You Snooze; You Lose: Using a SCALE-UP Approach to Increase Student Participation and Performance in a First-Year Mathematics Course

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Using a SCALE-UP Approach to Increase Student Participation and Performance in a First-year Mathematics Course

Mary Z. Krohn, Ph.D, Clemson University
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Active-Learning Environment

- Students engaged in solving problems during class
- Advantages of active learning environments:
  - Increased engagement
  - Formative assessment
  - Increased retention/time on task
Learning Activity
13 served hamburgers
8 served roast beef sandwiches
10 served pizza
5 served hamburgers and roast beef sandwiches
3 served hamburgers and pizza
2 served roast beef sandwiches and pizza
1 served hamburgers, roast beef sandwiches, and pizza
5 served none of these three foods

Total = 27

Likelihood of Serving All Three Foods: 1 in 27
Find the finishing order of a race involving contestants A, B, C, D, and E given that you overheard the following statements and know that the statements of those who finished first and second are false and the statements of all others are true:

A: D was third
B: E was not first
C: I was not last
D: C finished after B
E: B was second

<table>
<thead>
<tr>
<th></th>
<th>LIAR</th>
<th>TRUTHTELLER</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>LIAR</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>TRUTHTELLER</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>TRUTHTELLER</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>TRUTHTELLER</td>
<td></td>
</tr>
</tbody>
</table>
1. Send across 5 minute and 10 minute guys

2. 5 minute guy goes back with lantern

3. Send across 20 minute and 25 minute guys

4. 10 minute guy goes back with lantern

5. 5 minute and 10 minute guys cross again
Student/ Participant Comments

• Describe your group’s approach to the problems.
• What positive aspects did you experience in your group?
• What negative aspects did you experience in your group?
• Did your group have an expert? A novice? How did you handle your expert/novice?
DFW Rates

• DFW: % of students who earned a D, F or withdrew from the course

• Undergraduate courses with DFW rates ≥ 30% are placed on a list

• To reduce the DFW rate in listed courses, the University offers:
  – Supplemental Instruction
  – Free Tutoring through the Academic Support Center
SCALE-UP Calculus at Clemson University

• In 2006, Mathematical Sciences Department totally redesigned first semester differential Calculus
  – Section sizes increased to 45 students
  – Graduate Teaching Assistant and Undergraduate Supplemental Instructor were added to each class
  – Rooms were renovated
  – A new textbook was chosen
  – Common syllabus was revised
  – Weaker students were placed into a year-long PreCalc/Calculus course
Room Configuration

Windows

Whiteboard

Whiteboard
## Differential Calculus – 1 Semester

<table>
<thead>
<tr>
<th></th>
<th>Fall 2005 Traditional Lecture Format</th>
<th>Fall 2006 SCALE-UP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Students</td>
<td>786</td>
<td>677</td>
</tr>
<tr>
<td>Students receiving A, B, or C</td>
<td>443 (56.4%)</td>
<td>524 (77.4%)</td>
</tr>
<tr>
<td>Students receiving D</td>
<td>140 (17.8%)</td>
<td>27 (4.0%)</td>
</tr>
<tr>
<td>Students receiving F</td>
<td>139 (17.7%)</td>
<td>98 (14.5%)</td>
</tr>
<tr>
<td>Students receiving W</td>
<td>64 (8.1%)</td>
<td>28 (4.1%)</td>
</tr>
<tr>
<td>Final Exam Average</td>
<td>62.7</td>
<td>73.6</td>
</tr>
<tr>
<td>Overall Course Average</td>
<td>73.5</td>
<td>78.6</td>
</tr>
</tbody>
</table>
## Two Semester Calculus Comparison:
First Semester Credit Given for Pre-Calculus

<table>
<thead>
<tr>
<th></th>
<th>Fall 2005 Traditional Lecture Format</th>
<th>Fall 2006 SCALE-UP*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Students</td>
<td>247</td>
<td>290</td>
</tr>
<tr>
<td>Students receiving A, B, or C</td>
<td>128 (51.8%)</td>
<td>Pass/Fail Grading* 187 (64.5%)*</td>
</tr>
<tr>
<td>Students receiving D Students receiving F</td>
<td>47 (19.0%) 54 (21.9%)</td>
<td>Pass/Fail Grading* 91(31.4%)</td>
</tr>
<tr>
<td>Students receiving W</td>
<td>18 (7.3%)</td>
<td>12 (4.1%)</td>
</tr>
<tr>
<td>Final Exam Average (out of 100 points)</td>
<td>62.5</td>
<td>58.1</td>
</tr>
</tbody>
</table>
Two Semester Calculus Comparison: Second Semester Credit Given for Calculus

<table>
<thead>
<tr>
<th></th>
<th>Spring 2006 Traditional Lecture Format</th>
<th>Spring 2007 SCALE-UP*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Students Who Took Precalculus</td>
<td>247</td>
<td>290</td>
</tr>
<tr>
<td>Number of Students Not Continuing to Calculus</td>
<td>131(53.0%)</td>
<td>155(53.5%)</td>
</tr>
<tr>
<td>Student with Success in Calculus</td>
<td>67(27.1%)</td>
<td>91(31.4%)</td>
</tr>
<tr>
<td>Students Receiving D,F, or W in Calculus (Not Successful)</td>
<td>49(19.8%)</td>
<td>44(15.2%)</td>
</tr>
</tbody>
</table>
Student Comments

• “I liked the group work. It really does help when you don't understand and are able to ask someone for help. The journaled homework helped give a better understanding, but took too long to do. The teaching assistants were very helpful.”

• “The short lectures were good because many people have short attention spans. The learning activities helped to apply what you had just learned.”
“Learning activities and journal problems were definitely great ways to prepare for exams. The layout of the class was relaxed and served as a great learning environment where students were able to network with our peers for further help in the class. TAs were helpful when Dr. Z was occupied helping other students. They definitely play a vital role in the classroom.”
Student Comments

• “The set up with the short lecture in the beginning and learning activity in the end is very effective. There is a short lecture in the beginning and learning activity with TA's in the end. That way you learn the material at the beginning of the class, and reinforced at the end. The amount of journaled problem gave me enough problems to struggle at the start, understand the material in the middle, and just emphasize the material in the end.”