

Goal

To improve student retention in STEM disciplines, and thus increase the number of graduates in STEM fields, by reforming the curricula of the Engineering and Life Sciences Calculus sequences at USF.

Motivation

- At USF, 6-yr graduation rates were < 60% for STEM majors but > 80% for business, nursing and education majors.
- Passing rates (C or better needed to advance to the next course) averaged 55% for Engineering Calculus I, II and III and Life Sciences Calculus I and II.

Thrusts

PROJECT BASED INSTRUCTION

- Introduction of “bridge” projects into Engineering Calculus II and III and Life Sciences Calculus II by giving students the option of replacing the final exam with a project.
- Students work with a faculty member or supervisor in their workplace to define a problem, write and analyze appropriate equations, and write a narrative report – in essence, they write a story problem, and then answer it and write it up as a scientific report.

PEER LEADING

- Undergraduate peer leaders lead weekly, 50 minute cooperative learning inquiry sessions in Engineering and Life Science Calc. I.
- Curricula developed by faculty and graduate students focus on guiding students to discover concepts of calculus prior to lecture. Algebra and trigonometry warm ups are included.

STEM MART

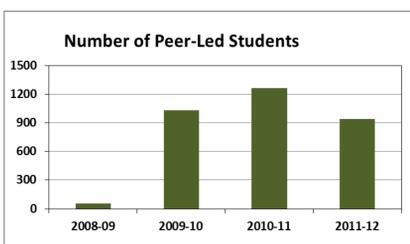
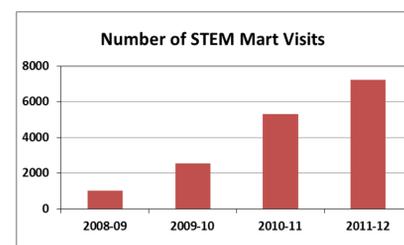
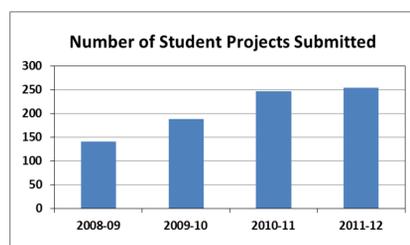
- Undergraduate tutors staff a “one-stop” tutoring lab with evening and weekend hours.
- They provide assistance in calculus and in introductory science courses such as chemistry, physics and biology.

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Implementation Progress

Project implementation began in Fall 2008. Institutional impact and resulting student gains are given below for each thrust.

INSTITUTIONAL IMPACT



A day at STEM Mart

STUDENT GAINS – OVERALL

The overall pass rate in Calculus increased from 55% in 2006 (before project inception) to 70% in 2011.

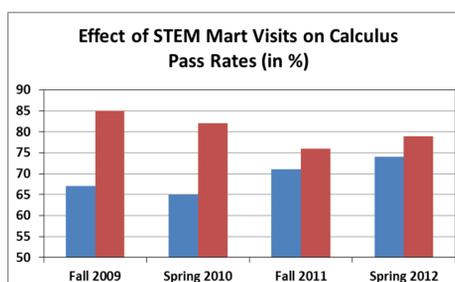
STUDENT GAINS – PROJECT BASED INSTRUCTION

Pass rates are over 25% higher for students who did projects compared to those who did not.



Scenes from a Student Poster Conference in which calculus students presented the results of their applied calculus projects to faculty and administrators of Florida universities and community colleges.

STUDENT GAINS – STEM Mart



Overall pass rate of calculus students (blue) and the pass rate of calculus students who made five or more visits to STEM Mart (red)

STUDENT GAINS - PEER LEADING

Use of peer leading in Engineering Calculus I and Life Sciences Calculus I increases the pass rate by 10% and decreases the withdrawal rate by 12%.

STUDENT GAINS - LATER COURSE

The pass rate of students in EGN 3343 Thermodynamics who took Calculus I before the project inception was 79%. The pass rate for students who took Calculus I *since* project inception is 84%.



A workshop was held at USF to disseminate the program to faculty and administrators of Florida universities and community colleges. A peer leading demonstration is being given to the participants shown in this photo.

Challenges and Opportunities

Challenges relate mostly to sustainability and institutionalization. However, several opportunities have arisen out of these challenges.

PEER LEADING

- The university has committed the resources, through the general education program, to fully support the peer leader program at USF (currently chemistry and mathematics).
- This includes continuous funding of 22 peer leaders and 4 graduate TAs every semester for Mathematics. These students will also provide support in STEM Mart.

STEM MART

- USF is providing space for STEM Mart as well as salary and benefits for the administrative support staff in the Learning Commons.
- The Student Success Task Force at USF recommended that USF assign a high priority to building a separate and highly visible Student Success Center on campus. When such a building becomes a reality, STEM Mart will be a prominent part of that building.
- The grant investigators were asked by the university administration to provide estimates for funding needed to support STEM Mart once the grant ends, not only to maintain it at its current level of service but also to expand it to cover additional mathematics and science courses.

PROJECT BASED INSTRUCTION

- The mathematics application activities have resulted in a new center (Center for Industrial and Interdisciplinary Mathematics, <http://ciim.usf.edu>) at USF being directed by Dr. Arcadii Grinshpan (a Co-PI of the STEP project). This center, serving the local industry and research, is a long term resource for the community.