centered and resisted through the creation of intentional theoretical and physical space to forefront Chicana/Latina embodied ways of knowing, being, and communicating.

In addition to examining the importance of racial/ethnic and gendered identities, educational researchers have begun to investigate the role of place in mediating educational inequities through pláticas methodology. For instance, [Gaxiola Serrano \(2023\)](#) developed walking plática methodology from her qualitative educational research with Latinx community college students in the Tijuana-San Diego border region. Gaxiola Serrano centered Chicana/Latina feminist concepts, such as the *brown body* ([Cruz, 2006](#)) and *la facultad* ([Anzaldúa, 2015](#)), to argue that the body stores memories that can be elicited through the exploration of space, leading to a form of grounded data-gathering technique.

[Puente and Vélez \(2023\)](#) also centered dimensions of space and spatiality in developing a platicando y mapeando (talking and mapping) Chicana/Latina feminist geographic information systems (GIS) methodology in educational research. In combining pláticas methodology with GIS, the scholars argued that spatial data could also foreground research collaborators’ lived experiences and spatial wisdom to depict their narratives and college (in)opportunities via maps, thus challenging dominant and oppressive higher education ideologies incongruent with students’ realities.

The emerging research that employs and expands pláticas methodology highlights this tool’s relevance for place-based educational investigations, especially when conducting research with institutionally marginalized students in border, rural, and other racialized areas. Pláticas is thus not only a culturally appropriate method and methodology for engaging rural Latinx youth in research but also appropriate given this article’s focus on exploring the role of rurality and geography on rural Latinx students’ STEMM degree and career pursuits and how such spatial contexts and upbringings influenced their desire to give back to their communities. Further, given the tight-knit culture of rural communities ([Stone and Serrata, 2023](#)), pláticas methodology was a highly useful tool in establishing warmth and trust ([Fierros and Delgado Bernal, 2016](#)) between the first author and the rural Latinx youth, facilitating conversations about their identities, rural communities, and STEMM aspirations over a 4-year academic period.

Of the four pláticas conducted with all rural Latinx youth, this article focuses on the fourth plática, held near the end of students’ third year of college. Rooted in the rural and higher education literature, the plática protocol was open-ended and conversational, but it also included prompts related to maintaining connections to family and community during college, the college transition, major experiences, and career aspirations. Central to pláticas methodology is providing space for research collaborators to center topics that matter to them and researcher reciprocity and vulnerability. Accordingly, the students and first author dove into additional conversations related to internships, research interests and projects, graduate school, and their upcoming summer plans, which allowed the first author to provide educational and career

advice, serve as a resource, and connect students with her personal and academic network. Each *plática* took place via Zoom, was audio- and video-recorded, and lasted between 90 and 120 min. The *pláticas* were first transcribed using Zoom's transcription feature and then edited by the research team.

Data analysis

The five *plática* transcripts were analyzed using Merriam and Tisdell's (2016) step-by-step qualitative data analysis process, from category construction to theorization. Each *plática* transcript was read and annotated, initially using rural Latinx students' exact words and phrases, known as *in vivo* coding, to capture the reasons for their STEM degree and career pursuits, grounded in their interpretations and understandings. Many of these words and phrases included "giving back," "helping others," and "doing good." Students contrasted these motivations with other external factors, such as "pay," "job," and "money." Still, these factors were described as secondary to the interests of rural Latinx college students pursuing STEM.

Given the similarities in the words and phrases used by rural Latinx students, we observed when these phrases were expressed, noting how students discussed their various involvements, majors, career paths, and future contributions to society. We thus engaged in axial coding to group the *in vivo* codes according to the different educational and professional areas students described as most salient to shaping their STEM pursuits. Interestingly, the students discussed their STEM pursuits across time and space, referencing K-12 experiences, their current interests and involvements in STEM, and future plans. They also situated their current STEM experiences within their respective colleges and surrounding communities, and the future environments they wished to work in. Many of them wanted to return home or remain connected to rural places in their future STEM professions. The back-and-forth, reflective, present, and forward-looking descriptions were evident across all students.

Taking into account the identities and experiences of each rural Latinx student, we considered the phrases and contexts that cut across all students as they described their STEM pursuits. We created a single list of codes and categories for each student and another list encompassing all five students' identities and experiences. This cumulative list was more abstractive, identifying what was universal in the experiences of the five rural Latinx students regarding their STEM pursuits, but also what was unique in their motivations for STEM that differed from what had been written generally about rural students and Latinx students in the STEM education literature, preserving the uniqueness and intersectionality of rural Latinx STEM college students.

