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Finding a Place in STEM: Racial Differences in Undergraduate Students' Sense of Belonging

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Abstract

A strong sense of belonging is important to undergraduate students' academic experiences and may be particularly significant for students from racial and ethnic groups historically underrepresented in Science, Technology, Engineering, and Mathematics (STEM). This study examines racial differences in STEM students' sense of belonging and identifies college experiences associated with belonging across racial groups. Data were drawn from the 2015 Freshman Survey and 2019 College Senior Survey of the Cooperative Institutional Research Program (CIRP), including approximately 3,500 undergraduate students enrolled in STEM majors during their senior year. Analyses included ANOVAs and hierarchical multiple regressions. Results indicated differences in sense of belonging across racial groups, with White students reporting the highest levels and Latino students reporting the lowest. Faculty support

emerged as the strongest predictor of belonging, followed by satisfaction with campus diversity and faculty contact. Positive cross-racial interactions were associated with greater belonging, whereas negative cross-racial interactions were associated with lower belonging. These relationships varied across racial groups, with faculty support and campus diversity particularly important for Latino and Black students. Overall, the findings suggest that STEM students' sense of belonging is shaped by institutional and interpersonal experiences. Strengthening faculty support, promoting inclusive campus climates, and fostering positive cross-racial interactions may help create more equitable and supportive STEM environments.

Keywords: Sense of belonging; STEM education; Racial disparities; Faculty support; Campus climate

Finding a Place in STEM: Racial Differences in Undergraduate Students' Sense of Belonging

Introduction

A growing body of research highlights the importance of a strong sense of belonging for college students, particularly those pursuing Science, Technology, Engineering, and Mathematics (STEM) degrees. Sense of belonging—students' perceptions of being accepted, valued, and included within their academic and social communities—has been associated with academic engagement, persistence, and other aspects of students' college experiences (Johnson et al., 2022; Fong et al., 2024). Although these relationships vary across contexts and student populations, recent research suggests that belonging can be particularly consequential for students from groups historically underrepresented in STEM (Fong et al., 2024). In STEM education, where students may encounter demanding academic environments as well as concerns related to representation and inclusion, a strong sense of belonging may be especially important for supporting students' continued engagement and persistence (Lewis et al., 2019; Gray et al., 2025).

At the same time, students do not experience belonging equally across racial and ethnic groups. Research with college students has found that Black, Hispanic/Latino, and Asian Pacific American students reported lower levels of belonging than their White peers, with perceptions of campus racial climate and other aspects of the college environment associated with students' sense of belonging (Johnson et al., 2007). Research focused specifically on STEM has similarly documented differences in belonging across racial and gender groups. For example, Lewis et al. (2019) found that students from underrepresented groups were less likely to report a strong sense of belonging in STEM, while a more recent study of STEM and non-STEM students found that academic, social, and campus belonging varied across racial and ethnic groups and that faculty-student interactions and academic support were important components of students' experiences (Ovink et al., 2024). These findings suggest that racial differences in belonging cannot be understood solely as differences in individual student characteristics; they are also connected to students' experiences within their institutional and interpersonal environments.

The college environment may shape belonging through students' interactions with faculty, peers, and the broader campus community. Faculty support and meaningful faculty-student interactions have been associated with stronger belonging, whereas experiences of faculty stereotyping and negative racial climates may undermine students' sense of inclusion (Kim & Lundberg, 2026). Similarly, research on STEM students has identified interpersonal relationships, representation, science identity, and students' perceptions of their academic environments as important factors in the development of belonging (Lewis et al., 2019). Research examining racially and ethnically diverse students also indicates that campus racial climate is an important correlate of belonging, suggesting that students' perceptions of whether their institution is welcoming and inclusive may matter alongside their individual academic experiences (Johnson, 2012).

Despite this growing body of research, additional attention is needed to understanding how students' experiences within the college environment may contribute to racial differences in

STEM students' sense of belonging. In particular, examining faculty interactions, campus climate, and peer relationships together may provide a more comprehensive understanding of how belonging is experienced across racial groups. Addressing these differences is important for identifying institutional conditions and educational practices that may support more equitable experiences of belonging among STEM undergraduates.

