IMPLEMENTING AND ORCHESTRATING ACTIVE LEARNING STRATEGIES IN CALCULUS

Debbie Gochenaur, Shippensburg University
Larissa Schroeder, University of Hartford

Outline

■ Active learning: What is it? And, why use it?
■ ALP #1:
  ■ Setting the stage for ALPs
■ ALP #2:
  ■ Strategic tasks
■ ALP #3:
  ■ Having students work together effectively
■ Further Participant Discussion
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.

  - Classroom environments in which students are provided opportunities to engage in mathematical investigation, communication, and group problem-solving, while also receiving feedback on their work from both experts and peers, have a positive effect on learning.

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


Playing the long-game in teaching

- Start gradually, picking and choosing strategies
- Build up a library of resources
- Do small new things one at a time and continue to grow in that way
“In each of us, two natures are at war – the good and the evil. All our lives the fight goes on between them, and one of them must conquer. But in our own hands lies the power to choose – what we want most to be we are.”

– Robert Louis Stevenson
Manage your own expectations and worries:

- You don't have to go 100% active. Do it strategically (over time) - collect things.
- Don't worry about getting it 100% right!
- When trying something new, the most important thing is to have a mechanism for adjusting things based on feedback.

Pre-tenure?

- *This is an opportunity to demonstrate your commitment to learning.*
- *Describe your successes and how you’ve learned from your failures.*
Tell us what you think about ALPs.

- Go to Socrative.com
- Click on STUDENT LOGIN
- Room Name: Gochenaur
For the Socrative quiz:

**One-Minute Papers:** students write about what they see as the muddiest or clearest point of a lesson, about their affective response (reaction value), or provide other responses to teacher-centered activity.

**Wait time:** a pause after an instructor’s question or comment used to allow students time to formulate a response or subsequent comment.

**Think-pair-share:** students work individually and then discuss work with a partner before select students report to the class.

**Group learning:** working (for extended times) with one or more partners) on either given problems or larger activities.

**Generating questions:** students create their own questions about the content to be shared with their group, class, and/or professor.

**Representations:** students expressing material in different mode than it is given, such as rewriting a theorem or definition in their own words, or drawing a picture to show a relationship between two verbally stated ideas.

**Analytic beginning/ending:** students write response to a challenging question at the beginning of class, revise their written work using a different color at the end of class, and are then asked how their thinking has changed.
ALPs #1: Setting the Stage

Building community while exploring expectations.
First Day of Class

Jason Aldean - The Only Way I Know
That's the only way I know
Don't stop ‘til everything's gone
Straight ahead, never turn round
Don't back up, don't back down
Full throttle, wide open
You get tired and you don't show it
Dig a little deeper when you think you can't dig no more
That's the only way I know

Next – with your group (sit down)

What do you believe to be critical characteristics of successful students in Applied Calculus?

www.padlet.com/gochenaur
Click on “Successful Applied Calculus Students”

Forming Groups

• Groups of 3
• Count off from the left

Meeting your teammates

What do you believe is important to understand and learn in Applied Calculus?

Mindset (on your own)

What do you think is the difference between a Growth Mindset and a Fixed Mindset?
# Mindset Discussion

*Fixed Intelligence Mindset*
- Intelligence is static
- You have a certain amount of it

*Growth Intelligence Mindset*
- Intelligence can be developed
- You can grow it with actions

<table>
<thead>
<tr>
<th>FIXED MINDSET</th>
<th>SKILLS</th>
<th>GROWTH MINDSET</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOMETHING YOU'RE BORN WITH</td>
<td>COME FROM HARD WORK.</td>
<td>CAN ALWAYS IMPROVE</td>
</tr>
<tr>
<td>FIXED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOMETHING TO AVOID</td>
<td>SHOULD BE EMBRACED</td>
<td>AN OPPORTUNITY TO GROW.</td>
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<tr>
<td>COULD REVEAL LACK OF SKILL</td>
<td>MORE PERSISTANT</td>
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<td>TEND TO GIVE UP EASILY</td>
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<tr>
<td>UNNECESSARY</td>
<td>ESSENTIAL</td>
<td>A PATH TO MASTERY</td>
</tr>
<tr>
<td>SOMETHING YOU DO WHEN YOU ARE NOT GOOD ENOUGH</td>
<td></td>
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<tr>
<td>GET DEFENSIVE</td>
<td>USEFUL</td>
<td>SOMETHING TO LEARN FROM</td>
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<tr>
<td>TAKE IT PERSONAL</td>
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<td>IDENTIFY AREAS TO IMPROVE</td>
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<tr>
<td>BLAME OTHERS</td>
<td></td>
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<tr>
<td>GET DISCOURAGED</td>
<td></td>
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<tr>
<td>SETBACKS</td>
<td></td>
<td>USE AS A WAKE-UP CALL TO WORK HARDER NEXT TIME.</td>
</tr>
</tbody>
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Mindset Discussion

