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Designing for Teacher Noticing in College Mathematics

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Abstract: We report on the first phase of a design-based research project aimed at investigating the efficacy of a video-annotation curriculum for college mathematics instructional teams centered on teacher noticing and aimed at supporting the teaching of proof-writing. Teacher noticing involves attending to student thinking and classroom interactions to guide teaching decisions. We discuss our design efforts and share the evolution of the design conjectures that resulted from an interdisciplinary collaboration between mathematics and education scholars.

Introduction and theoretical framing

The transition to upper division proof-intensive math courses can be challenging for college students, with many switching majors within three years (Leu, 2017). Additionally, math classrooms can be marginalizing spaces, particularly for women and students of color (Leyva et al., 2021). Research suggests that student-centered instructional practices can lead to higher learning gains and benefit all students and particularly minoritized students. Noticing in Mathematics for Student Success (NIMS²) is an NSF-funded research project aimed at investigating the efficacy of a video-annotation curriculum for college math instructional teams centered on teacher noticing. Noticing involves attending to and making sense of student mathematical thinking and interactions to inform teaching decisions (Jacobs et al., 2010). This includes ways teachers attend to issues of equity, culture, and power (van Es et al., 2022). While noticing has been examined extensively in K-12 settings, very limited research exists in higher-education contexts. This poster focuses on the project's first design phase and explores the design conjectures and considerations that drove the adaptation of noticing learning activities to the higher education context.

Mode of inquiry

The project is a partnership between the Mathematics Department and the School of Education at a public Hispanic-serving institution on the West coast of the United States. The interdisciplinary team, consisting of both faculty and PhD students, met weekly over the course of the first phase of the project to design the curriculum for instructional teams (including mathematics faculty, teaching assistants, and undergraduate learning assistants) teaching an introduction to proof-writing course. Data sources for the project included field notes from weekly meetings and relevant artifacts, such as conjecture maps outlining the working theory guiding the curriculum design. Artifacts were analyzed to document the design process and decisions.

Findings

Four considerations emerged from the project meetings that guided the design of the 10-hour video-annotation curriculum:

- The need for a proof-writing framework. In meeting discussions, it became clear that a central challenge of the noticing curriculum was to elevate the skills of proof writing (e.g., generating examples to make sense of the statement to be proved, or making use of a definition) from general mathematics content. While an assigned task may focus on functions (mathematics content), students must also access skills that proficient proof writers possess. Thus, we realized we needed a framework for proof writing to unveil potentially hidden aspects of the introduction to proof course.
- Supporting the development of a vision of high-quality mathematics instruction. The curriculum aimed to shift the vision of mathematics instruction at the college level by centering student thinking and participation. However, unlike K-12 teachers, college instructors lack pedagogical training and may feel pressure to cover material rapidly in large lecture courses. To support the enactment of noticing, parameters for high-quality mathematics instruction within the constraints of the college setting were made explicit, considering both lecture-based and group-work contexts. For example, we conjectured that the noticing curriculum would need to make explicit how interactions can be shaped to create opportunities to notice student thinking and responding in ways that support understanding in settings that are typically dominated by teacher-directed instruction. We also decided to make explicit norms for

discursive participation in noticing sessions to support an inquiry stance to student thinking and instructional practice.

- Centering equity. Drawing from research (Leyva et al, 2021) and our personal experiences with university mathematics departments, we recognized from the beginning that we needed to center issues of equity in the design of the noticing curriculum. Through project meetings, we continuously grappled with where and how to elevate this issue. Equitable, quality teaching is multidimensional, addressing student identity and authority as well as reimagining instructional practices (Aguirre et al., 2013; Schoenfeld et al., 2020). We determined that our equity and responsive teaching framework needed to explicitly attend to recognizing students' assets (instead of deficit perspectives) and discuss how implicit bias may impact what instructors attend to and how they interpret student responses. We thus included in the design opportunities for participants to consider how sociocultural and political factors might inform one's noticing. Finally, we decided to prioritize opportunities for instructional team members who have varied expertise and perspectives to collaborate and learn from each other.
- Practical constraints. The final set of design considerations stem from the practical constraints of developing a curriculum for college instructional teams. These included: acquiring video clips that would generate the type of thinking and conversation desired for our noticing tasks and coordinating participant schedules. To meet scheduling demands, the curriculum modules needed to have both face-to-face and online asynchronous components, with asynchronous tasks including opportunities to enact and reflect on learnings in practice.

Discussion and Next Steps

The main aim of the NIMS² project is to adapt a body of work that has been very generative for understanding and improving the competencies of K-12 mathematics teachers to the context of mathematics college teaching and instructors at various levels of their teaching careers. The first exploratory phase of the project was productive in that the interdisciplinary collaboration between education and mathematics scholars was able to surface specific needs and goals that can be integrated into the design of the video-annotation curriculum. A tension that remains is to design tasks and activities that are responsive to and engage productively mathematics department instructional teams while also preserving the complexity of theoretical understandings of high-quality teaching and equitable practices that we draw on from educational research. Ultimately the multiple opportunities to test and iterate the curriculum and revise it based on learning evidence and participant feedback will allow us to adjust and optimize the design.

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