ROADBLOCKS FOR IMPLEMENTING ACTIVE LEARNING STRATEGIES IN CALCULUS COURSES

Darryl Yong, Harvey Mudd College
Kim Presser, Shippensburg University
Larissa Schroeder, University of Hartford

What is active learning?

- Teaching methods to get students more involved in the learning process
- i.e. Techniques for engaging students
  - with each other AND with the content
- Remember, IBL is *active learning* but *active learning* is not necessarily IBL.
Why active learning?

- President’s Council of Advisors on Science and Technology:
  - increase the number of STEM bachelor’s degrees completed per year by 33%
  - recommends adoption of empirically validated teaching practices as critical to achieving that goal.

- Freeman et. al. (2014)
  - Compelling analysis of active learning strategies
  - Active learning leads to increases in examination performance that would raise average grades by a half a letter
  - Failure rates under traditional lecturing increases by 55% over the rates observed under active learning.

- For info on IBL see the latest Primus, vol. 27, issues 1&2

Darryl Yong
Harvey Mudd College

- Personal and Institutional Roadblocks
  - Department & Institutional culture
  - Training & Support
  - Student Expectations
  - Personal Expectations & Worries
  - Be yourself!
Kim Presser
Shippensburg University

- Establishing community
- Ask yourself, Why?
- Managing groups
Establishing Community

■ Create a friendly atmosphere.
  - Get to class early, ask questions, get to know the students.
  - Refer to students by name, especially when giving credit for ideas.

■ Help students to feel comfortable answering questions and sharing their work in informal ways.
  - Invite pairs of students to discuss their answers then come to the board or share their answers with the class.
  - Request contributions by row, column, pods of 4, etc.
Establishing Community

- Help students to get to know others in the classroom.
  - *Introductions*
  - *Ice-Breakers*
  - *Variety*

- Encourage communication outside of the classroom.
  - Advertise related events *in department or across campus*
  - Meet students *in lounge or tutoring area*
  - Discuss advisement issues as a class
Ask Yourself Why?

Why am I choosing to do group work?

- Concept exploration
  - Provide detailed instructions
  - For frequent use rotate groups often
  - For long-term projects encourage self-selected groups

- Concept check
  - Informally gather students to answer questions
  - Alternate the output: discussion, shared on board with class, turn-in worksheet
Ask Yourself Why?

- Concept review
  - Heterogeneous groups
  - Graded or ungraded assignment
  - Prepared materials of suitable length (more is better than less)

- Concept mastery
  - Homogeneous groups

- Other
Ask Yourself How?

*How much class time is available?*
- 5 minutes
- 15 minutes
- Entire period

*How will I assess their work?*
- One sheet for the group or individual sheets
- Correctness vs. Effort
- Wait to reveal output until later in the period
- Be adaptable

*How much of the semester will they be working on this project?*
Managing Groups

- Provide formal instruction for how “groups” work. Nothing is too obvious.
  - *Introductions and contact information*
  - *Arrangement*
  - *Establishing member roles.*
    - Example: Choose a facilitator who helps guide you through the questions, a recorder to take notes for your group, and a speaker (or 2) to present your summary to the class. It is okay if you don’t get to every question, but keep the discussion flowing.

- Get student feedback
  - *Publicly and privately accept student feedback*
  - *Formal feedback for long-term projects*
  - *Move to self-selected groups later in the semester*
Larissa Schroeder
University of Hartford

Getting Started: Choosing or Modifying Tasks
Estimate the area of the region trapped between the function and the $x$- and $y$-axes using a minimum of 7 subdivisions.

Choose tasks with multiple entry points and the potential for discussion.
Find tasks from other sources

Given the graph of \( f(x) \), which value is the best estimate of \( \int_{0}^{3} f(x) \, dx \)?

A. 13  
B. 17  
C. 65  
D. 85  

Reference: MathQuest/MathVote
Modify a task to promote discussion

What is wrong with this statement?

“It is decreasing, so it is concave down”
Allow students to struggle with traditional problems

But have a plan about where to go
Use Inquiry-Oriented Tasks

\[ \sum_{k=1}^{\infty} \frac{x^k}{2^k} \]

\[ \sum_{k=1}^{\infty} \frac{x^k}{3^k} \]

- Find values of \( x \) which make the series converge.

- Find values of \( x \) that make the series diverge.
When students explain their thinking it takes time
Instructors need strategies to foster Classroom Discussion

**Revoicing**

“So, you are saying...”

**Ask students to restate** someone’s reasoning

“Can you repeat what Ana just said?”

**Ask students provide a critique**

“Do you agree or disagree? Why?”

**Prompt students to add on**

“Sam would you like to add to that explanation?

Wait...wait....wait!

Reference: Chapin, O'Connor, Anderson (2013). Classroom Discussions in Mathematics
Resources

- Active Calculus (Boelkins, Austin, & Schlicker)
  http://scholarworks.gvsu.edu/books/10/

- MathQUEST/MathVote
  http://mathquest.carroll.edu/
Audience Questions