

Modules for Developing Statistics Graduate Teaching Assistants' Capacity for Teaching

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Keywords: graduate teaching assistant, introductory statistics, resources for teacher education

Although statistics graduate teaching assistants (GTAs) face the difficult task of teaching undergraduate students with a broad range of backgrounds, they often do so with little to no preparation in statistics teaching. There are resources developed for mathematics GTAs (e.g., <http://collegemathvideocases.org>); however, there is a lack of resources that can support *statistics* GTAs in addressing the disciplinary need of teaching and learning statistics. Based on a design-based approach, we developed four modules for Learning to teach Equitably with Authentic Data (LEAD modules; <https://sites.ced.ncsu.edu/lead-modules/>), building on existing frameworks of teaching mathematics and recommendations for teaching statistics. We introduce LEAD modules and examine the research question: What problems of practice emerged when GTAs participated in LEAD modules at two GTA communities?

The first module, *Teaching Statistical Thinking*, introduces the distinctive features of statistical thinking compared to those of mathematical thinking: context, variability, and inference (GAISE Committee, 2016; Smucker et al., 2024; Wild & Pfannkuck, 1999). The second module, *Launch, Explore, Discuss*, provides a framework for GTAs to structure a lesson centered on exploring statistical concepts (Lappan et al., 2009). This module responds to the persistent pattern of narrowly focusing on procedural aspects of doing statistics (Justice et al., 2017; Noll, 2011). The third module, *Teacher Discourse Moves*, offers a set of discourse moves for GTAs to facilitate classroom discussions during the Discuss phase of the lesson (Herbel-Eisenmann et al., 2017). Lastly, the fourth module, *Promoting Participation*, reflects the challenge of eliciting student participation commonly experienced by GTAs. The module asks GTAs to examine initial patterns of student participation and consider opportunities to broaden participation across the classroom (e.g., Byun, 2024).

Our preliminary findings show multiple problems of practice (hereafter, problems) emerged as GTAs worked toward implementing teaching approaches included in the modules. Informed by Cohen et al. (2003), we broadly categorized the problems by student-, teacher-, content-, and environment-related problems. Student-related problems included the perceived lack of students' prior preparation and participation, and their negative disposition toward the subject. Teacher-related problems highlighted difficulties in adopting new teaching strategies and uncertainty about how to respond to a wide range of student contributions. There were fewer problems related to content and environment, but implementing new strategies within the time constraint was salient.

Without adequate teacher learning opportunities, GTAs are likely to fall back on more familiar teaching approaches that they have experienced as mathematics learners, which often entail attending lectures, taking notes, and doing homework problems (Findley, 2022; Justice et al., 2017). The identified problems of practice offer valuable insights for further iterations of LEAD modules so that modules can better fill the void of resources when course coordinators and instructional mentors work with GTAs to reshape undergraduate teaching.

Acknowledgments

This material is based upon work supported by the National Science Foundation under Grant Nos. 2315434 and 2315435. Any opinions, findings, and conclusions or recommendations expressed in this article are those of the authors and do not necessarily reflect the views of the National Science Foundation.

References

- Byun, S. (2024). Interactional practices of inviting minoritized students to whole-class mathematics discussions. *Educational Studies in Mathematics*, 115(3), 321-350.
- Cohen, D. K., Raudenbush, S. W., & Ball, D. L. (2003). Resources, instruction, and research. *Educational evaluation and policy analysis*, 25(2), 119-142.
- Findley, K. (2022). Navigating a disciplinary chasm: The statistical perspectives of graduate teaching assistants. *Statistics Education Research Journal*, 21(1), 12-12.
- Herbel-Eisenmann, B., Cirillo, M., Steele M. D., Otten, S., and Johnson, K. R. (2017). *Mathematics Discourse in Secondary Classrooms: A Practice-Based Multimedia Resource for Professional Learning*. Math Solutions.
- Jackson, K. J., Shahan, E. C., Gibbons, L. K., & Cobb, P. A. (2012). Launching complex tasks. *Mathematics Teaching in the Middle School*, 18(1), 24-29.
- Justice, N., Zieffler, A., & Garfield, J. (2017). Statistics graduate teaching assistants' beliefs, practices and preparation for teaching introductory statistics. *Statistics Education Research Journal*, 16(1), 294-319.
- Lappan, G., Fey, J. F., Fitzgerald, W. M., Friel, S. N., & Phillips, E. D. (2009). *Connected Mathematics Project 2*. Boston: Pearson.
- Noll, J. (2011). Graduate teaching assistants' statistical content knowledge of sampling. *Statistics Education Research Journal*, 10(2), 48-74.
- Smucker, K., Sepúlveda, F., Weiland, T., Cannon, S., Casey, S., & Byun, S. (2024). Considering the 5 practices through a statistical lens. *Mathematics Teacher: Learning and Teaching PK-12*, 117(2), 86-97.
- Wild, C. J., & Pfannkuch, M. (1999). Statistical thinking in empirical enquiry. *International Statistical Review*, 67(3), 223-248.