Using Theory to Design Professional Development for Calculus I and II Instructors

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Calculus courses are a gateway for students entering STEM fields, but they sometimes hinder students, especially those from historically marginalized groups, from pursuing STEM (Bressoud et al., 2015; Ellis et al., 2016; Kogan & Laursen, 2014; Seymour & Hewitt, 1997). Thus, there is a need for instructional innovation in Calculus and the creation of professional development (PD) programs to better equip instructors to support students' success. Researchers have identified characteristics of successful college calculus programs, some of which include the "use of student-centered pedagogies and active-learning strategies" (p. 145) and diversity, equity, and inclusion practices (Hagman, 2021). There is a need for researchers to design PD programs that train calculus instructors to implement active learning and equitable teaching practices. Our project contributes to this need by designing such a PD program for Calculus I and II instructors at two Hispanic Serving Institutions, a research university and a community college. For this poster, we report on how varied theoretical frameworks inform this PD's design.

The literature on active learning and equity in mathematics is vast. There are myriad theoretical frameworks and recommendations for teaching practices that instructors can use to equitably implement active learning (e.g., Freeman et al., 2014; Mathematical Association of America, 2018). Thus, it can be a challenge for PD designers to identify the main characteristics of active learning and equitable teaching practices that are essential for instructors to learn to implement. To address this, we employed a qualitative analysis on several articles and books (i.e., Bartell et al., 2017; Freeman et al., 2014; Gutiérrez, 2009; Kuster et al., 2018; Laursen & Rasmussen, 2019; Reinholz, 2023), as well as the National Council of Teachers of Mathematics' (2014) list of effective teaching practices and the Mathematical Association of America's (2018) Instructional Practices Guide, that outlined active learning or equitable teaching practices. We inductively coded (Miles et al., 2013) each manuscript to identify the active learning or equitable teaching practices listed in frameworks, examples, or recommendations for instructors. We then performed axial coding (Miles et al., 2013) to group the coded practices into broader categories, including: *(i) use meaningful engaging math tasks, (ii) facilitate student collaboration, (iii) elicit, notice, and use evidence of students' mathematical thinking, (iv) orchestrate class discussion on students' mathematical ideas, (v) attend to participatory equity and access in the classroom, (vi) foster an inclusive class community, and (vii) equitably assess student work*.

We used these categories to inform the design of our PD program for Calculus I and II instructors. The PD program consists of a workshop series over two days before the beginning of the course with follow-up biweekly meetings for the instructors in a professional learning community (Stoll et al., 2006) to reflect and receive feedback on their implementation of the equitable active learning teaching practices they learned. Each workshop was designed to train instructors to implement techniques pertaining to one of the broader categories of equitable active learning teaching practices. The literature-based categories we identified were productive for informing the design of our PD workshop series, so we recommend for researchers and practitioners to use this theoretical framework to inform the design of their PD programs for instructors. Future research can further refine this framework and address the effectiveness of PDs designed with this framework of equitable active learning teaching practices.

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