

Mathematics Self-Efficacy in Collegiate Calculus

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Mathematics self-efficacy (MSE) refers to students' beliefs in their ability to successfully perform mathematics (Bandura, 1997). MSE is an important construct because it has been shown to impact students' perseverance, college major choice, likelihood of remaining in college, and success or failure in mathematics (Gill, 2019; Grigg et al., 2018; Hackett, 1985; Street et al., 2017). Generally high MSE has been linked to more beneficial outcomes, such as higher grades or choosing a STEM major. MSE can be measured globally, for an overall subject like mathematics, or locally, for specific topics or problems (Bandura, 1997).

A review of self-efficacy in higher education found that students' self-efficacy can change in higher education and that interventions designed around social cognitive theory or practical experiences that allow students to feel successful can improve self-efficacy (van Dinther et al., 2011). For MSE and MSE in calculus specifically, less research has been conducted though Nicolescu (2015) found that calculus at a community college generally raised students' MSE.

Research Design

This study examined the global and local MSE of students enrolled in collegiate calculus, with the goal of identifying and qualitatively describing cases of participants who reported changing MSE. Participants were 14 students enrolled in a first collegiate calculus class. A semi-structured interview was used to explore participants' mathematics experiences prior to calculus, their experiences in calculus, and their global self-efficacy beliefs before calculus and in calculus. Participants were also asked to rate their local MSE for three calculus problems (one on evaluating a limit graphically, one on finding a derivative that required the product rule and knowledge of the derivative of trigonometric functions, and one on using the first derivative test to find local extrema). Participants were asked to describe why they felt that confidence level and what solution strategy they would use to solve the problem.

Findings and Implications

Results show that some participants reported changed global MSE because of calculus, with 7 reporting lower MSE in calculus than previous mathematics courses, 4 reporting higher MSE in calculus than held previously, and 3 reporting the same MSE in calculus as other mathematics classes. Participants reported reasons for changes to their MSE included difficulty of the exams, pace of the courses, and differences in teaching style. For local MSE, participants were generally confident on the problems, reporting the highest confidence in finding the procedural derivative using the product rule (mean confidence 4.5 out of 5) and the lowest confidence on using the first derivative test (mean confidence 3.71 out of 5). Results have implications for our knowledge of MSE, a relatively stable belief that can still change under certain conditions (Bandura, 1997; Byars-Winston, et al., 2017; Friedel et al., 2010). Results also have implications for collegiate calculus instructors who wish to better support their students.

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