

Collaborative Teamwork Builds Confidence and Independence in Discrete Mathematics

Rebeca Hernandez Shandy Hauk Paul Carmody
San Francisco State University San Francisco State University San Francisco State University

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For many students, discrete mathematics is a first exposure to formal logical reasoning, proofs, and proving. Undergraduates entering discrete mathematics have a long history with procedural problem solving and often attribute the authority for sense-making to textbook, instructor, or software (Herbel-Eisenmann, 2007). Like calculus, discrete mathematics shares a history of enormous disparities in outcomes correlated to demographic variables (Campisi et al., 2024). Research in undergraduate mathematics education, notably in calculus, has indicated that disparities can be addressed by linked changes in student materials and instructional methods (Bressoud & Rasmussen, 2015). Groupworthy learning opportunities for students combined with use of socio-culturally informed instructional approaches can build positive relationships among students, between students and instructor (and institution), and foster engagement in and outside of class (Archie et al., 2022; Laursen et al., 2014; Leyva et al., 2022; Yoshinobu et al., 2023).

As part of a project developing and researching the use of team-worthy lessons in discrete mathematics, the poster reports on a small study of 3 instructors (M, A, and P) and their 105 students. Classroom observations indicated that the use of team-worthy lessons changed the structure of classroom activity from primarily didactic lecture to at least 75% student-centered activity (e.g., group work, student presentation; Weston et al., 2023). However, a change in observed structure is only evidence of an affordance, not of students' experience of it (was it equitable? productive for learning?). After each team-worthy lesson students were surveyed about what went well (and not). Analysis of student responses used a framework based on social learning theory (Bandura, 1997) and dimensions of equity (Guitierrez, 2009).

The poster presents results about students' experience of equity, agency, authority, creativity, self-efficacy, and collaboration. The majority of students indicated collaboration as an aspect they deemed positive. Yet, collaboration was also the area they felt needed the most improvement! For example, two of the survey prompts were: "Share at least one aspect of your experience today with math teamwork that NEEDS IMPROVEMENT" and "Share at least one aspect of your experience today with math teamwork that was POSITIVE." For the first question, students in M's class felt mostly satisfied (60%), while A's and P's students highlighted needs for clearer instructions, improved participation, and better collaboration. For the "positive" question, students from all three instructors indicated collaboration most frequently, with at least 30% for each instructor (Carmody, 2024). As will be illustrated on the poster, these distributions reflect students' reports of their needs, both met and unmet, for establishing and sustaining a more equitable learning environment.

Poster-side conversations will explore next steps in research and practice. In particular, the project is developing a short-course for instructors who use the lessons. The short-course focuses on student-centered methods, particularly noticing student thinking, and the idea of how to balance the use of new and old instructional skills. A likely next research area is: What (re)balancing of instructor skills is needed to realize the potential of the (re)balancing of activity structures afforded by the lessons? Future work can examine how instructional skills, combined with the affordances of lesson content, contribute to the development of agency, self-efficacy, belonging, and engagement in mathematical sense-making among discrete mathematics students.

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