Mar 28th, 2:00 PM - 2:45 PM

Compelling Student Support in Calculus

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Recommended Citation

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Mercer University
A friendly Quiz

• What is the measure of the angle between the minute hand and the hour hand of a clock at 1:25?
Supplementary Instruction

• The Supplemental Instruction (SI) Program helps students find new ways to solve old problems. SI is offered on campuses around the world and targets historically difficult courses on each campus. Historically difficult courses are those that traditionally have high rates of D's, F's and W's as final grades.

• Supplemental Instruction Leaders are qualified underclassmen who have already completed the course. They attend the class with students and then hold additional study sessions outside regular class meetings. The voluntary study sessions are conducted on a drop-in basis.

• National statistics indicate that students who attend SI sessions regularly can expect to earn final grades up to a letter grade higher than their classmates who do not attend SI.
Advantages of SI

• Service attached directly to a specific course.
• Service is proactive rather than reactive.
• SI leaders attend all classes for the targeted course.
• Service is not remedial.
• designed to provide a high-degree of student interaction and mutual support.
• SI leaders are trained
• Supplemental Instruction is supervised
SI Leaders at Mercer University

• All SI Leaders must have at least a 3.0 GPA and sophomore status or higher.
• SI Leaders are highly qualified tutors who receive additional intensive training for working specifically with high-risk classes for which Supplemental Instruction (SI) is scheduled.
• SI Leaders must attend all class meetings with the regular enrollees, serving as model students in class.
• In addition, the SI Leaders conduct two to three supplemental study sessions (outside regular class meetings) totaling 3 1/2 hours weekly.
• SI Leaders are also responsible for planning the content of their supplemental sessions, preparing study aids and handouts for SI, and completing required paperwork.
• Emphasis for SI Leaders is on reinforcing the professor's lessons, clarifying points of confusion, and providing organizational models the students can emulate in their own individual studying.
DFW Rates for Introductory Math Courses
# DFW Rates in Introductory Courses 2007-2011

<table>
<thead>
<tr>
<th>Course</th>
<th>n</th>
<th>A</th>
<th>D</th>
<th>F</th>
<th>W</th>
<th>DFW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finite Mathematics</td>
<td>364</td>
<td>21.43%</td>
<td>8.52%</td>
<td>9.34%</td>
<td>11.26%</td>
<td>29.12%</td>
</tr>
<tr>
<td>Elementary Statistics</td>
<td>926</td>
<td>26.67%</td>
<td>8.53%</td>
<td>5.83%</td>
<td>11.23%</td>
<td>25.59%</td>
</tr>
<tr>
<td>PreCalculus</td>
<td>722</td>
<td>16.48%</td>
<td>7.89%</td>
<td>10.53%</td>
<td>12.05%</td>
<td>30.47%</td>
</tr>
<tr>
<td>Business Calculus</td>
<td>308</td>
<td>12.34%</td>
<td>10.71%</td>
<td>8.77%</td>
<td>15.26%</td>
<td>34.74%</td>
</tr>
<tr>
<td>Calculus I</td>
<td>1217</td>
<td>14.13%</td>
<td>11.59%</td>
<td>9.53%</td>
<td>22.02%</td>
<td>43.14%</td>
</tr>
<tr>
<td>Calculus II</td>
<td>616</td>
<td>16.40%</td>
<td>11.20%</td>
<td>7.63%</td>
<td>15.91%</td>
<td>34.74%</td>
</tr>
</tbody>
</table>

![Graph showing DFW rates for each course]
Efforts to Combat high DFW

• Incorporation of Group Work/Projects
• Tremendous Tuesdays
• Change in online Homework System
• Reformulation of Math Index
• Change in Placement Exam Policy
• Extension of Add/Drop period
• Greater emphasis of office hour/academic resource availability
A Modest Proposal
Dr. Howard’s Calculus 1 DFW
Uri Treisman Berkeley model

1. A focus on helping minority students to excel at the University, not just avoid failure
2. Emphasis on collaborative learning; small-group teaching methods
3. Faculty sponsorship, which both nourished the program and enabled it to survive
4. Form self-supporting study groups for school year
5. Build relationships so students seek these out when in college too
Collaborative Learning

- Not just *group work* but an *academic support groups*:
- Write out what you know, make a first attempt before you meet
- Get together, compare, correct, critique, explain
- Have an *experienced guide* review your work
- Study and practice old exams; go through study guides
Preceptors