Lastly, we considered the giving back theoretical framework (Page-Reeves et al., 2019) in our constructed categories. We were guided by the first four domains that discussed ideas of leadership, reciprocity, mentorship, and redefining STEM identity, success, and professionalism to account for cultural factors. We extended the application of these theoretical ideas by considering not only students' Latinx identities and cultures but also their rural identities and geographical backgrounds, seeking to understand how giving back was related to students' intersectional, marginalized identities

and rural upbringings. Thus, in constructing the final themes, we reflected on students' words, the rural and Latinx STEM education literature, and the giving back framework, emphasizing the motivations that compelled rural Latinx STEM college students to give back to their communities.

Findings

Three findings explained how rural Latinx students' intersectional identities and geographical backgrounds influenced their desire to give back to their communities through STEM degrees and careers. These include: (a) helping and leading through STEM extracurricular activities; (b) choosing socially conscious STEM careers, and (c) addressing place-based inequities in rural areas. These findings underscore the interconnection between rural Latinx students' identities, rural upbringings, and motivations for pursuing STEM fields.

Helping and leading through STEM extracurricular activities

Rural Latinx college students engaged in various STEM-related extracurricular activities on their campuses. One of the main reasons students felt motivated to participate in these clubs and organizations was their desire to "help others," mainly because they had been helped at some point in their educational journey. Involvement for these students was thus rooted in values of reciprocity and leadership.

Mariana, for example, who "considered dropping out" of the university because of her "really hard" software engineering major, found "people who could help" her navigate her major and coursework through the campus's SHPE chapter (Society of Hispanic Professional Engineers). Mariana further explained:

Literally almost every day, [the boy mentor and I] would see each other, and we were studying all day, he would help me, and the girl [mentor], she would also help me, but she helped me in a different way. She helped me more in a mental health way.

Her assigned computer science undergraduate mentors' profound impact on her retention in the software engineering major and university motivated Mariana to remain an active member of SHPE, even as she managed multiple other commitments and responsibilities in pursuit of her degree:

I think that's why I put myself in the situation that I am now. Even in high school, I did [STEM-related extracurricular activities]. When it comes to SHPE, I'm not just a member; I'm a board member, too, and what I like about being a board member is that I can at least help others a little bit.

Mariana's dedication to SHPE was rooted in her record of mentoring marginalized individuals to pursue STEM since high school. Her efforts continued as a college student not

only because of the impact SHPE had on her educational and professional trajectory but also because she believed she could “help others” through her mentoring and leadership, especially given the underrepresentation of rural students, women, and computer science majors in the SHPE chapter on her campus.

Xavier was another student who reflected on his educational journey as a rural Latino, emphasizing that he had not discovered his passion for biology until he transferred to a public 4-year university, due to the limited STEM coursework and career guidance available in his K-12 education. Xavier immersed himself in a STEM community-based learning program at his university to help other students who shared his background. Xavier shared:

I work with kids. I have also worked with programs like community-based learning at [my college campus], where we teach science and hard science to students who don't have the opportunity to learn about that in school over the weekends.

One of Xavier's multiple jobs included serving as an educator and mentor in a university and NASA-sponsored, community-based learning program. This program provides local schools and communities with science exposure and learning opportunities to inspire young students to pursue STEM in higher education. Xavier showed a commitment to exposing marginalized youth from the San Joaquin Valley to STEM opportunities and pathways, including “hard” ones.

Another primary reason rural Latinx college students became involved in STEM-related extracurricular activities on their campuses was to acquire relevant leadership skills that would help them support others in their future STEM professions. Students were not only engaged in such efforts to give back in real time, as in Mariana and Xavier's examples, but they were also thinking about their future selves and the communities they would help through their leadership and skill development in STEM.

Michelle discussed the interconnectedness of her STEM education and extracurricular activities and their collective impact on her future self and career path:

Student life, or like extracurricular stuff, has been really important in shaping what I want to do, and just like my view of stuff. I feel like academics and outside-of-school stuff very much work together for me.

Michelle's coursework and extracurricular involvement contributed to her identity as an aspiring STEM professional. One of the student-run organizations Michelle was affiliated with since she was a first-year undergraduate student on her university campus was an environmental justice club for Students of Color. She described the skills she gained as a member of this club and its impact on her long-term career plans:

I've definitely gained a lot of skills cause now, I've been in it for like 3 years, and I've continued some of the campaigns that have been handed down through different generations of people, and this semester, we're working on putting a storytelling

publication together. So, I feel like I'm already starting to do the things I want to do on a micro-scale.

