The UCSD/SDSU Mathematics and Science Education
Doctoral Program Proudly Presents a Dissertation Defense:

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Improving Student Success in Calculus: A Comparison of Four College Calculus Classes

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The quality of education in science, technology, engineering, and mathematics (STEM) fields is an issue of particular educational and economic importance, and Calculus I is a linchpin course in STEM major tracks. A national study, funded by the NSF and under the auspices of the MAA, is currently being conducted examining the characteristics of successful programs in college calculus (CSPCC, 2012; Bressoud, Carlson, Mesa, & Rasmussen, 2013). In work related to the CSPCC program, this study examines the effects on student outcomes of four different teaching strategies used at a single institution. The four classes were a traditional lecture, a lecture with discussion, a lecture incorporating both discussion and technology, and an inverted model.

This dissertation was guided by three questions: (1) What impact do these four instructional approaches have on students' persistence, beliefs about mathematics, and conceptual and procedural achievement in calculus? (2) How do students at the local institution compare to students in the national database? And (3) How do the similarities and differences in opportunities for learning presented in the four classes contribute to the similarities and differences in student outcomes?

Quantitative analysis of surveys, exams, and enrollment records revealed few statistically significant differences in outcomes, and students in the inverted classroom often had poorer outcomes than those in other classes. Students in the technology-enhanced class scored higher on conceptual items on the final exam than those in other classes. Comparing to the national database, local students had similar switching rates, once differences in career goals were accounted for. However, local students exhibited less expert-like attitudes and beliefs about mathematics than the national average.

Quantitative analysis of focus group interviews, classroom observations, and student course evaluations showed that several implementation issues, some the result of pragmatic constraints, others the result of design choice, weakened affordances provided by innovative features and shrunk the differences between classes. There were substantial differences between the inverted classroom in this study and successful implementations in the literature. I identified a set of departures that forms the nucleus for a list of best practices for inverting classrooms. Students in all classes felt that prior calculus experience was a prerequisite for their current calculus class, and that class sessions felt rushed. These concerns implicate the constraints imposed by the curriculum shared by the four classes.