Literature Brief

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Sense of Belonging in Community College STEM: Why It's Important and How to Create More

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Introduction

This literature review examines the current state of knowledge regarding sense of belonging among community college STEM students, highlighting key findings, theoretical frameworks, and gaps in the existing literature.

Theoretical Frameworks for Understanding Belonging

The theoretical foundation for understanding belonging in educational settings draws heavily on Tinto's[1] model of student integration, which emphasizes the importance of social and academic integration for student persistence. Critics argue that Tinto's model emphasizes students' ability to integrate into the university environment, neglecting the impact of institutional policies, resource access, and societal inequalities on student success and retention, especially for diverse and nontraditional students attending community colleges.

Sense of belonging has been defined in several ways within the community college STEM context, drawing from both broader educational theories and specific applications to two-year institutions. The most commonly referenced definition in the literature comes from Strayhorn, who defines sense of belonging as "students' perceived social support on campus, a feeling or sensation of connectedness, and the experience of mattering or feeling cared about, accepted, respected, valued by, and important to the campus community or others on campus such as faculty, staff, and peers". [2] An earlier framing of belonging by Goodenow defines it as "students'

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[1] Tinto, V. (1993). Leaving college: Rethinking the causes and cures of student attrition (2nd ed.). University of Chicago Press.

[2] Strayhorn, T. L. (2012). College students' sense of belonging: A key to educational success for all students. New York: Routledge.

sense of being accepted, valued, included, and encouraged by others (teachers and peers) in the academic classroom setting and of feeling oneself to be an important part of the life and activity of the class". [3]

For community college STEM students specifically, researchers have adapted and expanded on this concept:

Classroom-centered belonging:

Since community college students often spend limited time on campus, researchers like Deil-Amen[4] and Garcia and Garza[5] emphasize socio-academic integration, where belonging develops primarily through classroom interactions rather than broader campus involvement.

Disciplinary belonging:

Johnson[6] and Espinosa[7] highlight the importance of developing a sense of STEM identity or belonging within the disciplinary community, which is particularly relevant for community college students preparing for transfer to university STEM programs.

Practical belonging:

Zumbrunn et al.[8] adapt belonging definitions to include students feeling that they have the practical support and resources they need to succeed in STEM, especially those that acknowledge the significant work, family, and financial responsibilities many community college students balance.

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[3] Goodenow, C. (1993). Classroom belonging among early adolescent students: Relationships to motivation and achievement. The Journal of Early Adolescence, 13(1), 21–43. https://doi.org/10.1177/0272431693013001002

[4] Deil-Amen, R. (2011). Socio-academic integrative moments: Rethinking academic and social integration among two-year college students in career-related programs. Journal of Higher Education, 82(1), 54–91. https://doi.org/10.1080/00221546.2011.11779085

[5] Garcia, G. A., & Garza, T. (2016). Retaining Latino males in community colleges: A structural model explaining sense of belonging through socio-academic integration. Journal of Applied Research in the Community College, 23(2), 41–58. https://www.ingentaconnect.com/content/montezuma/jarcc/2016/00000023/00000002/art00004

[6] Johnson, D. R. (2012). Campus racial climate perceptions and overall sense of belonging among racially diverse women in STEM majors. Journal of College Student Development, 53(2), 336–346. https://doi.org/10.1353/csd.2012.0028

[7] Espinosa, L. (2011). Pipelines and pathways: Women of color in undergraduate STEM majors and the college experiences that contribute to persistence. Harvard Educational Review, 81(2), 209–241. https://doi.org/10.17763/haer.81.2.92315ww157656k3u

[8] Zumbrunn, S., McKim, C., Buhs, E., & Hawley, L. R. (2014). Support, belonging, motivation, and engagement in the college classroom: A mixed method study. Instructional Science, 42(5), 661–684. https://doi.org/10.1007/s11251-014-9310-0

Transfer-oriented belonging:

Wang[9] expands the definition of sense of belonging beyond students' current institutions to broader STEM educational pathways, such as by empowering students to feel prepared for and connected to future transfer institutions.

