Scaling a Conceptual Approach to Arithmetic and Prealgebra

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N.A.D.E.
We conduct quantitative and qualitative research on:

- Teaching and learning in higher education
- Access to and success in postsecondary education
- High school to college transition
- Missions, governance, and accountability
- Workforce education
Our Challenge

• Over 60 percent of entering community college students are referred to developmental education

• Outcomes for students are discouraging
  – Vast majority of students do not complete the sequences to which they are referred
  – Completion rates of those who skip the sequence are similar to compliers
  – Traditional assessment and placement mechanisms have flaws
Innovation in Developmental Education

• CCRC national scan of reforms in developmental education suggests that experimentation and innovation are widespread

• However, most reforms affect relatively few students and remain small in scale and largely unknown outside their institutions

• Institutional norms in higher education make it difficult to sustain meaningful change
INSTRUCTIONAL REFORM APPROACHES

**Structure**
- Structural reforms focus on reorganization of instructional time and delivery (e.g., compressed courses, mainstreaming, and modularization).

**Curriculum**
- Curricular reforms focus on rationalizing and refining content (e.g., alternative pathways, contextualization, and course elimination).

**Pedagogy**
- Pedagogical reforms focus on changes to teaching (e.g., student-centered activities, conceptual learning, and metacognition).

Approaches are NOT mutually exclusive.
A project of the Community College Research Center funded by the William and Flora Hewlett Foundation

CCRC and partner colleges work to adapt and scale promising developmental education reforms at new institutions

Faculty-driven effort, with intentional focus on professional learning and classroom practice

For more information visit www.scalinginnovation.org
In Fall 2011, Concepts of Numbers became part of Scaling Innovation. Montgomery County Community College has established partnerships with Reading Area Community College and Berkshire Community College.
A Case Study for Scaling Meaningful and Sustainable Reform
MONTGOMERY COUNTY
COMMUNITY COLLEGE

- Suburban and rural campuses with 13,645 students
- 31% place into developmental math
- Prior to 2008, success rates in our arithmetic & prealgebra course were 35% - 45%
- This course had been taught in a traditional face-to-face format and proceeded through topics
- Concepts began as a single pilot in fall 2008
- Fall 2012, Concepts went full-scale at the MCCC
CONCEPTS OF NUMBERS

All learning outcomes of a traditional arithmetic course are covered but in a different order.

Students are assessed on the same skills as the traditional arithmetic course.

Lessons proceed through concepts using a discovery approach.
CONCEPTS' GUIDING PRINCIPLES

• Faculty become facilitators of knowledge; students learn through discovery
• New embedded skills are introduced on an as-needed basis
• If a student understands a skill and its usefulness, practice problems can be kept to a minimum
• Calculators are not used in this course
• All students can learn math

“Teach me, and I will forget. Show me, and I will remember. Involve me, and I will understand.”
Chinese Proverb
CONCEPTS OF NUMBERS OUTLINE

- Unit 1: History of Numbers
- Unit 2: The Real Number System
- Unit 3: Comparisons
- Unit 4: Addition
- Unit 5: Subtraction
- Unit 6: Multiplication
- Unit 7: Division
- Unit 8: Combinations

For more information, watch “Concepts of Numbers – Faculty Online Orientation” at: http://stream.mc3.edu/faculty/blontz/
UNIT 1: HISTORY OF NUMBERS

- By understanding the evolution of numbers, students will better understand/appreciate our present system.

- The following civilizations are covered:
  
  Babylonian
  Greek
  Egyptian
  Roman
  African
  Mayan

- The concepts of place value and place holders are explored.
UNIT 4: ADDITION

- Addition (combining) of the following quantities:

  - whole numbers
  - decimals
  - fractions
  - integers
  - algebraic expressions

- Application of the addition concept (perimeter, money problems)

- Identity element, commutative & associative properties, and binary operation concepts are introduced
**OUTCOME DATA**

