Examining Graduate TAs' Mathematical Knowledge for Teaching in a Teaching Seminar Context

Laurie Short
North Carolina State University

Logan Gray
UNC Chapel Hill

Bex Nelson
UNC Chapel Hill

Keywords: Graduate Mathematics Teaching Assistants, Teaching Assistant Preparation, Mathematical Knowledge for Teaching

Graduate mathematics teaching assistants (GMTAs) carry a substantial portion of the responsibility for teaching undergraduates (Speer, Gutmann, & Murphy, 2005), yet many enter their graduate programs with little to no prior teaching experience (Speer et al., 2005). With limited guidance, GMTAs are expected to help undergraduates bridge the gap between high school and college-level mathematics. Although GMTAs often possess extensive and nuanced content knowledge (Sarkar et al., 2024), content knowledge alone is not sufficient for effective teaching (Grossman, 1990).

Researchers in K-12 mathematics have long examined ways to conceptualize what knowledge is required besides content expertise. One of the most influential frameworks is mathematical knowledge for teaching (MKT), which is defined as the specialized understanding of mathematics required to support students' learning (Ball et al., 2008). MKT is strongly linked to instructional quality and student outcomes (Ball et al., 2008; Hill et al., 2005). More recently, studies have sought to expand MKT definitions to secondary and post-secondary teaching contexts, highlighting that both student populations and institutional contexts influence how MKT is defined and enacted in practice (Speer et al. 2015; Ko et al., 2021).

Building on this research, our study aims to answer the overarching research question: *How does participation in a graduate mathematics teaching seminar shape TAs' Mathematical Knowledge for Teaching?* We conducted a mixed-methods case study of a semester-long teaching seminar course for a group of thirteen beginning GMTAs at a large, public, research university in the Southern United States. Our data collection methods included observations of the seminar, semi-structured interviews with the instructor and GMTAs, and document analysis of course materials, which were triangulated to ensure reliability (Stake, 1995). Additionally, we administered a condensed and altered version of the Mathematical Knowledge for Teaching College Algebra Community College Version (MKT-CCA) instrument (Lim, Duranczyk, & Akoto, 2024) to examine GMTAs' mathematical knowledge for teaching in practice. As many graduate students at this university will eventually serve as instructors of record for college algebra, we administered this instrument at the beginning and end of the seminar to measure growth and compare quantitative findings with TAs' interviews, class interactions, and teaching.

Early evidence suggests that GMTAs enter their programs with highly variable MKT, but structured seminars can enhance this knowledge. A particularly influential mechanism for this development is facilitating increasingly legitimate peripheral participation.

The goal of our poster presentation is to engage RUME conference participants in discussing how we can support GMTAs in their development of MKT. Building on this work, we will pursue a design-based research project to iteratively refine the seminar curriculum and further investigate how structured support shapes GMTAs' growth in MKT.

References

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education, 59*(5), 389–407. https://doi.org/10.1177/0022487108324554

Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal, 42*(2), 371–406. https://doi.org/10.3102/00028312042002371

Grossman, P. L. (1990). *The making of a teacher: Teacher knowledge and teacher education.* Teachers College Press.

Ko, I., Mesa, V., Duranczyk, I., Herbst, P., Kohli, N., Ström, A., & Watkins, L. (2021). Understanding the characteristics of mathematical knowledge for teaching algebra in high schools and community colleges. *International Journal of Mathematical Education in Science and Technology, 55*(3), 590–614. https://doi.org/10.1080/0020739X.2021.2006348

Lim, D., Duranczyk, I., & Akoto, B. (2024, March). *Measuring Mathematical Knowledge for Teaching Community College Algebra* [Poster presentation]. AI@CC 2.0 VMQI Research Group. https://hdl.handle.net/11299/261688

Sarkar, M., Gutierrez-Bucheli, L., Yip, S. Y., Lazarus, M., Wright, C., White, P. J., Ilic, D., Hiscox, T. J., & Berry, A. (2024). Pedagogical content knowledge (PCK) in higher education: A systematic scoping review. *Teaching and Teacher Education, 144,* 104608. https://doi.org/10.1016/j.tate.2024.104608

Speer, N. M., King, K. D., & Howell, H. (2015). Definitions of mathematical knowledge for teaching: Using these constructs in research on secondary and college mathematics teachers. *Journal of Mathematics Teacher Education, 18*(2), 105–122. https://doi.org/10.1007/s10857-014-9283-4

Speer, N., Gutmann, T., & Murphy, T. J. (2005). Mathematics teaching assistant preparation and development. *College Teaching, 53*(2), 75–80. https://doi.org/10.3200/CTCH.53.2.75-80

Stake, R. E. (1995). *The art of case study research*. Sage Publications.