Characteristics of Successful Programs In College Calculus
A report on our findings

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PowerPoint available at
www.macalester.edu/~bressoud/talks
August 2011, Intel CEO Paul Otellini:

“Looking forward, this nation is at risk of a significant shortfall of qualified experts in science and math to meet the country’s needs.”
Bachelors Degrees, math-intensive majors

NCES data
Math-intensive Bachelor's degrees relative to number of 22 year-olds (degrees ÷ # of 22-year olds)
There were 1,089 Bachelors in Math or Stat earned by African-Americans in 1997. By 2009, that number was down to 876.
210,000 students per year enter four-year undergraduate programs intending to major in engineering, a physical science, mathematics, or statistics.

An additional 300,000 are enrolled in one of these programs in a two-year college.

We graduate 107,000 with a Bachelor’s degree in one of these disciplines.
Phase I: Survey

Aug. 2009 – July 2010, preparation of instruments, recruitment of institutions


  1. Institutional questionnaire, chair
  2. Calculus coordinator questionnaire
  3. Instructor pre-term survey
  4. Student 2nd to 3rd week survey
  5. Student 2nd to 3rd last week survey
  6. Instructor post-term survey
  7. Collection of final exams and grades

Feb. 2011 – forever, analysis of data
Phase II: Case Studies

Feb. 2011 – Aug. 2012, recruitment of teams, preparation of protocols, recruitment of institutions

Sept. – Nov. 2012, case study visits
Each of the four teams will make a 2–3 day visit to at least two and not more than four institutions

Dec. 2012 – forever, analysis of data, publication of results

July 2014, end of grant
People:

Marilyn Carlson, ASU, co-PI, coordinator for survey

Chris Rasmussen, SDSU, co-PI, coordinator for case studies

Phil Sadler & Gerhard Sonnert, Harvard, Statistical Analysis

Peter Ewell, NCHEMS, consultant and external evaluator

Michael Pearson, MAA, co-PI, program administrator

Olga Dixon, MAA, program coordinator
Case Study Team Leaders:

Chris Rasmussen, SDSU, co-PI, coordinator for case studies, doctoral universities

Eric Hsu, SFSU, master’s universities

Sean Larsen, PSU, bachelor’s colleges

Vilma Mesa, U Michigan, two-year colleges
168 colleges and universities

660 instructors representing almost 900 Calculus I classes and 34,000 students

12,000 students answered the initial survey
55% men

97% full-time students

75% freshmen

76% White, 14% Asian, 5% Black, 10% Hispanic
Total college population: 73% White, 9% Asian, 12% Black, 12% Hispanic

75% intend to major in Science or Engineering (Bio 30%, Eng 30%, Phys Sci 6%, CS 5%)
61% of all Calculus I students took a calculus class in high school. 61% of them earned an A (37% of all Calc I students).

For 69% of those took Calc in HS, it was an AP Calculus course (42% of all Calc I students).

81% of the AP Calculus students took the AP exam (34% of all Calc I students).

60% of those who took the exam earned a 3 or higher (just over 20% of all Calc I students).
11.4% of all Calc I students had earned a 4 or higher on the AB exam or a 3 or higher on the BC exam

0.9% earned a 5 on the BC Calculus exam

1.7% took AB Calculus one year, BC Calculus the following year, and then took Calculus I when they got to college. Extrapolates to over 5,000 such students in Fall Calculus I each year.
These are good students:

- Average SAT Math: 652, standard deviation = 76,
  Interquartile range [610,700]
- 95% believe they have knowledge and abilities to succeed in calculus
- 89% find using reasoning to solve math problems a satisfying experience
- 83% enjoy mathematics
- 65% would be taking this course even if it were not required
They are not looking for rote rules:

- 74% prefer to make sense of the mathematics rather than simply memorizing it

- 72% see the role of the instructor as helping students to reason through problems on their own rather than showing students how to work the problems

- 58% expect to earn an A in this course
Grade for college Calculus I:

- 22% A
- 28% B
- 23% C
- 27% D, F, or Withdrew
Calculators allowed for at least some exam questions

- Graphing calculator: 90% in high school, 50% in college
- Calculator with CAS: 60% in high school, 20% in college
My primary role as a Calculus instructor is to

1. show students how to work problems
2. help students learn how to reason through problems
Calculus students learn best from lectures, provided they are clear and well-organized.
During class ...

- **Blue** bars: I was lost and unable to follow the lecture or discussion.
- **Red** bars: I simply copied whatever was written on the board.

**Categories:**
- never
- sometimes about half the time
- most of the time
- every class

**Percentage Scale:**
- 0%
- 5%
- 10%
- 15%
- 20%
- 25%
- 30%
- 35%
- 40%
- 45%