**Success Rates**: Success is a grade of C or better. Withdrawals count as non-success.

<table>
<thead>
<tr>
<th>MAT010 Concepts of Numbers versus MAT010 Traditional Course</th>
<th>Fall 2008</th>
<th>Spring 2009</th>
<th>Fall 2009</th>
<th>Spring 2010</th>
<th>Fall 2010</th>
<th>Spring 2011</th>
<th>Fall 2011</th>
<th>Spring 2012</th>
<th>Fall 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Concepts of Numbers</strong></td>
<td>74%</td>
<td>63%</td>
<td>68%</td>
<td>60%*</td>
<td>58%**</td>
<td>57.4%</td>
<td>57.72%</td>
<td>61%</td>
<td>60%</td>
</tr>
<tr>
<td>N = 19</td>
<td>N = 19</td>
<td>N = 19</td>
<td>N = 255</td>
<td>N = 380</td>
<td>N = 289</td>
<td>N = 704</td>
<td>N = 316</td>
<td>N = 545</td>
<td></td>
</tr>
<tr>
<td><strong>Traditional Arithmetic</strong></td>
<td>45%</td>
<td>34%</td>
<td>41%</td>
<td>40%</td>
<td>40%</td>
<td>37.8%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = 664</td>
<td>N = 429</td>
<td>N = 567</td>
<td>N = 236</td>
<td>N = 284</td>
<td>N = 150</td>
<td></td>
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</tr>
</tbody>
</table>

* the top 13% of Arithmetic Accuplacer scorers were accelerated into the next course (a 4 credit beginning algebra class)

** an additional top 12% of Arithmetic Accuplacer scorers were accelerated into the next course (a 4 credit beginning algebra class)
DEEPER LEARNING

- Implementation Team
- Universal Portal

- course improvements
- journaling (reflections)
- video critiques
- response to literature
- class observations
- best practices discussions
SCALING A PROMISING REFORM

• Institution buy-in
  – financial
  – time for development

• Department approval
  – bringing to a larger scale
  – faculty willingness to try something new
  – training

• Monitoring/Assessing

• Replicating Process
READING AREA COMMUNITY COLLEGE

- Urban; high-poverty area
- 14 school districts in county; graduation rates from 67% to 92%
- 17-19% of students placement test into Math Skills range (upper elementary math); <5% students college ready in math
- High percentage with deficits in reading, writing, & math
- Curricular sequence: Math Skills; Prealgebra; Algebra
LAUNCHING CONCEPTS @ RACC

- Administrative Issues: non-credit course/faculty payment; curriculum appropriateness
- Faculty: 2 FT, 2 adjunct
- Curriculum & Alignment: using existing skill course (only offered online otherwise)
- Communication: via email & monthly meetings; plan professional development both Fall & Spring
- Results: 77% successful completion rate; n=45 students
• How we changed — total opposite of online “do-it-yourself” review
• What we discovered — skill deficits worse than expected; is it time to change what we do?
• Student ‘case management’ model helpful
• Student feedback — “I didn’t know what I didn’t know!” and “I can do it”
• Professional sharing — and spreading ‘discovery’😊
• Renewed passion for teaching
• Professional development is key
MOVING FORWARD

• Keep the flame alive!
• Simultaneous changes in college-level liberal arts math class—thinking quantitatively, using more models
• Changing the course that follows the skills course.
Rural
80% of students test into developmental mathematics
Students placing into prealgebra may need up to 9 credits of developmental mathematics before college level
LAUNCHING CONCEPTS @ BCC

- Fall 2012: selected to participate in Hewlett Scaling Project grant
- Administrative support
- Department concern for maintaining standards
- “... one semester, one course, one instructor”... experiment
- Curriculum – existing traditional prealgebra course
CONCEPTS @ BCC

• Three sections of Concepts

• Goals:
  — Improvement in success rates for prealgebra students
  — Professional development: interacting with colleagues in developmental mathematics at other institutions

• Success rate = 72% for n = 43 students (W’s not included)
REFLECTIONS FROM BCC

Faculty Reflections:
• Excitement in adopting a new pedagogy
• The approach empowered my students to share and learn mathematics.
• Part of a committed group of faculty within the grant
• Success rates for students exceeded expectations!
• Accuplacer retest data
MOVING FORWARD

• 2 additional faculty
• 4 sections, one with supplemental instruction model
• Professional development group: Concepts faculty, support staff
• Beginning my second semester with this approach, I look forward to working with my students.
MORE REPLICATING COLLEGES

- Palomar College
- West Chester University
- Luzerne County Community College
- Imperial Valley College
- Triton College