The present study investigates racial differences in college satisfaction and sense of belonging among undergraduate STEM students, with the goal of identifying the environmental and experiential factors that support inclusive educational outcomes. Specifically, this research examines three interrelated questions: (1) How does sense of belonging among STEM undergraduate students differ by students' racial backgrounds? (2) Which aspects of the college experience contribute to improved sense of belonging for this population? (3) Are the relationships between college experiences and belonging consistent across racial groups, or do they vary depending on students' racial background?

By addressing these questions, this study provides insight into both the disparities in belonging among racial groups in STEM and the institutional and interpersonal experiences that may enhance inclusion. Findings from this research offer implications for faculty practices, campus climate initiatives, and peer engagement programs designed to foster a sense of belonging and promote the retention and success of all students in STEM fields.

Methods

The data for this study were drawn from the 2015 Freshman Survey (TFS) and the 2019 College Senior Survey (CSS), administered through the Cooperative Institutional Research Program (CIRP) at the Higher Education Research Institute (HERI), University of California, Los Angeles. The CIRP is a national longitudinal research program designed to examine students' experiences, attitudes, values, and educational outcomes throughout college. The TFS is administered to incoming first-year college students and collects information about their demographic backgrounds, academic preparation, educational aspirations, expectations, values, and attitudes at the beginning of their college experience. The CSS is administered to college seniors and gathers information about their college experiences, academic engagement, interactions with faculty and peers, satisfaction with their undergraduate education, and educational and career plans near the completion of their undergraduate studies. Together, these surveys provide longitudinal data that allow researchers to examine changes in students' experiences and perspectives from college entry to graduation.

The study used a sample of approximately 3,500 undergraduate students who were enrolled in STEM majors (Agriculture, Biological and Life Sciences, Engineering, Health Professions, Mathematics, Computer Science, or Physical Science) during their senior year. The combined survey dataset included 10,189 survey responses. Participating students attended both public (21.1%) and private (78.9%) higher education institutions, with institutional enrollment sizes

ranging from small to large. Thus, the dataset represents students from a variety of institutional settings rather than a single type or size of institution.

For data analysis, analysis of variance (ANOVA) and hierarchical multiple regression analyses were conducted using IBM SPSS Statistics. ANOVA was used to examine differences across groups, while hierarchical multiple regression was employed to examine the relationships among study variables while accounting for relevant control variables.

Results

Level of Sense of Belonging Among STEM College Students by Student Race

Table 1 presents the mean levels of sense of belonging among STEM college students by racial/ethnic group. Overall, the data indicate variation in belonging across racial groups. White students reported the highest mean sense of belonging (M = 51.58), followed by Asian students (M = 49.02), Black students (M = 47.93), and Latino students (M = 46.99).

These findings suggest that White STEM students experience the greatest sense of belonging within their academic environment, whereas Latino students report the lowest. Asian students, despite being numerically well-represented in STEM fields, report a moderately high sense of belonging that is lower than that of White students. Black students also report relatively lower belonging, highlighting potential challenges related to underrepresentation and social inclusion in STEM disciplines.

The observed differences between racial groups underscore the persistent disparities in perceived belonging in STEM education. Specifically, the gap of 4.59 points between the highest (White) and lowest (Latino) mean scores illustrates a meaningful difference in students' experiences of inclusion and connectedness. These results have important implications for interventions aimed at improving STEM engagement and retention, particularly for historically underrepresented students. Efforts to foster inclusive environments, support networks, and equitable classroom climates may be critical for enhancing belonging among Black and Latino students, while initiatives promoting inclusivity for all students can help ensure that Asian students also experience full engagement and integration within STEM programs.

Table 1. Level of Sense of Belonging Among STEM College Students by Student Race

Race	Mean Score
Asian	49.02
Black	47.93
Latino	46.99
White	51.58

Predictors of Sense of Belonging Among STEM College Students

Table 2 presents the standardized regression coefficients (β) for predictors of sense of belonging among STEM college students. The findings indicate that multiple social and institutional factors significantly contribute to students' sense of belonging.

Faculty support emerged as the strongest positive predictor of belonging ($\beta = .23$, $p < .0001$), suggesting that students who perceive higher levels of guidance, encouragement, and mentorship from faculty feel more included and connected within their STEM programs. Satisfaction with campus diversity ($\beta = .22$, $p < .0001$) and satisfaction with faculty contact ($\beta = .19$, $p < .0001$) also positively predicted belonging, indicating that students' perceptions of an inclusive campus climate and meaningful interactions with faculty enhance their sense of belonging.

