

Title: Developing Sense of Belonging in Isolation: Insights from Two Projects Supporting STEM Undergraduates

Authors: Joseph Brobst, jabrobst@odu.edu, Old Dominion University
Elizabeth Litzler, elitzler@uw.edu, University of Washington
Sura Alqudah, alqudas@wwu.edu, Western Washington University
Regina Barber DeGraaff, barberr@wwu.edu, Western Washington University
Jill Davishahl, davishj@wwu.edu, Western Washington University
Perry Fizzano, fizzaanp@wwu.edu, Western Washington University
David Hartenstine, hartend@wwu.edu, Western Washington University
Andrew Klein, kleina5@wwu.edu, Western Washington University

Abstract: With the advent of the COVID-19 pandemic, two National Science Foundation S-STEM projects were suddenly tasked with building community and sense of belonging among students who were no longer able to gather in the same physical location as faculty members and/or one another. This study investigated the extent to which these programs' support efforts, aimed at fostering undergraduate STEM students' sense of belonging, maintained their effectiveness when transitioned to a fully virtual context. Of additional interest were which activities had the most / least influence on students' sense of belonging in the virtual context. Findings indicate that virtual support activities played an important role in developing students' sense of belonging, engaging students in a community during a challenging time.

Presented at the American Educational Research Association (AERA) Annual Meeting, April 21-26, 2022.

Purpose / Objective

Prior research indicates that STEM undergraduate students' perceptions including sense of belonging are important to their retention and success, especially for individuals belonging to historically underrepresented groups, e.g., females, students of color, students from low socioeconomic status backgrounds (Carlone & Johnson, 2007; Chang, Sharkness, Hurtado, & Newman, 2014; Hausmann, Schofield, & Woods, 2007; Johnson, Alvarez, Longerbeam, Soldner, Inkelas, Leonard, & Rowan-Kenyon, 2007; Pantic & Clark-Midura, 2019; Walton & Cohen, 2011). University projects supported by programs like the National Science Foundation's Scholarships in STEM (S-STEM) effort are designed to recruit and retain students from these underrepresented backgrounds and, as such, typically incorporate curricular and co-curricular support activities tailored toward building community and fostering sense of belonging among their participants. Common activities in these sorts of projects, included due to their demonstrated positive impacts on undergraduates, are summer bridge programs, cohort structures, first-year seminar courses, and peer mentoring programs (Lisberg & Woods, 2018, Martin-Hansen, 2018).

Previous studies conducted as part of two S-STEM projects at a university in the Northwestern United States have confirmed the utility of these types of supports for developing sense of belonging among students studying mathematics, computer science, and engineering (Authors, 2019; Authors, 2020; Authors, 2021). With the advent of the COVID-19 pandemic, however, both projects and all their associated activities (indeed, all university courses and activities) were abruptly shifted to a completely virtual/online format. Suddenly, these projects were tasked with building community and sense of belonging among students who were no longer able to gather in the same physical location as faculty members and/or one another. This situation fostered the following research questions, which guided the present study: To what extent do curricular and co-curricular activities aimed at building community and sense of belonging among STEM undergraduates from underrepresented groups maintain their effectiveness when transitioned to a fully virtual context? Which activities appear to have the most / least influence on students' sense of belonging in the virtual context?

Theoretical Perspective

This study is grounded in social cognitive career theory or SCCT (Lent, Brown, & Hackett, 1994), which models individuals' developing academic and career interests and plans as being shaped by their self-efficacy, outcome expectations, and goals. These components contributing to career interests and plans are influenced by factors like gender and race/ethnicity and mediated by boundaries encountered along academic and career pathways (Jordan & Sorby, 2014). SCCT has been widely used in studies of STEM students' academic and career choices and the types of factors that influence these choices, including affective factors like sense of belonging (Fouad & Santana, 2017). As discussed in prior work (Authors, 2019; Authors, 2020; Authors, 2021), the two S-STEM projects selected and implemented targeted activities listed above due to these activities' demonstrated effectiveness in supporting student success by positively influencing affective factors like sense of belonging, self-efficacy, and academic/professional identity.

Methods

Study Context

The data analyzed for this study were collected as part of educational research and external evaluation components of two separate NSF S-STEM projects hosted by the same institution. One project, MC (project acronyms are pseudonyms), draws students interested in majoring in math and/or computer science while the other, 3E, draws students interested in majoring in electrical, manufacturing, or plastics/composites engineering. Both projects include first-year seminar-style courses and peer mentoring components. The 3E program also includes a math-focused summer bridge program, designed to help students achieve math placement exam scores that allow them to take calculus in their first academic quarter, putting them on track for a 4-year time to graduation. Student cohort structures and intentional advising by project faculty are also hallmarks of both. While the PIs and Co-PIs differ across projects, the same educational researcher (1st author) and external evaluator (2nd author) work on both and co-manage data collection activities.

