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

<table>
<thead>
<tr>
<th>College</th>
<th>Size</th>
<th>Demographics</th>
<th>FT:PT</th>
<th>#Calc. I Sections/term</th>
<th>Class Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>South City College</td>
<td>&lt;5000</td>
<td>Minority: 51%</td>
<td>7:10</td>
<td>2</td>
<td>30-35</td>
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<td></td>
<td></td>
<td>18-24 y.o.: 22%</td>
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<td></td>
<td></td>
<td>Part time: 72%</td>
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<tr>
<td>Midwest Urban College</td>
<td>&lt;10000</td>
<td>Minority: 62%</td>
<td>9:20</td>
<td>3 to 4</td>
<td>30</td>
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<td></td>
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<td>18-24 y.o.: 22%</td>
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<td></td>
<td></td>
<td>Part time: 67%</td>
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<tr>
<td>West Rural College</td>
<td>&lt;3000</td>
<td>Minority: 61%</td>
<td>7:0</td>
<td>1</td>
<td>30 (52)</td>
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<td></td>
<td></td>
<td>18-24 y.o.: 43%</td>
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<td>Part time: 58%</td>
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<tr>
<td>Southeast Suburban</td>
<td>&gt;10000</td>
<td>Minority: 26%</td>
<td>35:30</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>College</td>
<td></td>
<td>18-24 y.o.: 47%</td>
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<td></td>
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<td>Part time: 58%</td>
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<tr>
<td>College</td>
<td>Interviews Instructors (Other)</td>
<td>Classroom Observations</td>
<td>Student Focus Groups</td>
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</tr>
<tr>
<td>South City College</td>
<td>3 (6)</td>
<td>2</td>
<td>4, 43 students</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Midwest Urban College</td>
<td>5 (8)</td>
<td>2</td>
<td>1, 26 students</td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Rural College</td>
<td>1 (5)</td>
<td>1</td>
<td>1, 42 students</td>
<td></td>
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<tr>
<td>Southeast Suburban College</td>
<td>8 (9)</td>
<td>5</td>
<td>3, 39 students</td>
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<td><strong>Total</strong></td>
<td><strong>17 (28)</strong></td>
<td><strong>10</strong></td>
<td><strong>9, 150 students</strong></td>
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</table>

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 reenforce 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 ≈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
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.
-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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Selected theoretical and analytical references:


References: II. Characterizing Instruction


Selected theoretical and analytical references:


III. Task Analysis


Selected theoretical and analytical references:

