Support for Active Learning in Introductory Calculus: Exploring the Relationship Between Mathematics Identity and Pedagogical Approaches

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Calculus I is a main gatekeeper course for STEM majors, so increasing student success in this course is imperative to retaining more students in STEM fields. Since students' mathematics identity is a strong predictor of pursing a STEM career, more information is needed about how students are developing these identities in introductory mathematics courses. This study reports a piece of a larger mixed methods approach to gain more insight into how instructional approaches in introductory calculus are related to students' mathematics identity development. Interviews were conducted to explore students' perceptions of the pedagogy used in their introductory calculus class. Students' descriptions of their mathematics identity, which includes the constructs of interest, recognition, and performance/competence beliefs are discussed and compared between an active learning environment and a traditional lecture classroom.

Keywords: Calculus Success, Mathematics Identity, Active Learning

Student success in introductory calculus is imperative to obtaining a degree in any STEM field, with about 75% of students taking Calculus I intending to have a career in STEM (Bressoud 2015). Calculus I has been shown to be gatekeeper course, and research continues to show that Calculus I "lowers students' confidence, enjoyment of mathematics, and desire to continue in a field that requires further mathematics" (Bressoud 2015). One reason for this continued problem is a lack of information about how pedagogical choices influence the culture established in the calculus classroom and how this impacts students' mathematics identity development. Engineering identity has been shown to be significantly related to grade performance in introductory engineering courses, which merits taking a closer look at this relationship for introductory calculus (Schar 2017). Also, Cribbs (2012) found that students' mathematics identity strongly predicts their career choice in STEM fields.

Results from the 2015 MAA national calculus study showed that traditional lecture was the predominant instructional method used in Calculus I throughout the country. However, a meta-analysis of 225 studies comparing traditional lecture to active learning in STEM courses found that failure rates under traditional lecture increase by 55% over the rates observed under active learning (Freeman 2014). A smaller study at a large research university of student grade trends in Calculus I revealed that failure rates were significantly lower when an active learning model was implemented in the mathematics department (Norton et al. 2017). Since introductory calculus still functions as a gatekeeper role for STEM majors, more attention needs to be paid to the learning environments that are being provided for these students.

This study will report a piece of a larger mixed methods approach to gain more insight into how instructional practices in introductory calculus are related to students' mathematics identity development. Interviews were conducted to explore students' perceptions of the pedagogy used in their introductory calculus class. Students' descriptions of their mathematics identity, which includes the constructs of interest, recognition, and performance/competence beliefs (Cribbs 2015), will be discussed and compared between an active learning environment and a traditional lecture classroom. Preliminary analysis revealed that the group work provided in the active learning classroom supported students' performance/competence beliefs as well as their feelings of recognition as a mathematics student.

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