Data source and analytical approach

The data source for this study consisted of transcripts from focus group interviews conducted with first-year students from both projects, held toward the end of their first academic year (2020-21). Four total focus groups were held: 10 of 14 first-year students from MC (71%; 9 female, 1 male) participated across two groups, while 8 of 13 first-year students from 3E (69%; 3 female, 5 male) participated across two additional groups. Focus groups lasted approximately 1 hour each and were conducted via Zoom, co-facilitated by the projects' educational researcher and external evaluator. Focus groups were video recorded and transcribed verbatim. Student responses placed in the Zoom chat were read aloud by the facilitators so that these data could also be captured in the transcripts.

Focus group protocols asked students about their experiences and satisfaction with curricular and co-curricular activities associated with their respective S-STEM project, including the extent to which their experiences with these activities influenced their perceptions or affect. Using QSR NVivo 12 software, focus group transcripts were coded first for a priori themes including whether student responses mentioned specific project components or activities and whether responses touched upon feelings of community / sense of belonging. Then, a second round of coding was applied identifying the type of sentiment (positive or negative) expressed by students in discussion that touched upon sense of belonging.

Results

Project Activities, Sense of Belonging, and Student Sentiment: Big Picture

The NVivo software was used to generate hierarchy charts (Figures 1 & 2) showing how, when discussing feelings of community or sense of belonging, students' sentiment varied by type of project activity. The size of each blue box reflects the percentage of belonging-related discussion made in reference to each project component. Within these, green boxes represent percentage of positive sentiment, red represent negative sentiment, and orange represent mixed sentiment.

As is evident from the figures, when students discussed how particular project activities connected to their feelings of community or sense of belonging, they overwhelmingly shared positive sentiments. Discussion of seminar courses in relation to sense of belonging made up a much higher proportion of the transcripts for students the MC project. A possible explanation for this difference is that MC seminar courses were specific to students in the project, whereas 3E students were required to participate in larger first-year seminar courses that included other engineering students from outside the project.

[Insert Figures 1 & 2 here]

Project Activities, Sense of Belonging, and Student Sentiment: In Their Own Words

As noted, discussion of seminar courses as impacting sense of belonging came from students in both projects but was much more prevalent (more than 2x as many instances) in transcripts from students in the MC project. The following quotes describe the importance of seminar courses to MC students' sense of belonging:

Jennie (MC student, pseudonym): *I think, more than anything, that especially right now while half of us are still living at home off campus and half of us are on campus but everything's closed, it gives us a chance to, you know, really get a community of people, because otherwise, without this program, if I was just taking classes from home, picking my classes and just going to Zoom meetings all day, I probably wouldn't have any friends in college I would know absolutely nobody. And so, with this group, it makes it so much more bearable to be in the situation that we're in.*

Adrienne (MC student, pseudonym): *I would have felt lost without it fall quarter, the community was amazing and helped make the transition to college so much easier and fun. And staying at home, it was great being able to form bonds with each other.*

For 3E students, the combined sequence of summer bridge program leading into seminar courses was also noted as positively impacting students' sense of belonging:

Dahlia (3E student, pseudonym): *I think it really helped me like get my foot in the door, like socially because I was like well it's all online and I've met no one, but by the first day of like actual classes, I was like I already know these people, and we have little jokes and stuff on. And it was not like a forced group, but like I was paired up with people who were more like me than just random people like we had, at least, you know, a couple things in common, which I really needed.*

While students did not mention the mentoring program as much as seminar courses when discussing feelings of community and sense of belonging, there were some who felt it had important impacts:

Andrea (MC student, pseudonym): *I don't know if this would be the answer in a normal year but, for me, this year, one of the best things about the program is another human being. I've been very grateful for another human being, that I'm obligated to interact with in my life and who I, like I enjoyed doing it . . . I'm lucky enough that I actually can meet*

my mentor in person, too I don't know if everyone else has been able to do that or not, if, for the on-campus people at least.

Adrienne (MC student, pseudonym): *We talked a lot about pandemic stress and it felt good being able to support each other, it went both ways in the virtual world, so my favorite thing was being able to relate to each other.*

There were also challenges related to mentoring and sense of belonging mentioned by one of the 3E students:

Faruk (pseudonym): *I think at the end of the day it boils down to how similar you are or how much they want to help you and, like the effort that goes into the relationship. Obviously, I think those factors are, I think they derail the relationship more now during COVID, especially since you're meeting with them through a screen and I feel like if it were in person, maybe it would be easier to talk to them and sort of build on a mentor-mentee relationship like that.*

This was one of relatively few instances where students described negative impacts of the pandemic on the effectiveness of the MC and 3E projects' support activities. Overall, while acknowledging that aspects of the activities might have functioned better in-person, students expressed gratitude to have access to these sorts of supports during what was a uniquely challenging time for higher education.