In addition, positive cross-racial interactions contributed positively to belonging ($\beta = .07$, $p < .0001$), although the effect was smaller than the institutional and faculty-related factors. In contrast, negative cross-racial interactions were negatively associated with belonging ($\beta = -.16$, $p < .0001$), highlighting that experiences of conflict, exclusion, or microaggressions across racial lines can significantly diminish students' sense of inclusion.

These results demonstrate that both supportive institutional structures and the quality of social interactions within diverse settings play important roles in shaping STEM students' belonging. Notably, faculty engagement and satisfaction with the campus environment are particularly influential, underscoring the importance of mentoring, representation, and inclusive practices. While positive cross-racial interactions have a modest positive impact, negative interactions can substantially undermine students' sense of belonging, emphasizing the need for interventions that foster constructive and inclusive intergroup engagement.

Table 2. Predictors of Sense of Belonging Among STEM College Students

Independent Variables	eta
Faculty Support	
	23**
Satisfaction with Campus Diversity	
	22**
Satisfaction with Faculty Contact	
	19**
Positive Cross-Racial Interaction	
	07**
Negative Cross-Racial Interaction	
	.16**

*p < .01, **p< .0001

Predictors of Sense of Belonging Among STEM College Students by Student Race

Table 3 presents the standardized regression coefficients (β) for predictors of sense of belonging among STEM college students, disaggregated by student race. Overall, the findings indicate that faculty support, campus diversity, faculty contact, and cross-racial interactions significantly predict students' sense of belonging, though the strength of these relationships varies across racial groups.

Faculty support was a consistently strong positive predictor across all racial groups (Asian: β = .20, Black: β = .25, Latino: β = .27, White: β = .23; all p < .0001). This finding highlights the critical role of faculty mentorship, guidance, and encouragement in promoting belonging for all STEM students. Notably, Latino students reported the strongest association between faculty

support and belonging (β = .27), suggesting that faculty engagement may be particularly influential for underrepresented students in fostering inclusion.

Satisfaction with campus diversity also positively predicted belonging across groups, with the effect strongest for Latino students (β = .34, $p < .0001$) and Asian students (β = .26, $p < .0001$). Black (β = .23) and White students (β = .22) also benefited from perceptions of a diverse and inclusive campus environment. These findings underscore the importance of institutional climate and students' perceptions of diversity in supporting belonging, especially for students from historically underrepresented groups.

Satisfaction with faculty contact was a modest but significant predictor across all groups (β = .15–.19, all $p < .0001$), indicating that frequent and meaningful interactions with faculty contribute to students' sense of inclusion.

Positive cross-racial interactions were positively associated with belonging for all groups, with the strongest effects observed for Black (β = .23, $p < .0001$) and Asian students (β = .17, $p < .0001$), and more modest effects for Latino (β = .12, $p < .0001$) and White students (β = .05, $p < .0001$). This pattern suggests that opportunities for constructive and supportive interactions across racial lines may be particularly important for students of color in enhancing their sense of belonging.

Conversely, negative cross-racial interactions were negatively associated with belonging for all racial groups (Asian: β = -.16, Black: β = -.18, Latino: β = -.11, White: β = -.13; $p < .01$ or $p < .0001$), highlighting that experiences of conflict, exclusion, or microaggressions can undermine students' inclusion and connectedness. The effect was largest for Black students, indicating that negative cross-racial experiences may disproportionately impact their sense of belonging.

Taken together, these results suggest that while faculty support and campus diversity are critical for all students, the relative importance of positive and negative cross-racial interactions varies by race, with students from underrepresented groups—particularly Black and Latino students—benefiting most from supportive interactions and being most vulnerable to negative interactions. These findings highlight the need for targeted interventions that promote inclusive faculty engagement, supportive cross-racial interactions, and positive diversity climates within STEM programs.

Table 3. Predictors of Sense of Belonging Among STEM College Students by Student Race

Student Outcome	Sense of Belonging			
Independent Variables	Asian	Black	Latino	White
Faculty Support	.20**	.25**	.27**	.23**
Satisfaction with Campus Diversity	.26**	.23**	.34**	.22**
Satisfaction with Faculty Contact	.17**	.16**	.15**	.19**
Positive Cross-Racial Interaction	.17**	.23**	.12**	.05**
Negative Cross-Racial Interaction	-.16**	-.18**	-.11*	-.13**

*p < .01, **p< .0001

Discussion

The present study examined racial differences in STEM college students' sense of belonging and identified key predictors of belonging across racial groups. The results reveal persistent disparities in belonging, as well as the critical role of faculty support, campus diversity, and cross-racial interactions in shaping students' experiences of inclusion.