Cultural belonging:

Hurtado and Carter[10] emphasize that for diverse community college populations, belonging involves feeling that one's cultural identity is valued within STEM spaces, not just feeling integrated into existing structures.

Evidence that Belonging Matters for Community College STEM Students

How sense of belonging influences community college STEM student outcomes has not been widely studied. Existing research by Stephens et al.[11] and Hansen et al.[12] links sense of belonging to increases in persistence rates, especially for low-income, nontraditional STEM students.[13] Other studies demonstrate that, in STEM fields, a strong sense of belonging correlates with higher retention rates.[14,15] Conversely, students who don't feel like they belong

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[9] Wang, X. (2020). On my own: The challenge and promise of building equitable STEM transfer pathways. Cambridge, MA: Harvard Education Press.

[10] Hurtado, S., & Carter, D. F. (1997). Effects of college transition and perceptions of the campus racial climate on Latino college students' sense of belonging. Sociology of Education, 70(4), 324–345. https://doi.org/10.2307/2673270

[11] Stephens N. M., Fryberg S. A., Markus H. R., Johnson C., Covarrubias R. (2012). Unseen disadvantage: How American universities' focus on independence undermines the academic performance of first-generation college students. Journal of Personality and Social Psychology, 102, 1178–1197.

[12] Hansen, M. J., Palakal, M. J., & White, L. J. (2024). The importance of STEM sense of belonging and academic hope in enhancing persistence for low-income, underrepresented STEM students. Journal for STEM Education Research, 7(2), 155-180.

[13] Hausmann, L. R. M., Schofield, J. W., & Woods, R. L. (2007). Sense of belonging as a predictor of intentions to persist among African American and White first-year college students. Research in Higher Education, 48(7), 803–839. https://doi.org/10.1007/s11162-007-9052-9

[14] Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2019). Active learning increases student performance in science, engineering, and mathematics. Proceedings of the National Academy of Sciences, 111(23), 8410–8415. https://doi.org/10.1073/pnas.1319030111

[15] Pittman, L. D., & Richmond, A. (2008). University belonging, friendship quality, and psychological adjustment during the transition to college. The Journal of Experimental Education, 76(4), 343–362. https://doi.org/10.3200/JEXE.76.4.343-362

may not persist: a study by Bryk et al.[16] reveals that a high level of uncertainty about students' sense of belonging in a developmental math course was the single best predictor of their leaving the course.

Gopalan and Brady[17] theorize that greater variability in community college student backgrounds, goals, and experiences may mean that, for two-year students, sense of belonging is more important at the course, major, or professional levels than at the general institutional level. This theory is supported by Hansen et al.'s[18] research, in which STEM domain–specific belonging was a stronger predictor of persistence than general belonging. In the same study, STEM-specific belonging and academic hope significantly predicted students' one-year persistence and intentions to persist to degree completion in information technology. A study of an intensive advising and structural support intervention at a two-year college found impressive causal effects on academic success, accompanied by increases in belonging.[19] Espino and Meza's (in press) systematic literature review of National Science Foundation (NSF) S-STEM scholarship programs in community colleges reveals that scholarship recipients who engaged in associated programmatic support services felt a boost in confidence and enhanced sense of belonging as scientists and scholars.

Strategies for Increasing Sense of Belonging

This section presents various strategies identified in the literature to increase sense of belonging.

Intentional Cohorts

Sense of belonging among peers is an important factor for individuals who may not have a strong familial or cultural connection to STEM or higher education.

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[16] Bryk, A. S., Yeager, D. S., Hausman, H., Muhich, J., Dolle, J. R., Grunow, A., and Gomez, L. (2013). Improvement research carried out through networked communities: Accelerating learning about practices that support more productive student mindsets. Palo Alto, CA: Carnegie Foundation for the Improvement of Teaching. https://www.carnegiefoundation.org/wp-content/uploads/2014/09/improvement_research_NICs_bryk-yeager.pdf

[17] Gopalan, M., & Brady, S. T. (2020). College students' sense of belonging: A national perspective. Educational Researcher, 49(2), 134-137.

[18] Hansen, et al., The importance of STEM sense of belonging.