Through this club, Michelle gained experience organizing campaigns to make environmental science “less white and bring in different perspectives” to diversify the field, and also gained knowledge about publishing and creative writing, like storytelling. Other leadership roles she had on her college campus, such as serving as an “Environmental Justice Associate,” also provided her with “a mini look into what [she] could potentially do in the future.” She led “book clubs” and “teach-ins,” exposing her to “the idea of organizing” for environmental justice on behalf of marginalized communities like those in her home of the San Joaquin Valley.

Violet also discussed her involvement in STEM extracurricular activities as central to her leadership development as an aspiring physician who wanted to help others. Throughout the plática, she described “wanting to do more outside of school” and the importance of “getting experience” in her field. Violet was involved in multiple student organizations on her campus related to medicine, many of which were Latinx or rural-focused, to deliberately “connect these types of experiences to [her] future.”

One of the organizations she participated in worked to address education, language, and health disparities within farm worker communities. Violet explained why participating in this organization was central to her rural Latina and STEM identities and leadership development:

I like going to Compas as well, especially since it has to do with farm workers and since my parents are some. We all have the same goal, but I relate to it through medicine, whereas others relate to it in other ways, like maybe politically. Overall, we see a whole bunch of problems with the farm working community, and I feel like it has to be us who talk about it and advocate because I don't think anybody else will advocate as loud as we do 'cause it's us. Our people are the people that are the farm workers. We're the ones that are affected by it.

Violet's participation in this student-run organization was driven by her desire to apply her STEM studies and interest in medicine to issues and communities that mattered to her. Her involvement in this organization and others like it was particularly impressive, given her university's location in an urban environment, which did not deter her but instead reinforced her commitment to her rural, farm worker community. This involvement simultaneously prepared her for a career and lifelong commitment to addressing health issues affecting farm workers as a future physician.

Choosing socially conscious STEM careers

The notion of giving back transcended their current college commitments and was also apparent in their career decision-making. While their STEM degrees provided numerous career opportunities, the rural Latinx college students in this study intentionally selected careers that allowed them to give back.

They were often willing to forgo stable job opportunities and higher pay for ethical reasons and community commitments.

Mariana, who had many possibilities in the U.S. government and defense industry as a future software engineer, discussed how this was a last resort for her:

I don't wanna work for the defense companies. A lot of STEM people, specifically like engineering, go into that right after college. But I think that's like the one step where I would hope I don't end up. I think that would be the last, last option, like the Department of Defense, you know, like government defense companies, that is one of the ones that I would probably not want to work at.

While many of Mariana's peers gravitate toward career opportunities offered by the U.S. Department of Defense, Mariana emphasized that developing technology for these companies was not her professional aspiration. When asked to elaborate why, she shared that upon attending engineering conventions to search for internship and career opportunities, she learned that many of the top U.S. defense contractors were "sending missiles to Ukraine," leaving her shocked, and confirming that she did not "want [her] name on that," even if it meant passing up employment opportunities with major tech companies that could provide career and financial stability and benefits. Mariana shared what she instead envisioned for herself career-wise:

I would wanna end up somewhere where I can help others, and I feel like that's always been my goal. I wanna end up at a company that is literally doing that. I don't just wanna work for whatever company. I wanna end up somewhere contributing to something good.

Mariana implied that she had numerous career options given her STEM degree; however, it was essential for the future company she worked for to be a place that aligned with her values of wanting to "help others" and "contribute to something good" in the world. In the *plática*, she emphasized that such values were congruent with how her migrant farm worker parents had raised her.

Michelle also discussed wanting to "connect" what she studied with "what [she wants] to do in the world, and where [she comes] from." Initially, she thought of using her conservation and resource studies degree to pursue a career in urban planning:

I was like, 'This is really interesting.' But I don't think I want to be an urban planner or focus on that forever. And I was like, 'What's the through line, though, with everything else, why was I interested in planning?'

Michelle attended a university in an urban area, where many of her classes focused on environmental issues related to the surrounding communities near the institution, rather than her home region of the San Joaquin Valley. The focus of her coursework and the location of her institution "definitely influenced" her initial interests in urban planning; however, as she continued to think

about her long-term career plans, she realized this was ultimately not how she wanted to use her STEM degree, explaining:

I see how different issues are connected within urban places and rural. But I didn't feel like [urban planning] was long-term. I don't know how it connects to being able to serve communities like where I come from.

In addition to not seeing the connection between urban planning as a career path and giving back to rural communities, Michelle shared additional reasons for thinking more thoughtfully about her conservation and resources studies degree:

Something else that deterred me was it kind of felt a little bit like more bureaucratic, too. Like, if I were a planner.

This sentiment from Michelle echoes Mariana's concerns about employment with government agencies. Rather than operating within bureaucratic conditions, Michelle envisioned using her degree in conservation and resource studies to "think about environmental issues" in relation to their "impact on the community." She explained further:

I have a better vision than I did before. I kind of just see myself doing like community organizing or like working at a community organization. . . I think I'll find my way that way.

Addressing environmental issues for rural communities by serving as a community organizer or working at a non-profit organization was more aligned with Michelle's rural Latina identity and values.

Wendy also discussed multiple options and common career paths for students pursuing an agricultural science degree at her university. She referenced various concentrations within the major, including animal, plant, dairy, and noted that business was a popular concentration. Wendy was taking an alternative career route with her plant science concentration, stating, "I really do like the educational pathway, that's where I'm thinking of going right now." Her motivation for teaching stemmed from her high school teachers' impact on her educational and professional journey, which led her to choose the same agricultural science major and university as her Future Farmers of America (FFA) advisor. Wendy emphasized her interest in teaching as a career path:

Honestly, I hope to just really be a good educator. I had some really great teachers growing up that I think they were the ones who just really inspired me to want to go into teaching. Because I love the way that they taught me and other students, and I really wanted to be like them. So, I think, like through this [major], I just really want to be a good educator.

Pursuing a teaching career with an agricultural science degree was a less common path, as many students in her major at the university were motivated to start a business. Yet, Wendy's desire to enter the teaching profession was motivated by her rural Latina identity, educational experiences in a small town, and her desire to reciprocate the guidance and support she received from her teachers to her future students.

Another student, Xavier, was also passionate about using his biology degree to become an educator, emphasizing that he was “set in stone for teaching biology at the college level.” While Xavier was committed to this profession, he contemplated his career choice due to advice from his professors and mentors, such as, “If you are gonna be in education, you cannot be in this for the money.” Yet, he maintained steadfast in his desire to leverage his STEMM degree to teach, sharing:

I don’t wanna do something for the money. If I wanted to do something for the money, I’d get my biology degree, work for a hospital laboratory, and then I’d go to medical school and I’d become a doctor and then I’d get a lot of money, but that’s where I feel like there has to be a balance. You have to love what you do, and I love teaching.

Xavier considered multiple career paths, from becoming a doctor to conducting scientific research in a lab. He ultimately realized that his passion was teaching, even if it meant accepting a lower salary compared to more popular career paths offered by biology degrees.

Addressing place-based inequities in rural areas

As the rural Latinx college students sought purpose in their STEMM careers, they also considered their role in making greater and lasting change that would substantially transform the inequitable conditions and infrastructure of their rural communities.

For instance, Violet was motivated to become a physician in the San Joaquin Valley agricultural region. She argued that in her home region, “There’s a problem with not enough doctors. You have to travel away to actually see a good specialist and that sucks.” She detailed how her plans to remain in Los Angeles after college changed as she thought more carefully about the systemic health disparities in the Valley and her potential role in addressing them:

I remember at first I wanted to stay in the LA area, and I don’t anymore. I completely switched. But now I see myself more like in the Fresno area working there, and I feel like I’d be happier there than in LA. And that has to do again with my family, and me myself building a family later on as well. . . I definitely do think I’d sound a little hypocritical if I stay in LA, and I’m over here saying that, ‘I’m trying to fix it here’ or that ‘We need more doctors over here.’

While Violet had first imagined herself remaining in LA post-undergrad, she considered her family, as well as her future family, in wanting to return to the San Joaquin Valley for work. She also realized that the systemic issue of limited doctors and other medical and healthcare disparities would persist if she were yet another doctor who chose not to work in the region. A consideration for Violet was that doctors in the area “get paid less.” Yet, she remained committed to returning to the Valley, expressing:

At the end of the day, for me, it’s not so much about the money, but more like passion, and wanting to switch or change medicine overall.

Changing medicine for Violet meant returning to the San Joaquin Valley and increasing the supply of accessible doctors by serving as a physician in the area. It also meant serving the predominantly Spanish-speaking farm worker population by “helping with language barriers.” Violet noted that “having a translator is annoying” and “not the same” as having access to a bilingual doctor, which she emphasized could be “a lifesaver” for Spanish speakers seeking medical care in the Valley.

Another student, Wendy, also discussed her desire to return home and contribute to positive changes in her community as an agricultural science teacher. Wendy emphasized:

I know for sure I want to go to the Valley. I want to head back. I mean, I love this [college] area. I really do. But I’ve always just made it a point that once I’m done here, I do want to head back to the Valley.