Conclusions, Limitations, and Significance / Implications

The findings described here suggest that STEM undergraduates' access to tailored activities and supports, i.e., summer bridge programs, first-year seminars, mentoring, and cohort structures, played an important role in engendering feelings of community and sense of belonging despite pandemic restrictions limiting all the above to taking place in virtual contexts. Congruent with findings from our previous research, first-year seminar courses appear to have had an outsized effect on students' sense of belonging, especially within the MC project.

It is important to acknowledge that our findings have limitations, as they are drawn from a small sample of students and a single university site. Though students were encouraged to be open and honest during focus groups and informed that their responses would only be shared with project faculty anonymously or using pseudonyms, it is possible that they may have been hesitant to communicate negative sentiments.

While the COVID-19 pandemic is a unique historical event, and it is likely that many traditional college campus activities and structures will return to in-person formats, this study has implications that apply beyond the pandemic context. As mentioned above, though the current results suggest program activities were critically important to developing sense-of-belonging during the pandemic, we have other data that shows they were always beneficial. Drawing upon this, our findings suggest that first-year seminar courses and peer mentoring programs could have utility in supporting students' success in online-only degree programs. Similarly, undergraduate support programs spanning multiple sites within an institution or across institutions might successfully foster feelings of community and sense of belonging among

participants without necessarily having to bring them together in-person – that is, so long as virtual activities are thoughtfully designed and well-targeted.

Figures

Figure 1: Student sentiment related to belonging by type of support activity - MC

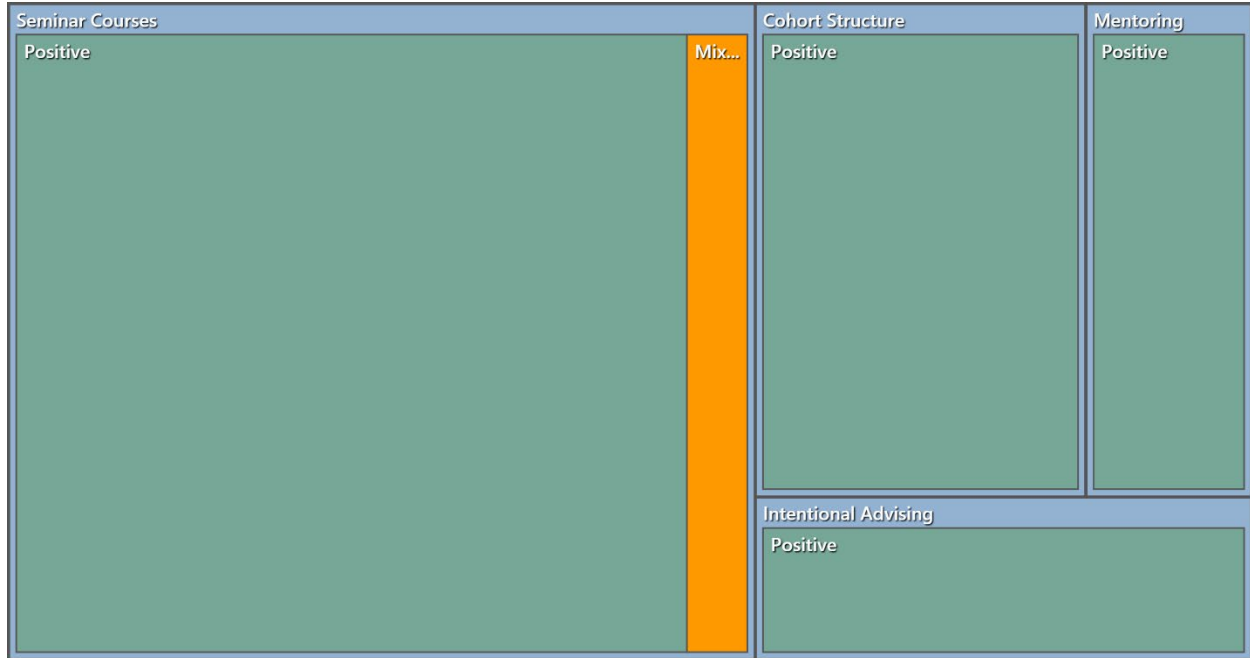
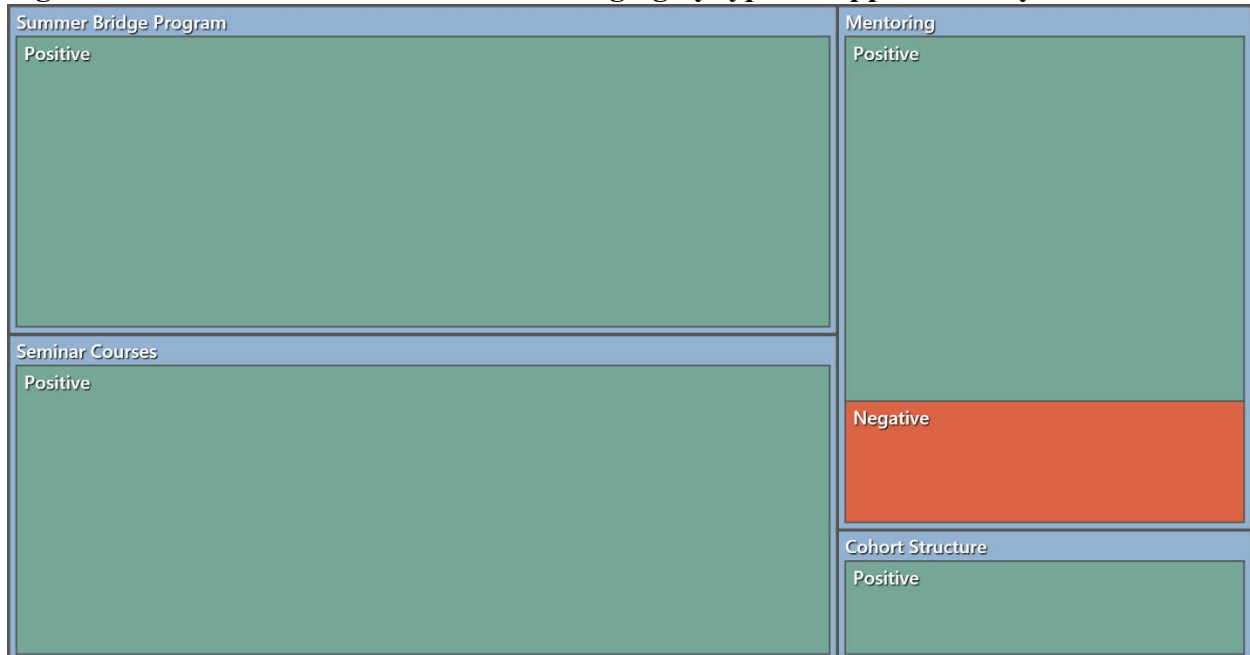


