

Helping At-Risk Students with Calculus

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Three years ago, as part of program review, Department discussed concerns about student learning in precalculus and in calculus. (In Fall 2017 those hold 1262 students.)

Precalculus, calculus and CHEM 11, are known to be gatekeeper courses that discourage many students from STEM, especially under-represented students.

Precalculus is our most basic course for STEM/Business students. To be admitted to SCU, students are *supposed* to already know this material.

Precalculus Difficulties:

Half of the students in precalculus get a D or F, drop, or withdraw (DFW).

New Calculus Preparation Committee immediately revised curriculum and pedagogy and these statistics started to improve, but not enough.

Of those who get A's and B's in precalculus, one third DFW Calculus I.

Possible reason: Placement exam indicates that about one fifth of SCU students, who will take calculus, do not know 9th grade algebra (not covered in precalculus).

Other departments don't want us to create a 9th grade algebra course since it would put students too far behind.

Calculus Difficulties:

All STEM majors take at least some of STEM Calculus sequence (Math 11 - 14).

New STEM Calculus Committee interviewed all STEM departments. (Are students prepared after calculus? What are your goals for calculus? What topics should be included? Give us calculus problems from your courses.)

And we gave a Calculus Retention Exam to a large sample of Math 13 and 14 students.

Unhappy with results regarding student learning from both sources.

How to solve Precalculus and Calculus Difficulties

Interviewed several math programs at benchmark universities. Everyone struggling with same two problems.

Solution according to all experts: active learning pedagogies. But they are time-consuming. Flipped classrooms not working for precalculus and calculus.

Average number of contact hours elsewhere for STEM calculus over 4 quarters/3 semesters is 156. At SCU it is 130. So we're almost a quarter short.

Other universities use the extra time so both active learning pedagogies and lecture occur in the classroom and/or labs.

From interviews of other SCU STEM departments, we can't trim syllabi. So we don't have time for such pedagogies.

Problem: Not enough time for Active Learning Pedagogies

With help from Dean's and Development Offices, raised funds from the Koret Foundation and anonymous donors (parents of a current student).

Much of the funding going to create extra lab sections for precalculus, STEM Calculus I (Math 11) and Business Calculus I (Math 30).

A lab section is a fourth meeting per week. Only active learning pedagogies are used.

Extra lab sections for precalculus piloted 2016 - 2018

The Calculus Readiness Exam uses ALEKS software for placement. Students must place into Calculus to register for Calculus.

Students who performed poorly on ALEKS invited to labs. All LEAD students in precalculus and Calculus I required to take lab.

Extra lab sections for precalculus piloted 2016 - 2018

ALEKS explains to us exactly where the students are having trouble (both 9th grade algebra and precalculus).

Used this information to design lab materials - mostly group work on longer, conceptual problems covering problematic topics. This has been shown to be most effective.

In Summer 2018 will work with Chemistry faculty on precalculus problems from Chemistry to introduce to labs.

Extra lab sections for precalculus piloted 2016 - 2018

Summers 2016 & 2017: Four Math Ed faculty from outside SCU gave workshops here on active learning pedagogies. Attended by those running labs and other interested faculty.

Workshops will continue each summer.

Assessment of Fall 2016 precalculus labs

First two precalculus labs ran in Fall 2016. 17% DFW rate (significant improvement over old 50%).

Of those students who took precalculus in Fall 2016 and MATH 30 in Winter 2017, those who took the lab in precalculus got significantly higher grades in MATH 30 than those who did not. No difference for students moving from precalculus to MATH 11.

Further Success in Calculus

This quarter we are piloting labs for MATH 11 and 30 and opened the Mathematics Learning Center (MLC).

We hired Linda Burks (M.S. Math, Ph.D. Math Ed) to run the MLC. She coordinates with Drahmman Center.

Tutors mentor study groups associated to particular sections and there is tutoring by appointment as well.

Linda mentors tutors, helps us with assessment of labs and learning center, etc.

So there's hope.