

Characteristics of Successful Programs in College Calculus: Findings from the Two-Year College Case Studies

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MAA Mathfest
August 7, 2014
Portland, Oregon



The Big Picture

In 2010 in the United States, 21% of students taking Calculus I were doing so at a two-year college.¹

¹Blair, R. M., Kirkman, E. E., Maxwell, J. W., & American Mathematical Society. (2013). *Statistical abstract of undergraduate programs in the mathematical sciences in the United States: fall 2010 CBMS survey*.

Our Case Studies

College	Size	Demographics	FT:PT	#Calc. I Sections/term	Class Size
South City College	<5000	Minority: 51% 18-24 y.o.: 22% Part time: 72%	7:10	2	30-35
Midwest Urban College	<10000	Minority: 62% 18-24 y.o.: 22% Part time: 67%	9:20	3 to 4	30
West Rural College	<3000	Minority: 61% 18-24 y.o.: 43% Part time: 58%	7:0	1	30 (52)
Southeast Suburban College	>10000	Minority: 26% 18-24 y.o.: 47% Part time: 58%	35:30	10	30

College	Interviews Instructors (Other)	Classroom Observations	Student Focus Groups
South City College	3 (6)	2	4, 43 students
Midwest Urban College	5 (8)	2	1, 26 students
West Rural College	1 (5)	1	1, 42 students
Southeast Suburban College	8 (9)	5	3, 39 students
Total	17 (28)	10	9, 150 students

Documents: exams, syllabi, homework, quizzes, worksheets, college publications and reports, college/department websites

Three Analyses

- I. Facts & Features from “key” interviews
 - Themes of successful institutions
- II. Qualitative analysis of instructor interviews and student focus groups
 - Characterization of instruction and resources shaping instruction
- III. Task analysis → Characterization of task quality and instructors’ orientation towards creation/selection of tasks

I. Facts & Features → Themes

What makes Calculus I at these sites “successful”?

Instruction:

- ① High Quality Instructors
- ② Faculty autonomy and trust in the teaching of Calculus

Student Support

- ③ Attention to Placement
- ④ Supporting students academically and socially (e.g. study groups, clubs, tutoring centers)
- ⑤ Transfer Policies

Improvement Efforts

- ⑥ Instructional support/collegiality
- ⑦ Assessment and data collection

II. Describing Instruction

In the four selected institutions:

Q1 *What are the instructional goals for students in Calculus I?*

Q2 *What is the nature of classroom instruction in Calculus I?*

Q3 *What resources support Calculus I instruction?*

Q3 → Resources are “jointly necessary” and reinforce each other.

E.g.,

- Classroom technology (conventional resource) supported classroom instruction when combined with instructors’ personal skill in using software to create illustrations to reinforce course content.
- Small class size (conventional resource), supported learning when combined with faculty’s ability to foster interaction, personal relationships, and a culture of trust.

III. Analysis of Homework and Exam Tasks

Coded \approx 5000 homework, worksheet, and exam tasks from five instructors at Southeast Suburban Two-Year College.

Codes included:

Cognitive Demand

- Remember
- Recall and Apply Procedure
- Recognize and Apply Procedure
- Understand
- Apply Understanding
- Analyze, Evaluate, Create

Representations

- Symbolic
- Graphical
- Verbal
- Numeric
- Multiple

III. Analysis of Homework and Exam Tasks

Some findings:

- Cognitive orientation of problems at this “successful” institution are markedly more complex than national sample.
- Exams tend to include more complex problems than other coursework, but there is still substantial emphasis on Simple Procedures.
- Bookwork and Webwork display similar trends in cognitive demand
- Instructors’ orientations towards task design/selection visible across types of coursework, even when using the same textbook.

Synthesis: Some Implications & Recommendations

- A- Social integration must be a classroom goal in two-year colleges.
 - Encourage students to take the preparatory courses in the college (e.g. Precalculus) → creates common experiences, fosters use of rigorous language, sets-up expectations → creates a community ready for Calculus.
 - Encourage or require study groups; facilitate their possibility through online media such as Google hangouts, Skype, or online forums.

- B- Implications for hiring: high quality instructors are centrally important.
 - A good textbook is not a “fix-all.” Instructors bring their personal resources to selecting textbook tasks. We found that instructors’ orientations towards task selection come through strongly, even when using common textbook.
 - “High quality” includes instructors’ resources beyond just content knowledge. Social resources such as abilities to form relationships and create trust are just as important, especially in this setting.

THANK YOU!

Slides and references to be posted on CSPCC website:



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