Mathematics Support Structures for Calculus and Precalculus: What are the Impacts on Student Outcomes?

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A long-standing body of evidence (e.g., Bressoud, 2014; Whitcomb et al., 2020) suggests that Calculus I often serves as a gatekeeper course – meaning that a relatively high percentage of students are unsuccessful in Calculus I, and that a failure in the course often causes students to leave STEM degree programs. Some research suggests that Precalculus can play a similar role (e.g., Cooper & Woodward, 2011, Wang et al., 2017). Given the need to maintain a strong STEM pipeline and sustain student career aspirations, there is significant need for university interventions to support student success in courses such as Calculus I and Precalculus. Research indicates that peer-to-peer interactions and mentoring, paired with curricular support, can be effective structures to help students be successful in their early mathematics courses. For instance, co-requisite models have demonstrated success at the Developmental Mathematics level (e.g., Childers et al., 2021; Ngo & Melguizo, 2024), though there is less research on the role of co-requisite courses at the level of Precalculus and above.

This research aims to add to the body of knowledge about co-requisite and peer-led supports by evaluating the success of two mathematics support options for undergraduates at a large public university: an intensive summer "Bootcamp" immediately prior to the start of the Fall semester, and "Companion Courses" which run throughout the semester on a weekly basis. Both structures are supervised by faculty members and implemented by Undergraduate Learning Assistants and incorporate just-in-time mathematics practice, conceptually-oriented review, and study skills support. The Bootcamp was aimed at incoming first-year students who demonstrated readiness for Precalculus or Calculus I, while the Companion Courses are offered to all students enrolled in Calculus I. To understand the effects of these structures, we analyzed data related to student course outcomes (passing grades of ABC vs. repeating grades of DFW and course GPA) for students who participated in these two structures, compared to the general student population.

Results suggest that both structures promoted student success, though the impacts were different for the two programs. For instance, 83% of students who participated in the Bootcamp (N=54) earned passing grade in their first mathematics course, and they earned an average grade of 2.93 (on a four point scale). In comparison, for non-attending students in those same classes (N=431), only 65% earned a passing grade, with an average grade of 2.30 (these differences are statistically significant with $p < .05$). The Companion Course showed more limited evidence of impact, with 63% of enrolled students (N = 40) earning a passing grade in their Calculus class, compared with 62% of non-enrolled students (N = 402; not statistically significant). These results should be interpreted with caution, as selection bias is a significant complicating factor. Our poster will share additional data and explore implications for university policymakers.

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