Peer Assisted Teaching and Learning in Calculus I

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Abstract

Calculus I is a well-known bottleneck course with high enrollments and low success rates. At Sacramento State, Calculus I serves a variety of majors, including mathematics, physics, chemistry, geology, computer science, and engineering. In Fall 2014, 93 out of 281 Calculus I students earned repeatable grades. Calculus I students, often freshmen, lack both study skills and the ability to engage in the active learning demands of the university environment. They have difficulty understanding that learning comes from independent and intra-personal study, rather than a hierarchical transfer of knowledge from master to student.

To address these challenges, the Department of Mathematics and Statistics has teamed with the Center for Teaching and Learning to implement two projects: a Peer Assisted Learning (PAL) program and a Calculus Faculty Learning Community (FLC). The PAL program is a type of supplemental instruction where students, not faculty, facilitate learning. This model employs senior students, who can empathize with the inevitable cognitive frustrations that arise during learning, to coach novice students to acquire and practice effective study skills. The Calculus FLC, will enable mathematics faculty to collaboratively design and review scaffolded worksheets for the PAL program and align the scope and sequence of the separate Calculus I sections.

The results of a pilot effort supported by the National Science Foundation is extremely encouraging. In Fall 2013, there was a 16.7 percentage point difference in pass rates between PAL and non PAL participants, 90% of students enrolled in PALs passed Calculus I, while only 74% of non PAL students passed. This represents the highest overall pass rate in Math 30 in over a decade (58% compared to 77%, an increase of 19 percentage points).

We were recently awarded a CSU Chancellors Proven Course Redesign Grant to fully implement the PAL and FLC programs. With this support we will develop a standard course syllabus and calendar to better coordinate the PAL program and establish continuity between the Pre-Calculus, Calculus I, and Calculus II courses.

Methods

Students enroll in a one-unit class which meets for two hours per week. In the meetings, students work in groups on worksheets designed by lead faculty. The worksheets are focused on threshold concepts and are carefully scaffolded to enhance learning. Undergraduate students who have previously mastered the course material (PAL Leaders) facilitate the sessions and assist the calculus students with the problems.

Conclusions

The pilot project was an unqualified success, with the highest Math 30 pass rates in over a decade. Moreover, students who participated in the PAL sections were far more likely to pass than students who did not participate. Further, borderline students with ‘advisory’ Calculus Readiness (CR) diagnostic scores who enrolled in PALs performed at the same level as students with ‘qualified’ CR diagnostic scores. With the Proven Course Redesign Grant, we will improve the pilot worksheets to make them more transparent for the student. Moreover, we will increase faculty collaboration and begin the institutionalization of our successes.

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