Successful Calculus Programs: Two-Year Colleges to Research Universities

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A pdf file of this PowerPoint is available at
www.macalester.edu/~bressoud/talks
Outline of Session

• Overview of the Characteristics of Successful Programs in College Calculus project (CSPCC)

• Findings from case studies at selected two-year colleges, undergraduate colleges, regional universities, and research universities

• Discussion and questions
The Need for More STEM Majors

PCAST (2012) found that economic forecasts point to a need for producing, over the next decade, approximately 1 million more college graduates in STEM fields than expected under current assumptions.

Problem is two fold:
• Increase number of students interested in a STEM major
• Retaining college students who start out in a STEM major
Students Leaving STEM

As reported in the *American Freshman* studies of the Higher Education Research Institute, UCLA (HERI, 1992), there is a consistently high field switching rate (40% to 60%) for STEM majors.

In Seymour’s (2006) testimony to Congress, she noted that, contrary to what is commonly assumed, students do not leave STEM majors primarily for financial or academic reasons.

- Poor instruction in their mathematics and science courses, especially calculus, is often cited as a primary reason for students’ discontinued STEM course taking.
Characteristics of Successful Programs in College Calculus

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Project Goals

1. To improve our understanding of the demographics of students who enroll in **mainstream** calculus,

2. To measure the impact of the various characteristics of calculus classes that are believed to influence student success,

3. To conduct explanatory case studies of exemplary programs in order to identify why and how these programs succeed,

4. To develop a model that articulates the factors under which students are likely to succeed in calculus, and

5. To use the results of these to leverage improvements in calculus instruction across the United States.
Three parts:

1. National survey of students in College Calculus I and their instructors
2. Statistical model of factors influencing changes in student attitudes and intention to persist from start to end of Calculus I
3. Case studies of 17 institutions with “successful” Calculus I programs
<table>
<thead>
<tr>
<th>Institution Type*</th>
<th>Total Number of Type</th>
<th>Sample Size **</th>
<th>Response Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two-year Colleges</td>
<td>1121</td>
<td>207 (18%)</td>
<td>54 (26%)</td>
</tr>
<tr>
<td>Undergraduate Colleges</td>
<td>1015</td>
<td>134 (13%)</td>
<td>60 (45%)</td>
</tr>
<tr>
<td>Master’s Universities</td>
<td>181</td>
<td>60 (33%)</td>
<td>26 (43%)</td>
</tr>
<tr>
<td>Research Universities</td>
<td>197</td>
<td>120 (61%)</td>
<td>73 (61%)</td>
</tr>
</tbody>
</table>

* CBMS Classifications
** Used the CBMS sampling frame
Fall 2010
Phase I: Survey

Responses from

213 colleges and universities

502 instructors representing
  663 Calculus I classes and
  26,257 students

14,184 students
Dependent Variables for Statistical Model

- **Attitudes – Change, pre to post**
  - **Confidence**
    - I am confident in my mathematics abilities
  - **Enjoyment**
    - I enjoy doing mathematics
  - **If I had a choice**
    - If I had a choice: I would never take another mathematics course to I would continue to take mathematics”

- **Change in Interest, post only**
  - This course has increased my interest in taking more mathematics

- **Intention to take Calc II – Change, pre to post**
  - Do you intend to take Calculus II?
3-Level HLM Model Structure
Main Effects

Institutional
- Selectivity

Course
- # of students
- Pedagogy
- Professor Characteristics

Student
- Initial Career Goal
- HS Pedagogy
- HS Math grades
HLM Where the issues lie?

- Variance explained
  - Students are very different
  - Instructors are somewhat similar
  - Institutions are very similar
“Good Teaching”

My Calculus Instructor:
• listened carefully to my questions and comments
• allowed time for me to understand difficult ideas
• presented more than one method for solving problems
• asked questions to determine if I understood what was being discussed
• discussed applications of calculus
• encouraged students to seek help during office hours
• frequently prepared extra material

Assignments were challenging but doable
My exams were graded fairly
My calculus exams were a good assessment of what I learned
Team Leaders for Case Study Visits:

Vilma Mesa — two-year colleges

Sean Larsen — undergraduate colleges

Eric Hsu — masters universities

Chris Rasmussen — research universities
Case Study Site Visits – Fall 2012

- 2-3 days in duration
- Interviewed faculty, GTAs, relevant administrators, engineering and science faculty, student focus groups, and ..... 
- Observed classrooms 
- Retained copies of relevant documents

Data Corpus

- 16 site visits plus 4 pilot studies 
- Nearly 400 interviews 
- Over 100 class observations 
- Over 40 student focus groups