Unlike Violet, whose realization of wanting to return home and contribute to positive change in her home region emerged later in her undergraduate career, for Wendy, remaining in the area where her college was located was temporary, and her goal was always to return home to the San Joaquin Valley for her career.

When asked what compelled her to return, Wendy emphasized her commitment to transforming the educational experiences and opportunities of students who shared her identities and background:

I know, at least for me, my advisors weren’t Hispanic. So, I feel like being able to be an advisor or agriculture teacher within the ag setting in the Valley and be someone who could also identify with a lot of the identities of the students who are predominantly in the Valley is really great.

Wendy reflected on her high school educational experiences, noting that her teachers, while helpful, did not reflect her racial/ethnic identity as a Latina. Returning to the Valley as an agricultural advisor meant that she could represent the identities of the students within the region. It also meant that she could serve as a resource to rural Latinx college-going youth, as she had left the Valley for college and had accumulated a wealth of knowledge and experiences about higher education, especially selective universities like the one she attended. Wendy emphasized:

I just really want to be that helpful resource that can share my experiences, like things I learned, went through, the hardships I had to go through that wouldn’t have been as hard if people had helped me, and just like help others through that, because I feel like, especially coming from a small town, it’s really hard learning certain things or having these big questions that you might think are dumb. As someone who comes from a small

town and didn't have as much of an opportunity to learn the most about college, being able to share that is really important to help someone go through those issues.

Wendy was committed not only to returning to the Valley and serving as an agricultural teacher for other rural Latinx students but also providing college-related guidance and information to transform the higher education pathways of rural Latinxs, including “decreasing drop rates” by “helping people find the school and the major that really fits them.”

Xavier also wanted “to be home” and “stay home” for his career, envisioning himself as a biology professor at the community college in his hometown, where he had attended before transferring. Like Wendy's remarks about the lack of racial/ethnic diversity within her agricultural teachers at her high school, Xavier noted that there were “not a lot of Hispanics in biology, especially in teaching,” such as his middle school and high school biology teachers who were “white” and “didn't know Spanish.” He continued:

It was always on my mind. It's like, ‘None of you guys know Spanish. None of you guys know what it means to have a parent who woke up at six in the morning to go to work in the fields,’ and not that that's a requirement to be my teacher, but we can't relate on that.

Xavier continued emphasizing that he felt it was important to “have someone who looks like you, who talks like you, who understands the [cultural] references,” as an educator. Even if his teachers were “country girls,” and there were some similarities in their geographical backgrounds, he still felt that specific references were overlooked due to racial/ethnic differences, creating separations between teachers and students that he hoped to address as a future biology professor. He detailed his reasons for wanting to return home and “give back” to his community:

It's the community. I love the community. People there genuinely care. . . I wanna go back home, be able to see my family. . . but I also want to give back. That's also huge because [the community college] gave me a lot of scholarships to come over here [to the 4-year university].

For Xavier, his desire to return to his community and serve as a biology community college professor was motivated by several factors, including his desire to serve as an educator and mentor to youth who shared his identities and background, his attachment to his community and family, and his desire to give back to students attending his community college alma mater, which was a pivotal point of entry for Xavier's educational and professional trajectory.

Discussion

The identities and educational experiences of five rural Latinx college students pursuing STEM in fields such as software engineering, conservation and resource studies, biology, and agricultural science provided insight into how rural Latinx

students' intersectional identities and geographical backgrounds impact their pursuit of STEM degrees and careers, and their desire to give back to their communities. Findings demonstrate that rural Latinx college students experience inequities at the K-12 and higher education levels in pursuit of STEM. However, they persist in these fields because of deep commitments to helping others, enhancing their leadership skills, and addressing place-based inequities in rural communities. Their desire to “give back,” expressed in a variety of ways, including through extracurricular activities, reimagining STEM professional identities and career possibilities, and transforming structural and spatial inequities in rural environments, surpasses individualized interests in commonly researched and touted factors like job stability, career prestige, and high earnings, that, while important, were secondary to the STEM motivations of rural Latinx students.

Similar to the literature on rural students' pursuit of STEM (Saw and Agger, 2021), this article found that the STEM identities, educational experiences, and learning opportunities of rural Latinx students were influenced by their attendance at under-resourced high schools and their location in rural and small towns. This led to Xavier not discovering his passion for biology until he left his hometown for college. Notably, all the women in the study discussed difficulties with math and science, which is consistent with the literature that finds gender disparities in STEM fields (Rodriguez and Blaney, 2021). The lack of STEM resources and exposure led two students to change their majors from one STEM field to another. The four young women in the study pursued higher education and STEM degrees outside of the San Joaquin Valley agricultural region because institutions outside of this area were “better” for their STEM fields or because their majors were not available at institutions within the region, highlighting how the region lacks a STEM culture, also consistent with the rural STEM literature (Henley and Roberts, 2016). Issues of academic underpreparedness and a lack of exposure to STEM appear to be universal experiences for rural students across various racial/ethnic and geographic areas.

