

Exploring Students' Understanding of Belonging and Self-Efficacy in a Transformed Introductory Mathematics Course

Te'a Riley
The Ohio State University

Xingfeiyue Liu
The Ohio State University

Susan Olesik
The Ohio State University

Lin Ding
The Ohio State University

Raeshan Davis
The Ohio State University

Keywords: sense of belonging, self-efficacy, diversity, inclusion, culturally responsive teaching

Achieving diversity, equity, inclusion, and justice (DEIJ) remains a major challenge within STEM fields, especially at the higher education level. Particularly, at The Ohio State University, students from minoritized groups in STEM have felt othered and isolated within the STEM environments. To address disparities in participation and retention of minoritized students in STEM, our HHMI grant provides both financial and structural support to foster racial, ethnic, and gender justice. The HHMI-supported courses offer culturally responsive pedagogies (CRP), active learning opportunities, and smaller classroom sizes. As a part of the project, this poster focuses on accessing the pedagogical changes in one of the four foundational STEM courses, Math 1151, which has undergone integrated DEIJ-driven adjustments.

This poster investigates how students' experiences in a transformative mathematics course shape their sense of belonging (SB) and self-efficacy (SE). Research shows that higher SE and SB are key to student success and retention (Bandura, 1977, 1993; Hausmann et al., 2007; Zimmerman, 2000). Using the mixed-method approach, we compare pre- and post-class surveys results focused on these constructs, based on the Leibowitz et al. (2020) survey of SB, students' perceptions of CRP, and SE. Additionally, we analyzed open-ended questions to offer insights into how their course experiences impact their SB and SE.

The Fall 2024 study included a sample of 766 undergraduates who completed both pre- and post-class surveys, which included five-point-Likert-scale and open-ended questions. The sample was 82% first-year students, with 6% enrolled in HHMI sections. Analysis showed modest changes: students' SE slightly decreased, while perceptions of CRP increased. Group comparisons between HHMI and non-HHMI sections showed higher mean scores in HHMI, but not statistically significant pre-post changes. Further investigation of class standing revealed that first-year students reported significantly greater increases in CRP perceptions compared to upper-class students. Several themes emerged from the open-ended questions on how instructors have supported and could better support students' learning, including providing clear explanations and engaging environments which were cited for both improvement and appreciation. The most common response for improvement was that students already felt well-supported by their instructors suggesting that factors outside of this course (e.g. prior academic experiences, other course engagements, peer relationships) may have influenced the quantitative results. Although no statistically significant increases were observed in HHMI courses, the mean scores for SB and SE were already relatively high at baseline—4.02 and 4.14, respectively—aligning with participants' satisfaction with their instructors in open-ended responses. As the project progresses, we anticipate observing further improvements.

Acknowledgments

This work was funded by the Howard Hughes Medical Institute: awards #GT15972.

References

- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191–215. <https://doi.org/10.1037/0033-295X.84.2.191>
- Bandura, A. (1993). Perceived Self-Efficacy in Cognitive Development and Functioning. *Educational Psychologist*, 28(2), 117–148. https://doi.org/10.1207/s15326985ep2802_3
- 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>
- Leibowitz, J. B., Lovitt, C. F., & Seager, C. S. (2020). Development and Validation of a Survey to Assess Belonging, Academic Engagement, and Self-Efficacy in STEM RLCs. *Learning Communities: Research & Practice*, 8(1), 3.
- Midgley, C., Maehr, M., Hruda, L., Anderman, E., Anderman, L., Freeman, K., Gheen, M., Kaplan, A., Kumar, R., Middleton, M., Nelson, J., Roeser, R., & Urdan, T. (2000). *The Patterns of Adaptive Learning Scales (PALS)*.
- Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary educational psychology*, 25(1), 82-91. <https://doi.org/10.1006/ceps.1999.1016>