[19] Scrivener, S., Weiss, M. J., Ratledge, A., Rudd, T., Sommo, C., & Fresques, H. (2015). Doubling graduation rates: Three-year effects of CUNY's Accelerated Study in Associate Programs (ASAP) for developmental education students. New York, NY: MDRC. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2571456

The formation of peer networks plays a crucial role in developing belonging within STEM pathways at community colleges. Deil-Amen[20] conceptualizes "socio-academic integration" as particularly important for students at community colleges, where academic and social interactions often occur simultaneously rather than as distinct processes. Reinforcing this concept, Tinto[21] and also Rodriguez and Blaney[22] find that participation in structured learning communities and cohort-based learning communities where students took the same STEM courses enhanced sense of belonging and persistence rates. However, even less formal study groups and collaborative learning have been identified as important for community college STEM students. For example, Crisp and Taggart[23] find that informal study groups contributed to developing science identity and belonging for community college students in introductory science courses.

Classroom Climate and Pedagogical Approaches

Classroom experiences represent a primary site for developing belonging in community college STEM contexts.

In a study focused specifically on community college students, VanOra[24] finds that classroom-based experiences were more influential than broader campus involvement on sense of belonging, highlighting the centrality of the classroom in two-year institutions. Student perceptions of instructor support and peer interactions in the classroom have been found to influence sense of belonging[25], and active learning strategies in introductory STEM courses have been linked to increases in students' sense of belonging compared to traditional lecture-based approaches.[26] Bensimon's[27] research on equity-minded teaching practices reveals the benefits of fostering belonging among racially minoritized students in community college STEM contexts.

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[20] Deil-Amen, R.,. Socio-academic integrative moments.

[21] Tinto, V. (2012). Completing college: Rethinking institutional action. Chicago: University of Chicago Press.

[22] Rodriguez, S. L., & Blaney, J. M. (2021). "We're the unicorns in STEM": Understanding how academic and social experiences influence sense of belonging for Latina undergraduate students. Journal of Diversity in Higher Education, 14(3), 441.

[23] Crisp, G., & Taggart, A. (2013). Community college student success programs: A synthesis, critique, and research agenda. Community College Journal of Research and Practice, 37(2), 114–130. https://doi.org/10.1080/10668920903381847

[24] VanOra, J. P. (2019). The impact of learning communities on the experiences of developmental students in community college: A qualitative study. Learning Communities Research and Practice, 7(1), Article 2. https://files.eric.ed.gov/fulltext/EJ1218544.pdf

[25] Zumbrunn, S. et al., Support, belonging, motivation, and engagement in the college classroom, pp.661–684.

[26] Freeman, S. et al., Active learning increases student performance in science, engineering, and mathematics.

[27] Bensimon, E. M. (2007). The underestimated significance of practitioner knowledge in the scholarship on student success. Review of Higher Education, 30(4), 441–469. https://doi.org/10.1353/rhe.2007.0032

Similarly, Hammond[28] demonstrates the effectiveness of culturally responsive teaching approaches for creating inclusive classroom environments.

Peer and Faculty Mentoring

Seeing individuals from their backgrounds excel in STEM fields can shatter stereotypes and empower students to pursue those paths themselves.

Brooms and Davis[29] demonstrate how peer mentoring initiatives targeted toward underrepresented students in STEM facilitate greater belonging. STEM students in their study reported that meeting STEM professionals of their own gender and ethnicity was particularly beneficial. In a 2020 study, matching mentors and mentees based on demographic backgrounds did not guarantee improved academic performance but did improve belonging and persistence in STEM.[30] Other studies find that ensuring matched mentors were culturally aware of their mentees' values and circumstances contributed to community college STEM students' sense of belonging.[31,32]

Institutional Structures and Programs

Mentoring, research experiences, professional development activities, learning communities, interactive courses, and cognitive interventions are all empirically effective practices. No single practice is universally effective.

"The LiFT," a scholarship program for low-income community college STEM students, combines financial resources with academic support, peer mentors, transfer institution exposure, and

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[28] Hammond, Z. (2014). Culturally responsive teaching and the brain: Promoting authentic engagement and rigor among culturally and linguistically diverse students. Thousand Oaks, CA: Corwin Press.