One distinction from the leading rural STEM education literature and findings from this study is that rural Latinx students recognize the lack of teachers in their communities who share their racial/ethnic backgrounds. Saw and Agger (2021) highlighted lower levels of teaching capacity in rural and small towns, which included a lack of math and science teachers, teacher self-efficacy, and professional development. Given the large Latinx population and student population in California and the San Joaquin Valley region, the recruitment and retention of high-quality Teachers of Color and Latinx teachers are also issues, with rural schools found to have an above-average share of white teachers (Monk, 2007). Students like Xavier and Wendy emphasized that they did not have biology and agriculture science teachers or Future Farmers of America (FFA) advisors who shared their racial/ethnic identities, although they did share country lifestyles and a passion for agriculture. This finding highlights the uniqueness of rural communities, which are diverse and growing (Lichter and Johnson, 2020), as well as the particular educational and instructional needs of diverse rural STEM students.

Despite some of the adverse effects these K-12 disparities may have had on rural Latinx students' educational experiences, these same inequities motivated them to pursue higher education and STEM degrees and careers in particular. This finding highlights the importance of shifting away from deficit-based approaches that focus on the problems or shortcomings of rural students and communities and instead employing asset-based perspectives in rural STEM educational research. These perspectives emphasize the cultural wealth of rural students, including their resourcefulness and ingenuity (Crumb et al., 2023). Such asset-based framings are also being employed in the Latinx STEM education literature (Rincón et al., 2020; Mein et al., 2020; García, 2024), highlighting a general trend in STEM education research across race, ethnicity, and geography. In line with this theoretical trend, this article employed Page-Reeves et al.'s (2019) framework of giving back to examine how rural Latinx students' intersectional identities and geographical backgrounds positively influenced their pursuit of STEM degrees and careers. The structural and spatial disparities rural Latinx students experienced in their upbringings and K-12 educational experiences did not deter youth from STEM, but instead inspired these STEM pursuits, fueling them with love, care, and empathy for their hometowns and home region, and contributing to their desire to initiate change within their communities and for generations of rural Latinx students and people.

Notably, all the students were actively involved on their college campuses, particularly in clubs and organizations where they could develop their leadership and skills in STEM fields. Rural Latinx students did not wait until they achieved their STEM degrees to make a difference. Instead, they were actively working to improve STEM educational experiences and opportunities and address disparities in health and the environment for students who shared their backgrounds and came from their respective communities. This finding is consistent with Page-Reeves et al.'s (2019) theorization of giving back as a way to engage in reciprocity, leadership, and mentorship. While the Latinx STEM education literature also discusses students' desires to help others and create positive social change, a key distinction for the students in this study was how they discussed skill and leadership development in alignment with giving back. Their enrollment in 4-year universities and participation in STEM clubs and organizations gave them access to information, knowledge, and experiences they did not have back home. The rural Latinx college students intentionally leveraged these experiences to enhance their STEM professional development and opportunities, and to give back in ways they had not yet imagined but were learning through their collegiate experiences.

Similar to the Latinx STEM education literature (McGee and Bentley, 2017; Rodríguez et al., 2020), the rural Latinx students demonstrated social justice values and commitments. However, a unique facet of rural Latinx students' altruism is that they discussed their impact as place-specific, consistently referencing their desire to return "home" and create change within their communities and the broader San Joaquin Valley region. Place and community attachments can thus be understood as a universal value for rural people. However, unlike the rural STEM education literature that has found that rural students generally feel deterred from pursuing

STEM because of a lack of local employment opportunities in their communities (Henley and Roberts, 2016), the rural Latinx students in this study were committed to returning home and finding or creating employment for themselves. There was a sense of duty and optimism as rural Latinx college students discussed their future return to their hometowns and home region for STEM employment. Their expressions of deep responsibility to return and create change may be due to their collectivist cultures (Arevalo et al., 2016) and values of *familismo* (Martínez, 2013).