• case study comparing the SI model used for these courses with a preceptor model
• 2 preceptors for 1 course vs 1 SI for 2 courses
• Each preceptor assigned to student groups of no more than 5 students with no more than 16 students total.
• Preceptors have same training as SI
• Meets once a week with individual groups and once will all groups
Course Modifications

• Students required to participate in groups with outside meetings with preceptor
• Students assigned weekly small group problem sets (5% of total grade, graded based upon participation)
• Problems set has individual portion and group portion
Group Formation

• Students completed individual time sheets
• Matched based upon math index
Group Meeting Schedule
MAT 191: Calculus I
Group Problem Set #2: Part I

Limits and Continuity

1) Given the function \( f(x) = \begin{cases} 
\frac{|x+1|}{x+1}, & x < 0 \\
1, & 0 \leq x \leq 1 \\
\frac{2-x}{2-|x|}, & x > 1. 
\end{cases} \)

Find all discontinuities and identify them as being either a removable discontinuity, a jump discontinuity or an infinite discontinuity. If there are any removable discontinuities then give a function that removes them.

2) Consider the function \( f(x) = \sqrt{x^2 + x + 1} \).

a) Determine the formula for the slope of the secant line connecting the points \( x = a \) and \( x = a + h \).

b) Determine the slope of the secant line between the point \( x = 1 \) and \( x = 1.1 \) using your answer from (a).

c) Determine the formula for the slope of the tangent line at the point \( x = a \) using your answer from (a).

d) Determine the slope of the tangent line at the point \( x = 2 \) using your answer from (c).
Limits and Continuity

Evaluate the following:

1) Let \( f(x) = \begin{cases} 
ax^2 + 4, & x \leq -2 \\
a + bx, & x - 2 < x < 2 \\
4x - b, & x \geq 2.
\end{cases} \)

Find all values of \( a \) and \( b \) that would make the function continuous. Show how you found your values.

2) Consider the function \( f(x) = \frac{1}{\sqrt{x}} \).

   a) Determine the formula for the slope of the secant line connecting the points \( x = a \) and \( x = a + h \).

   b) Determine the slope of the secant line between the point \( x = 1 \) and \( x = 1.1 \) using your answer from (a).

   c) Determine the formula for the slope of the tangent line at the point \( x = a \) using your answer from (a).

   d) Determine the slope of the tangent line at the point \( x = 2 \) using your answer from (c).
Mathematical Attitudes Survey

• Pre/Post
Attitudes Towards Mathematics Inventory

10. My mind goes blank and I am unable to think clearly when working with mathematics.
9. Mathematics is one of my most dreaded subjects.
8. I can think of many ways that I use math outside of school.
7. High School math courses would be very helpful no matter what I decide to study.
6. Mathematics is one of the most important subjects for people to study.
5. Mathematics is important in everyday life.
4. Mathematics helps develop the mind and teaches a person to think.
3. I get a great deal of satisfaction out of solving a mathematics problem.
2. I want to develop my mathematical skills.
1. Mathematics is a very worthwhile and necessary subject.
Attitudes Towards Mathematics Inventory

20. I am always confused in my mathematics class.
19. I expect to do fairly well in any math class I take.
18. I am able to solve mathematics problems without too much difficulty.
17. I have a lot of self-confidence when it comes to mathematics.
16. Mathematics does not scare me at all.
15. It makes me nervous to even think about having to do a mathematics problem.
14. When I hear the word mathematics, I have a feeling of dislike.
13. I am always under a terrible strain in math class.
12. Mathematics makes me feel uncomfortable.
11. Studying mathematics makes me feel nervous.
A friendly Quiz

• What is the measure of the angle between the minute hand and the hour hand of a clock at 1:25?
A friendly Quiz

\[
\frac{360^\circ}{12} = 30^\circ
\]

\[30^\circ \times 5 = 150^\circ\]

\[30 + 30 \times \frac{5}{12} = 42.5^\circ\]

\[150^\circ - 42.5^\circ = 107.5^\circ\]
Performance Results

A   D   F   W
0.00% 5.00% 10.00% 15.00% 20.00% 25.00% 30.00%

DFW
0.00% 10.00% 20.00% 30.00% 40.00% 50.00% 60.00% 70.00% 80.00%

SI
Preceptor
Performance Results

![Bar chart showing performance results for different categories such as Calculus I, Howard, SI, and Preceptor. The chart displays the percentage of performance for A, D, F, and W grades.]
Concluding Perceptions

• Students
• Preceptors
• Faculty Perception
• Administration