Using AI to Adapt Secondary Mathematics Discourse Frameworks for Graduate Teaching Assistant Development

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Graduate teaching assistants (TAs) play a pivotal role in undergraduate mathematics instruction, often leading recitations that shape students' early university experiences. However, while the literature on TA training highlights the need for pedagogical preparation (Shannon, Twale, & Moore, 1998; Speer, Gutmann, & Murphy, 2005), few resource materials have been developed specifically for this audience. This gap exists, for example, in the area of classroom discourse, and contrasts with the robust set of discourse-based professional learning tools available for secondary mathematics teachers. As a result, TA training often lacks the concrete, discipline-specific examples necessary to help novice instructors develop productive discourse practices in settings where their assistantships are situated (e.g., calculus recitations). This is important because in mathematics, a recitation is not intended to replicate the lecture but to provide a smaller, discussion-based environment where students actively engage with problems and reasoning. Ideally, in this context, TAs facilitate collaboration, questioning, and sense-making rather than delivering additional content. Such active-learning structures have been shown to enhance students' conceptual understanding and engagement in undergraduate mathematics (Freeman et al., 2014; Laursen & Rasmussen, 2019).

Upon learning that students in my first-semester TA-training course were unhappy with being asked to learn about engagement, classroom discourse, and teacher discourse moves using materials for secondary instructors, I used AI (i.e., Chat GPT 5), to generate new transcripts that made use of discourse frameworks (e.g., Freeburn and Arbaugh's (2017) communication moves for productive struggle and Herbel-Eisenmann et al.'s (2017) Teacher Discourse Moves. Thus, this project builds on two research-based established frameworks and analysis of classroom roles and participation structure to generate Calculus Transcripts that adapt secondary-level discourse cases for the graduate TA context. The new materials were designed for use in a semester-long TA training course at a research-intensive university. The cases were created to simulate authentic challenges TAs face—such as encouraging student reasoning and sustaining mathematical discussions—while maintaining fidelity to the original pedagogical constructs.

The poster shares the adaptation process, examples of the resulting Calculus Transcripts, and reflections from pilot implementation. Preliminary observations suggest that ChatGPT did a reasonably good job of generating these transcripts with the following exceptions - the AI: (a) consistently had students providing correct, polished answers with precise vocabulary, (b) had the instructor continuously praise student contributions, and (c) continuously went into telling mode after the vignette to point out all of the things in the case that I wanted the TAs/students to notice about the discourse. Ultimately, this project contributes to addressing the need, identified by Speer et al. (2005), for providing a mechanism to generate research-based pedagogical tools and resources that explicitly bridge the K–12 and postsecondary mathematics education communities. By expanding discourse-based case study resources to the calculus classroom, this initiative supports a more coherent trajectory of teacher learning across educational levels and offers a model for developing reflective, discussion-oriented TA training in mathematics.

References

Freeburn, B., & Arbaugh, F. (2021). Responsiveness in the mathematics classroom: Understanding how teachers respond to student thinking. Journal of Mathematics Teacher Education, 24(5), 483–507.

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences, 111*(23), 8410–8415. https://doi.org/10.1073/pnas.1319030111

Herbel-Eisenmann, B., Cirillo, M., Steele, M. D., Otten, S., & Johnson, K. R. (2017). *Mathematics discourse in secondary classrooms: A practice-based resource for professional learning*. Sausalito, CA: Math Solutions.

Laursen, S. L., & Rasmussen, C. (2019). *Inequality and student-centered learning: Toward inclusive innovation in undergraduate mathematics.* PRIMUS, *29*(7), 799–816. https://doi.org/10.1080/10511970.2018.1499083

Shannon, D. M., Twale, D. J., & Moore, M. S. (1998). TA teaching effectiveness: The impact of training and teaching experience. The Journal of Higher Education, 69(4), 440–466.

Speer, N., Gutmann, T., & Murphy, T. J. (2005). Mathematics teaching assistant preparation and development. College Teaching, 53(2), 75–80.