Overview of M150A Redesign Moodle Website

Proven Course Redesign: Closing the Gap in Persistence and Graduation for STEM Bottleneck Course Calculus I M150A

by Carol Shubin, Professor of Mathematics and Werner Horn, Chair of Mathematics, CSUN

Calculus I M150A was a high demand, low success course and a pedagogical bottleneck to entry into virtually all STEM majors.

The redesigned M150A course shows marked increases in student success.

Key Takeaways from the CSUN Project

1. Responded to the bottleneck crisis by redesigning Calculus I. Over a two year period, pass rates increased from 58% to 67%.
2. Improved the students’ average scores and the distribution of the grades.
3. Reformed departmental placement test procedures that were barriers to student success.
4. Developed a system that identifies at-risk students based on their pre-requisite performance.
5. Required at-risk students to take a one-unit supplemental hybrid lab.
6. Developed a parallel approach for the courses proceeding and succeeding Calculus I, Trigonometry M104 and Calculus II M150B.
7. Augmented traditional physical tutoring lab with an online tutoring lab to providing additional support students in the evening.
8. All interventions are easily transferable to other CSU campuses. This project is scalable.

Overview

M150A Calculus I is a pre-requisite for a range of higher-level courses in math and other subjects. Because of this, M150A Calculus I is a gateway course for science, technology, engineering, and mathematics (STEM) fields. M150A directly affects approximately 25% of the total STEM student population of 5000. Secondarily, mathematics service courses impact at least 43 non-mathematical STEM courses required by 25 degrees in Engineering, Computer Science, Mathematics, Physics, Chemistry and Biology.

Historically, M150A has had a 50-60% pass rate. Success in this course is highly correlated to retention and timely graduation. Of the CSUN students admitted as first-time freshmen between 1996 and 2002 who entered STEM majors less than 30% completed a degree in 6 years. Of this, only 4% completed their degrees in 4 years. In examining the data closely to determine what factors led to success, we found that over 80% of entering freshmen who began as a STEM major and took Calculus I in their first semester received a degree. Failure to pass Calculus I negatively impacts retention rates and delays degree completion. Thus, the most promising approach to increasing retention of freshmen entering STEM majors is to ensure their timely matriculation in Calculus and required Mathematics courses.

CSUN has developed a technology-enhanced hybrid course model that has significantly improved student success and proven cost efficient and scalable. The model, first fully implemented in 2011, incorporates interventions and practices, such as improved course coordination, supplemental hybrid instruction, and online tutoring. We believe that even further improvements can be made which will reduce the achievement gap. Math can be taught more inclusively. We know that we can adopt our teaching practices to improve all students’ performance, particularly underrepresented minority (URM)
and disadvantaged economic groups.

**Repository of Calculus Materials for Faculty**

The Calculus Repository houses a wealth of information for course instructors. It includes sample syllabi, Student Learning Outcomes, sample WeBWorK problems, instructions for using WeBWorK, instructions for using the online tutoring center, instructions for using Moodle, information about the Math Placement Test, sample lecture notes, links to free calculus resources textbooks and such as Merlot, links of calculus archives, numerical stimulations, videos, pre-calculus review sites, and articles on how to improve math exposition. There are sample midterms and finals and solutions. Faculty members have a place to blog or post forums.

- [News forum](#)

**Calculus Redesign Reports**

Students and the State can save time and money by reducing the number of course repeats. This means that University resources can be used more effectively, and students can obtain a degree in a timely and efficient manner. High quality content and teaching methods are maintained. The Calculus Redesign maintained standard Calculus content and resulted in student outcome gains:

- Course Objectives
- Sample Syllabus
- Course Redesign Report
- [Overview Calculus M150 Redesign Folder](#)
- [Calculus Redesign Forum](#)

**Assessment Reports from Sp 2007 and Sp 2013**

Results for two problems on the common final exams from Sp 2007 and Sp 2013 have been examined. These two problems, in part, assess Student Learning Outcomes. Represent, understand and explain mathematical information symbolically, graphically, numerically and verbally.

- [Assessment Reports Folder](#)
- [Assessments - What should we measure? Are we measuring the right things? Forum](#)

**Webwork Homework Problems**

![WeBWorK](image)

**What is WeBWorK?**

WeBWorK is an open-source online homework system for math and sciences courses. WeBWorK is supported by the MAA and the NSF and comes with a National Problem Library (NPL) of over 20,000 homework problems. Problems in the NPL target most lower division undergraduate math courses and some advanced courses. Supported courses include college algebra, discrete mathematics, probability and statistics, single and multivariable calculus, differential equations, linear algebra and complex analysis.
Online Tutoring Center

In response to high failure rates in mathematics, the Math Department initiated an Online Math Tutoring Center in Fall 2010. The purpose of the center is to provide students with homework practice assignments and activities, self-assessment tools, discussion forums and online access to Math Tutors and Faculty. The Online Tutoring Center services are closely aligned with the M150A curriculum. These efforts included specialized training for Math Tutors and careful supervision by Faculty.

The Online Tutoring Center provides a virtual space where students can get advice and strategies for problem solving, receive step-by-step assistance with problems, and collaborate with other students on solving homework problems.

To accommodate students' non-traditional schedules, the Online Tutoring Center is open in the evening and on weekends. In addition, the Tutoring Center seeks to accommodate all learning styles to make mathematics accessible to our diverse student body.

- Online Tutoring Center Presentation (ppt) File
- How the Online Tutoring System Works Page
- Online Tutoring Center Folder
- Online Tutoring Forum

Webwork Remediation in Labs

During the first week of class, students retake the MPT. This checks if their skill set is up to par when it is needed.