Racial Differences in STEM Belonging

Consistent with prior research, White students reported the highest mean sense of belonging, followed by Asian, Black, and Latino students. The 4.59-point gap between White and Latino students highlights meaningful disparities in perceived inclusion within STEM environments. These findings underscore that students from historically underrepresented racial groups continue to experience lower belonging in STEM, despite institutional efforts to promote diversity and inclusion. Asian students, although often well-represented in STEM, reported moderately high belonging that still lagged behind White students, suggesting that representation alone does not fully address feelings of inclusion and connection.

Faculty Support and Faculty Contact

Faculty support emerged as the strongest and most consistent predictor of belonging across all racial groups. Latino and Black students, in particular, showed stronger associations between faculty support and belonging, indicating that mentoring, guidance, and faculty engagement may be especially critical for students from underrepresented groups. Satisfaction with faculty contact also positively predicted belonging, although its effects were more modest, suggesting that both

the quality and perceived supportiveness of faculty interactions are important for fostering inclusion in STEM programs.

Campus Diversity

Satisfaction with campus diversity was another robust predictor of belonging. Latino and Asian students reported particularly strong effects, indicating that positive perceptions of diversity and inclusion in the campus climate can enhance feelings of connectedness for students from racially minoritized groups. These results support prior research emphasizing the importance of institutional climate in promoting STEM belonging and engagement.

Cross-Racial Interactions

The role of cross-racial interactions was nuanced. Positive cross-racial interactions were associated with higher belonging, particularly for Black and Asian students, whereas negative interactions were consistently linked to lower belonging, with the strongest negative effect for Black students. These findings highlight that the quality of intergroup interactions matters more than the mere presence of diversity. Experiences of conflict, exclusion, or microaggressions can undermine the benefits of a diverse environment, while constructive and supportive interactions can enhance inclusion and connectedness.

Implications for Practice

Taken together, these findings indicate that interventions aimed at improving STEM students' sense of belonging must operate across multiple levels of the educational environment. Faculty engagement and mentorship emerge as particularly critical, especially for Black and Latino students, for whom supportive relationships with faculty have the strongest association with belonging. Institutions should therefore invest in faculty development programs that promote culturally responsive mentoring and encourage behaviors that foster guidance, encouragement, and inclusion. In addition, the broader campus climate plays a key role in shaping belonging. Universities should prioritize initiatives that enhance perceptions of diversity and inclusion, including the implementation of substantive diversity policies and programs that make equity visible and tangible to students. Beyond institutional and faculty factors, the quality of peer interactions across racial groups significantly influences belonging. Facilitating positive cross-racial engagement through structured collaboration, dialogue, and inclusive peer networks can help mitigate the negative effects of conflict or exclusion and strengthen students' sense of connection to their STEM community. Collectively, these findings underscore the importance of coordinated strategies that integrate faculty support, inclusive campus climates, and meaningful peer interactions to promote belonging among all STEM students, with particular attention to historically underrepresented groups.

Limitations and Future Directions

Although the study provides valuable insights, several limitations warrant consideration. First, the data are cross-sectional, precluding causal inferences. Second, self-reported measures of belonging and perceptions of support may be influenced by social desirability or individual differences in reporting. Third, while the study disaggregated predictors by racial group, intersectional factors such as gender, socioeconomic status, and first-generation college status were not fully examined and may moderate the observed effects.

Future research should explore longitudinal trajectories of belonging, examine interactions between race, gender, and other demographic factors, and assess the effectiveness of targeted interventions aimed at enhancing faculty support, diversity climate, and cross-racial engagement. Additionally, qualitative studies may provide richer insights into the lived experiences underlying these quantitative patterns.

Conclusion

Overall, this study highlights persistent racial disparities in STEM students' sense of belonging and identifies key institutional and interpersonal factors that promote inclusion. Faculty support, campus diversity, and positive cross-racial interactions emerge as critical levers for fostering belonging, particularly for historically underrepresented students. Addressing these factors can contribute to more equitable, inclusive, and engaging STEM learning environments, ultimately supporting the retention and success of all students in STEM disciplines.

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