[29] Brooms, D. R., & Davis, A. R. (2017). Staying focused on the goal: Peer bonding and faculty mentors supporting Black males' persistence in college. Journal of Black Studies, 48(3), 305–326. https://doi.org/10.1177/0021934717692520

[30] Kricorian, K., Seu, M., Lopez, D., Ureta, E., & Equils, O. (2020). Factors influencing participation of underrepresented students in STEM fields: Matched mentors and mindsets. International Journal of STEM Education, 7(1), 1–9. https://doi.org/10.1186/s40594-020-00219-2

[31] Pearson, J., Giacumo, L. A., Farid, A., & Sadegh, M. (2022). A systematic multiple studies review of low-income, first-generation, and underrepresented, STEM-degree support programs: Emerging evidence-based models and recommendations. Education Sciences, 12(5), 333. https://doi.org/10.3390/educsci12050333

[32] Byars-Winston, A., Womack, V. Y., Butz, A. R., McGee, R., Quinn, S. C., Utzerath, E., Saetermoe, C. L., & Thomas, S. (2018). Pilot study of an intervention to increase cultural awareness in research mentoring: Implications for diversifying the scientific workforce. Journal of Clinical and Translational Science, 2(2), 86–94. https://doi.org/10.1017/cts.2018.25

other resources. A 2024 study by Hansen et al.[33] reveals that students in the LiFT program had significantly higher one-year persistence and sense of belonging than a matched comparison group. Dowd et al.[34] find that dedicated STEM support programs created counterspaces where community college students could develop disciplinary identities and stronger connections to STEM fields.

Transfer-focused programs represent another important institutional structure affecting belonging. Early exposure to four-year institutional environments through bridge programs enhanced community college students' sense of belonging in STEM pathways.[35] Ghazzawi et al.[36] use a rigorous propensity score matching methodology to measure the effectiveness of a STEM enrichment summer bridge early intervention program and find that the program was effective in enhancing the retention rates and academic performance among underrepresented Pell-eligible students. These types of cohort-based programs can provide students with the peer networks and academic support they need to be successful in persisting to degree completion.

In addition, Eagan et al.[37] find that structured undergraduate research experiences positively impacted belonging and persistence, particularly for underrepresented students.

Limitations

Much of the literature on sense of belonging in STEM focuses on (often selective) four-year colleges. This review has focused on evidence-based research on STEM students enrolled in community colleges to argue that college setting matters. Research suggests sense of belonging may be experienced differently for community college students, but more research is needed to guide community college students' sense of belonging in STEM.

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[33] Hansen, M. J., Palakal, M. J., & White, L. J. (2024). The importance of STEM sense of belonging and academic hope in enhancing persistence for low-income, underrepresented STEM students. Journal for STEM Education Research, 7(2), 155-180.

[34] Dowd, A. C., Pak, J. H., & Bensimon, E. M. (2013). The role of institutional agents in promoting transfer access. Education Policy Analysis Archives, 21(15), 1–44. https://doi.org/10.14507/epaa.v21n15.2013

[35] Reyes, M. E. (2011). Unique challenges for women of color in STEM transferring from community colleges to universities. Harvard Educational Review, 81(2), 241–263. https://doi.org/10.17763/haer.81.2.324m5t1535026g76

[36] Ghazzawi, D., Pattison, D., & Horn, C. (2021, July). Persistence of underrepresented minorities in STEM fields: Are summer bridge programs sufficient?. In Frontiers in education (Vol. 6, p. 630529). Frontiers Media SA.

[37] Eagan, M. K., Hurtado, S., Chang, M. J., Garcia, G. A., Herrera, F. A., & Garibay, J. C. (2013). Making a difference in science education: The impact of undergraduate research programs. American Educational Research Journal, 50(4), 683–713. https://doi.org/10.3102/0002831213482038

Conclusion

Sense of belonging represents a crucial element for understanding and supporting student success in community college STEM pathways. The literature reveals the multifaceted nature of belonging in these contexts, influenced by classroom experiences, peer interactions, institutional structures, and student identity factors.

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