If there are weaknesses, students must remediate on those topics. The topics include:

1. Functions
2. Linear Functions and Inequalities
3. Polynomials
4. Rational Functions
5. Geometry
6. Trigonometry
7. Exponentials
8. Logarithms

- Supplemental Hybrid Laboratory for At-risk Students Page
- Webwork Remediation Folder
- Hybrid Labs Forum
Reducing the Achievement Gap

Course redesign has paid off. CSUN multi-section M150A course is better coordinated and more effective. The course is more consistent and of higher quality.

Well-coordinated courses are easier for instructors to teach. All instructors have access to the course repository and can view “best practices” and access a wealth of common resources. Novice instructors may find this repository particularly useful.

The additional one-unit for the supplemental hybrid lab is money well-spent by the student and the State. There is no replacement for well directed time on task.

Teaching assistants and tutors are well-trained and monitored through-out the term. Each supplemental hybrid lab is directly tied to one instructor’s course. Instructors and teaching assistants are in contact on a weekly basis.

It takes time and effort to write mathematics correctly. Here are some useful articles.

- [Calculus I - How to Write Mathematics Better and Common Errors Folder](#)
- [CSUN’s Plan for Closing the Achievement Gap Page](#)
- [Closing the Achievement Gap Forum](#)

Hybrid Lab Handouts for In-lab Work

1. Review of Functions
2. Limits
3. Continuity
4. Differentiation
5. Related Rates
6. Graphing
7. Optimization
8. Differentials
9. Integration
10. Integration Techniques
11. Volumes

- [Practice for the MPT -- part of hybrid lab URL](#)
- [Lab Handouts Folder](#)
- [Calculus Videos - Captioned Page](#)

Sample Exam and Final Problems

- [Calculus I Exam and Final Problems Folder](#)
Universal Design and Accessibility

Mathematical Content for the Web

This website provides an overview on How to Create, View and Listen to Math Content on the Web. Mathematics is a core branch of education and is required in most other educational fields. In general, mathematical education involves the use of symbols, operators, etc. that are very unique to Mathematical Studies. With the advent of the World Wide Web, more and more Math teachers want to use the Internet as a means of pedagogy between them and their students. However, using these symbols, operators, etc. used, is generally quite complex and, therefore, most of the time cannot be rendered on the World Wide Web using Standard HTML format. The W3C recommends the use of MathML to display math content on the web. MathML not only makes it easier to display math content on the web, but also makes it accessible to students with a multitude of learning styles.

- Universal Design: Creating Math Content on the Web URL
- Writing Math on the Web Forum

Analytics and Analysis

Our project addresses student success outcomes. We track accountability metrics, and engage in formative and summative assessments and evaluations as outlined by Chancellor White in the “Reducing Bottlenecks and Improving Student Success” RFP. We will track data on B4 and B5. Increasing the Number of Degrees Awarded, C1. Improving CSU Graduation Rates, D1 and D4 Reducing Time to Degree.
Many CSU campuses offer math placement exams to determine eligibility to enroll in specific math courses.

The MTP tests are designed to measure student readiness for a broad range of mathematics courses. More importantly, the tests were developed to provide students and the Math Department with diagnostic information about student preparedness. This information can help students identify specific areas where additional study or review is needed. It can help teachers identify topics and skills that need more attention in courses.

- Improving the test procedure is an obvious (and excellent) way to cost to the student and the State by decreasing the time to graduation

  Test procedures have been improved. The number of placement tests was reduced from two to one and the test is now given online. Improved information is provided to Students and Advisors. Payment is online with test registration. The length of time to complete the test was lengthened. Students are now directed to a test preparation site.

  - The percentage of test takers who placed into calculus increased from 32.4% to 40.4%
  - The percentage of test takers who placed into pre-calculus or trigonometry increased from 10.6% to 12%.

CSU Fullerton Calculus Redesign

We hope to learn more!

http://math.fullerton.edu/mathews/n2003/NumericalUndergradRes.html
San Francisco State Calculus Redesign: Transforming Course Design -- Calculus in the new Millennium

The class has an online video lecture / quiz component due before class meetings.
Academic Technology at SFSU made this video in which we invite interested mathematics teaching faculty to contact us. The clip is streamed from youtube

Contact:
Pedagogy of supervising work in groups:
Eric Hsu (erichsu @ math.sfsu.edu)
Technology -- video - online social aspects of learning
Arek Goetz (goetz @ sfsu.edu)
Technology -- automatic homework grading
David Meredith (meredith @ sfsu.edu)

• San Francisco State Calculus Redesign Page

Resources for Calculus Instruction

MERLOT Math and Statistics Portal

Funding and Acknowledgments
Many CSUN faculty members have collaborated on this project. A major push came when Dr. Vicki Pedone, Dr. Cristina Cadavid, and Dr. Werner Horn were awarded a National Science Foundation (NSF DUE 0969627, $1.268,004) grant called Students targeting physical sciences (STEPS). This grant helped to pay for the development of some of the materials. Dr. Carol Shubin, Dr. Alexander Alexander, Dr. Jacek Polewczak, and Universal Design Center Director Sue Cullen were funded by both CSUN Provost's Office and Chancellor's Office for improvements made to MPT Practice Website, ELM CSU Student Success Website, and Online Tutoring System. We gratefully acknowledge Dr. David Protas’ contributions to the course design and management. He contributed the assessment report. We thank many authors for the CSUN Calculus homework Webwork database. Dean Stinner and Math Department Chair Werner Horn contributed additional funds to the Online Tutoring scale-up.
This work was made possible by Provost Harry Hellenbrand’s enthusiastic support and guidance.