Lastly, an important consideration for rural Latinx college students was the type of career they aspired to, and how to merge their rural Latinx identities and values with the kind of STEM professional they wanted to be and see in the world. This finding is consistent with those of Jaumot-Pascual et al. (2023) regarding the merging of Native identities and computing careers and the reimagining of technology to serve tribal sovereignty and preserve cultural and language heritage. Rodríguez et al. (2020) also found that Latina STEM undergraduates were frustrated by the capitalistic nature of STEM, such as developing products for private industries. The rural Latinx students in this study emphasized that money and career prestige were secondary to "helping others" and "contributing to something good." For some students, helping and contributing meant utilizing their STEM degrees to pursue careers in teaching. For others, it meant moving away from bureaucracy and government agencies that harm institutionally marginalized communities. These findings emphasize that giving back through STEM degrees and careers was more valuable to the rural Latinx college students in this study than commonly assumed measures of STEM success, like job security, career prestige, and high earnings.

Limitations and future research

A potential limitation of this article is that only five rural Latinx students' STEM degree and career pursuits were analyzed. These students were part of a larger mixed methods research study that included 16 students (Puente, 2022). The focus of the larger study was on higher education access. Some scholars, however, have argued that there is "power" in "small scale, qualitative research" (Ladson-Billings, 2025, p. 16) and that generalization is not a primary goal of qualitative research (Merriam and Tisdell, 2016). Still, future researchers might consider focusing their purpose and questions more explicitly on the educational and professional pursuits of rural STEM students and reflecting a wider range of student identities and experiences in their studies. The students in this article were mostly Mexican, women, from migrant farm worker backgrounds, first-generation college students, and enrolled in a public 4-year institution in California. Rural students' interest, pursuit, and commitment to STEM may vary by factors like race, ethnicity, gender, socioeconomic status, STEM degree, and institutional type. This article is thus reflective of the STEM pursuits of rural Latinx students from particular identities and geographical backgrounds, offering insights into their unique experiences and perspectives, but not representative of all rural STEM students.

In addition to potentially increasing the number and diversity of rural STEM students, future research should continue interrogating the relevant role of giving back. Because of the uniqueness of the rural Latinx students' identities, upbringings, and geographical backgrounds in this article, giving back included particular ways of "contributing to something good." Giving back may be a relevant perspective to consider, given that rural students have a strong attachment to place and rural communities have tight-knit cultures. However, these motivations may vary depending on personal values, cultural backgrounds, life experiences, individual goals, and geographic contexts. Researchers must continue to investigate what giving back means for rural students, what it looks like in practice, and identify the challenges or opportunities rural students face in giving back through their STEM degrees and careers. Additional asset-based frameworks and models congruent with rural ways of life and values should be explored to increase STEM interest, persistence, and completion among rural students. Such approaches can help move the subfield of rural STEM educational research away from individualistic and capitalistic models of STEM interest and success that may not fully capture the motivations of rural students for STEM degrees and careers.

Implications for practice

Rural-serving school districts

The literature and this study identify some of the most persistent issues deterring STEM access and success for rural students. These include systemic academic underpreparedness and limited exposure to STEM. Rural-serving school districts play a significant role in addressing these issues, as early educational experiences and exposure can increase interest in and the choice of STEM as a major and career path for rural students.

Rural students require greater access to high-quality STEM curriculum and teaching at the K-12 level. There is a need to mitigate negative academic experiences with STEM coursework at the college level that can hinder rural students' progress in their STEM studies and career pursuits or deter these aspirations altogether. Increasing access to Advanced Placement (AP) STEM courses and dual enrollment opportunities can broaden interest and curiosity in STEM and enhance academic preparation in these fields, especially when considering the high academic rigor of research-intensive universities that some rural students may attend. Rural students also require committed and diverse teachers who are from the community, understand the community, and reflect the demographics of the student body and community. Such teachers must also be supported by having the necessary funds and school district backing to continue enhancing their professional development and learning ways to teach STEM through culturally relevant approaches, congruent with the needs of their rural students, the local community, and the broader region in which they are situated.

Additionally, given the importance of STEM extracurricular activities to rural students, as found in this study, rural schools should establish STEM clubs on campus to further develop students' interests and learning. Early exposure, participation,

and leadership in these clubs will also help build rural students' familiarity and confidence in participating in STEM fields, while simultaneously enhancing their college resume and improving their chances of admission and declaring a STEM major. These clubs serve as a means to leverage rural cultural wealth (Crumb et al., 2023) by designing activities and service-learning opportunities that build upon the available resources and assets of rural people and places, addressing issues in rural communities. This will enhance leadership development and skills among rural students, as well as increase their connections to STEM, by cultivating meaningful, relevant, and timely learning opportunities that highlight the possibility of giving back to their communities through STEM degrees and careers.

