A STEP to Grow in Science-Engineering-Mathematics Undergraduate Degrees

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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 are < 60% for STEM majors but > 80% for business, nursing and education majors.
- Passing rates (C or better needed to advance to the next course) average 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.

Rationale

Calculus Passing Rates - 2006

Section	No help session or project	Help session OR project	Help session AND project
Morning	49%	59% (help session)	85%
Evening	45%	67% (projects)	N/A

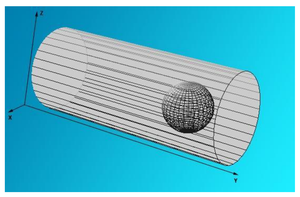
Implementation Progress

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

PROJECT BASED INSTRUCTION

Institutional impact for Engineering Calculus II and III and Life Sciences Calculus II:

Year	# Sections	# Students Registered	# Submitted Projects
2008 - 09	9	474	141
2009 - 10	12	625	188
2010 - 11	19	992	247



From a student project on medical imaging

Student gains caused by project based instruction :

	Passing Rate
Section level:	
Sections with Project Based Instruction	68 %
Sections without Project Based Instruction	58 %

Individual level:

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

PEER LEADING

Institutional impact for Engineering Calculus I and Life Sciences Calculus I:

Year	# Sections	# Students Registered	# Different Instructors per semester (F/S)
2008-2009	1	54	0/1
2009-2010	28	1031	6/7
2010-2011	38	1263	5/5

Student gains caused by peer leading :

	Passing Rate
Eng Calc I Sections with Peer Leading	61 %
Eng Calc I Sections without Peer Leading	48 %
Life Sci Calc I Sections with Peer Leading	62 %
Life Sci Calc I Sections without Peer Leading	52 %

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STEM MART

Institutional impact for STEM Mart:

Year	# Student Visits
2008 - 09	1,020
2009 - 10	2,555
2010 - 11	5,308

A day at STEM Mart

Student gains caused by STEM Mart :

Pass Rate	Fall 2009	Spring 2010
Overall	67 %	65 %
Five visits or less	65 %	60 %
More than five visits	85 %	82 %

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 the additional funding needed to support STEM Mart once the grant ends. They were asked not only for estimates to maintain it at its current level of service but also for estimates to expand it to additional mathematics and science courses.

PROJECT BASED INSTRUCTION

- The mathematics application activities have resulted in a new center (Center for Industrial and Interdisciplinary Mathematics) 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.