Figure 2: Student sentiment related to belonging by type of support activity – 3E



References

Authors (2019)

Authors (2020)

Authors (2021)

- Carlone, H.B., & Johnson, A. (2007). Understanding the science experiences of successful women of color: science identity as an analytic lens. *Journal of Research in Science Teaching*, 44(8), 1187-1218. <https://doi.org/10.1002/tea.20237>
- Chang, M.J., Sharkness, J., Hurtado, S. and Newman, C.B. (2014), What matters in college for retaining aspiring scientists and engineers from underrepresented racial groups. *J Res Sci Teach*, 51(5), 555-580. <https://doi.org/10.1002/tea.21146>
- Fouad, N.A., & Santana, M. C. (2017). SCCT and underrepresented populations in STEM fields: moving the needle. *Journal of Career Assessment*, 25(1), 24-39. <https://doi.org/10.1177/1069072716658324>
- Hausmann, L., Schofield, J., & Woods, R. (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>
- Johnson, D. R., Alvarez, P., Longerbeam, S., Soldner, M., Inkelas, K. K., Leonard, J. B., & Rowan-Kenyon, H. (2007). Examining sense of belonging among first-year undergraduates from different racial/ethnic groups. *Journal of College Student Development*, 48(5), 525-542.
- Jordan, K. L., & Sorby, S. A. (2014, June), *Intervention to Improve Self-Efficacy and Sense of Belonging of First-Year Underrepresented Engineering Students*. Paper presented at 2014 ASEE Annual Conference & Exposition, Indianapolis, Indiana. 10.18260/1-2—20695
- Lent R.W., Brown, S.D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior*, 45, 79-122.
- Lisberg, A. & Woods, B. (2018). Mentorship, mindset and learning strategies: an integrative approach to increasing underrepresented minority student retention in a STEM undergraduate program. *Journal of STEM Education*, 19(3).
- Martin-Hansen, L. (2018). Examining ways to meaningfully support students in STEM. *IJ STEM Ed*, 5, 53. <https://doi.org/10.1186/s40594-018-0150-3>
- Pantic, K., & Clark-Midura, J. (2019). Factors that influence retention of women in the computer science major: a systematic literature review. *Journal of Women and Minorities in Science and Engineering*, 25(2), 119-145. DOI: 10.1615/JWomenMinorScienEng.2019024384

Walton, G.M., & Cohen, G.L. (2011). A brief social belonging intervention improves academic and health outcomes of minority students. *Science*, 331(6023), 1447-1451.
doi:10.1126/science.1198364.