A further consideration is exposing rural students to multiple fields within STEM, beyond the commonly discussed fields like biology, and careers such as healthcare. This is imperative for several reasons, including nurturing a diversity of STEM talent that can address the various and interconnected challenges facing rural communities and economies. It also diversifies paths in STEM that are less commonly pursued, which require rural perspectives and ingenuity in those areas. School counselors can develop major and career presentations that expose students to various paths and partner with alumni, local organizations, and industries to serve as guest speakers, showcasing the possibilities of various STEM careers in rural areas. These organizations and industries can also provide rural students with internships and job opportunities, allowing them to gain real experience in STEM fields and further solidify their interest in and capacity to envision themselves as future STEM professionals and leaders.

Higher education institutions

In addition to early exposure and academic preparation at the K-12 level, higher education institutions play a significant role in retaining and graduating rural students in STEM fields. The literature and this study have demonstrated a disconnect between rural students' identities and values and their STEM majors and desired career paths. Higher education institutions must expand their programming, services, and curricular offerings to align with the diverse student identities, experiences, and career aspirations for STEM majors.

Rural students' desire to transform their rural communities' inequitable conditions and environments necessitates that this approach be reflected in students' STEM curriculum and majors. STEM faculty must work to develop connections between their lectures, course materials, and real-world applications rooted in social justice values, and then provide rural students with opportunities to showcase how such teachings apply to their respective contexts. In addition to these assignments, STEM faculty can encourage service-learning opportunities by partnering with local schools, organizations, and communities, where rural students can practice and enhance their STEM knowledge. Even experiences in urban environments, as discussed by some of the rural Latinx students in this study, help them understand the differences and similarities between urban and rural places, which in turn help them better define their STEM goals and purpose.

Beyond the classroom, elevating the voices and efforts of rural students involved in on-campus organizations serving rural

communities should be highlighted to incoming rural students. STEMM retention and satisfaction increase when rural students find ways to give back to others, especially in their communities. Many rural college students are already involved in these efforts, even at urban-based institutions. Exposure to these student-run organizations can help incoming rural STEMM students find a sense of community on their campuses and meaning in their STEMM pursuits. STEMM departments should also consider rewarding rural students involved in these efforts, such as developing more holistic approaches when assessing who is or is not suited to remain in STEMM disciplines, beyond just considering performance in coursework and grades. Considering leadership and involvement in STEMM extracurricular activities when determining STEMM progression can reduce the pushout (Fematt et al., 2024) that Latinx and rural students experience in fields that are hyper-focused on academics and overlook vital efforts of giving back.

Rural students' coursework and leadership development in clubs and organizations prepare them for careers in STEMM. These extracurricular opportunities also help them reimagine the possibilities of STEMM careers and the types of STEMM professionals they aspire to be. For instance, a rural Latina student in this study described her active involvement in giving back through service since high school and her career goal of wanting to "contribute to something good." However, she could not identify a specific company or location where she might work as a software engineer doing "good" work. This suggests that STEMM departments must develop in-house career mentoring and counseling programs that expose rural students to STEMM careers beyond those typically pursued, are rooted in social justice, and can potentially occur in rural communities and regions where many rural students wish to remain. Software engineers, for example, can work remotely for a company. Rural students may be unaware of these possibilities, especially since many are the first in their families to pursue higher education and STEMM professions. STEMM departments on college campuses should develop career counseling programs, partner with institutional career service centers, and invite speakers from various STEMM industries and organizations to expose rural students to the multiple possibilities of STEMM careers, especially ones rooted in giving back to local communities.

Conclusion

The U.S. needs STEMM talent, and it can be found and cultivated among rural populations and in rural areas. However, there must be alignment between rural identities, values, and ways of life and STEMM. For rural Latinx students, the ability to give back to their communities is central to their pursuit of STEMM majors and careers. They actively give back (a) through their participation and leadership in STEMM-related extracurricular activities, (b) by choosing career paths that are geared toward social justice and helping others, and (c) intending to return and stay connected to their rural communities as future STEMM professionals, with hopes of transforming the inequitable conditions and environments of their communities through STEMM. Their identities and upbringings are inextricably linked to STEMM pursuits, and rural-serving school districts and

higher education institutions must reflect these identities and values to continue increasing the supply of rural STEMM degree holders, professionals, and contributors to society.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Ethics statement

The studies involving humans were approved by the University of California Santa Barbara Human Subjects Committee. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

MP: Resources, Conceptualization, Formal Analysis, Data curation, Visualization, Project administration, Validation, Software, Methodology, Writing – review and editing, Supervision, Funding acquisition, Investigation, Writing – original draft. MR: Writing – original draft, Formal Analysis. DR: Formal Analysis, Writing – original draft. GG-S: Writing – original draft.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The authors declare that no Generative AI was used in the creation of this manuscript.

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