

Empowering Undergraduates Through Community-Engaged Mathematics Outreach: A Model for Undergraduate-Led AMC Workshops

Tanya Huffman
Florida Gulf Coast University

Daniel Kern
Florida Gulf Coast University

Kayla Kerr
Florida Gulf Coast University

Mason Huffman
Florida Gulf Coast University

Keywords: community engagement, STEM outreach, experiential learning

This study investigates the impact of undergraduate-led mathematics workshops on both undergraduate instructors and middle school participants. The workshops are built around topics from the American Mathematics Competition (AMC), providing a rich context for exploring problem-solving and conceptual understanding beyond the standard K-12 mathematics curriculum. Specifically, the study examines how designing and teaching these AMC-based workshops influence undergraduate students' communication, leadership, and research skills. It explores whether participation in these teaching experiences enhances undergraduates' confidence in explaining mathematical concepts, strengthens their collaboration and pedagogical abilities, and deepens their understanding of the broader societal impact of mathematics education. In parallel, the study investigates the extent to which middle school students demonstrate measurable knowledge gains after participating in the workshops. It assesses improvements in their problem-solving abilities and conceptual understanding through pre- and post-assessments, providing insight into how undergraduate-led initiatives can effectively support K–12 learning in mathematics.

This project builds on existing research highlighting the dual benefits of STEM outreach for both undergraduate instructors and K–12 learners. Studies consistently show that undergraduates who engage in teaching or outreach develop stronger communication, leadership, and content knowledge skills (Felege et al., 2022; Schalk et al., 2009). Feldon et al. (2011) found that graduate students with teaching experience demonstrated stronger research design and hypothesis development than peers focused solely on research.

STEM outreach further promotes confidence, collaboration, and public engagement skills essential for future educators and researchers (Curtis, 2017; Pickering et al., 2004; Philipp et al., 2016). Beyond undergraduate benefits, outreach programs have been shown to enhance younger students' engagement and conceptual understanding in science and mathematics (Volbrecht et al., 2019). Embedding such experiences within the undergraduate curriculum strengthens students' preparedness for professional STEM careers while fostering community connections and mentoring relationships (Caldwell et al., 2007; Pfund et al., 2012).

Overall, the research demonstrates that structured outreach creates reciprocal learning benefits—advancing STEM education through meaningful engagement between college and pre-college students.

References

- Caldwell, K., McCoy, J., Albers, L., Smith, A., & Parry, E. (2007, June). *The impact of K–12 outreach programs on graduate and undergraduate experiences. Proceedings of the 2007 American Society for Engineering Education Annual Conference & Exposition*, 12.1430, 1–23.

- Curtis, K. (2017). Science after school: Way cool! A course-based approach to teaching science outreach. *Advances in Physiology Education*, 41(1), 10–15.
<https://doi.org/10.1152/advan.00115.2016>
- Felege, C. J., Hunter, C. J., & Ellis-Felege, S. N. (2022). Personal impacts of the undergraduate teaching assistant experience. *Journal of the Scholarship of Teaching and Learning*, 22(2), 33–66. <https://doi.org/10.14434/josotl.v22i2.31306>
- Feldon, D., Peugh, J., Timmerman, B., Maher, M., Hurst, M., Strickland, D., Gilmore, J., & Stiegelmeier, C. (2011). Graduate students' teaching experiences improve their methodological research skills. *Science*, 333(6045), 1037–1039.
<https://doi.org/10.1126/science.1204109>
- Pfund, C., Matheiu, R., Austin, A., Connolly, M., Manska, B., & Moore, K. (2012). Advancing STEM undergraduate learning: Preparing the nation's future faculty. *Change: The Magazine of Higher Learning*, 44(6), 64–72. <https://doi.org/10.1080/00091383.2012.728955>
- Philipp, S. B., Tretter, T. R., & Rich, C. V. (2016). Development of undergraduate teaching assistants as effective instructors in STEM courses. *Journal of College Science Teaching*, 45(3), 74–82.
- Pickering, M., Ryan, E., Conroy, K., Gravel, B., & Portsmore, M. (2004, June). *The benefit of outreach to engineering students. Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition.*
- Schalk, K. A., McGinnis, J. R., Harring, J. R., Hendrickson, A., & Smith, A. C. (2009). The undergraduate teaching assistant experience offers opportunities similar to the undergraduate research experience. *Journal of Microbiology & Biology Education*, 10(1), 39–42.
<https://doi.org/10.1128/jmbe.v10.97>
- Volbrecht, P. J., Frenette, R. S., & Gall, A. J. (2019). An effective model for engaging faculty and undergraduate students in neuroscience outreach with middle schoolers. *Journal of Undergraduate Neuroscience Education*, 17(2), A136–A150.