Fixed Mindset
intelligence is static
- Challenges … avoid
- Obstacles … give up
- Effort … no point
- Criticism … deflect
- Success of others … feel threatened

Growth Mindset
intelligence is developing
- Challenges … embraces
- Obstacles … fortitude
- Effort … work hard
- Criticism … learns
- Success of others … celebrates

Growth Mindset

- I am firmly in the Growth Mindset camp.
- I believe that each of you is capable of learning Calculus.
- Together, let’s work as a team to get you through this semester!
Adjusting to SU (again?)

- Study skills
- Time management
- Work/Life balance
- Stress management
- Self-care
- Honesty, Integrity and Perseverance
- Seek help

- Office hours
- Required materials
- Expectations
  - Assignments
  - Help your group be the best it can be.
  - Find a Study Buddy
  - In-class work
- Seeking help
- Academic Integrity
- Accommodations
- Course Calendar
- Let’s do some math!
The Study Cycle

**Week 3 Day 1:**

**Preview**
- **Set a Goal** - Decide what you want to accomplish in your study session
- **Attend class** - GO TO CLASS! Answer and ask questions and take meaningful notes.

**Study**
- **Review before class** - Skim the chapter, note headings and boldface words, review summaries and chapter objectives, and come up with questions you’d like the lecture to answer for you.
- **Review after class** - As soon after class as possible, read notes, fill in gaps and note any questions.
- **Study** - Repetition is the key. Ask questions such as ‘why’, ‘how’, and ‘what if’.
  - Intense Study Sessions* - 3-5 short study sessions per day
  - Weekend Review – Read notes and material from the week to make connections

**Assess**
- **Reward Yourself** - Take a break - call a friend, play a short game, get a snack
- **Review** - Go over what you just studied

**Intense Study Sessions**
1. Set a Goal 1-2 min
2. Study with Focus 30-50 min
3. Reward Yourself 10-15 min
4. Review 5 min

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*Intense Study Sessions: 3-5 study sessions per day.
Can you see yourself having a mindset discussion with your students?

How would you make this Setting the Stage strategy your own?
ALPs #2: Incorporating and Orchestrating Inquiry-Oriented Tasks
The task

Each group is given one of the power series:

\[
\sum_{k=1}^{\infty} \frac{x^k}{2^k} \quad \sum_{k=1}^{\infty} \frac{x^k}{3^k} \quad \sum_{k=1}^{\infty} \frac{x^k}{4^k}
\]

**Directions:** Find the values of \(x\) for which the power series converges.

Discussion Questions

1. What mathematical concepts does this task build on?
2. What mathematical idea is this task building towards?
3. Where might students struggle? What questions can you ask?
4. How do you orchestrate the discussion?
5. What can you do next to build on this investigation?
What happens in my class...

\[
\sum_{k=1}^{8} \frac{x^k}{2^k}
\]
\[\text{[0, 2]}\]
\[-1, 0, 1\]
\[-2 \leq x \leq 2\]

\[
\sum_{k=1}^{8} \frac{x^k}{3^k}
\]
\[-2, -1, 0, 1, 2, \frac{1}{2}, 0 < x < 3\]

\[
\sum_{k=1}^{8} \frac{x^k}{4^k}
\]
\[0, 1, 2, 3, 3.9, 3.99, 3.999, -4 < x < 4\]
Follow up Question

\[ \frac{(x - 1)^k}{3^k} \]

Find the values of \( x \) for which this series converges.
Questions to consider

■ What is the task and what’s the purpose?
■ How does this task build toward the lesson objectives?
■ What is the instructor’s role?
■ Who summarizes the findings and how?
■ What questions should you ask?
■ How can you build on this task?
ALPs #3:

Getting students to work together effectively
Establishing Group Communities

- Create a friendly atmosphere
- Communicating IN the classroom
  - Help students feel comfortable answering questions and sharing work
  - Use ice breakers, introductions, etc.
- Communication OUTSIDE the classroom
  - Meet students outside of class
  - Discuss related department/university events
Managing Groups

- Provide formal instruction for how “groups” work. Nothing is too obvious.
  - Introductions and contact information
  - Arrangement
  - Establishing member roles
Why group work?

- Exploring concepts
  - *Detailed instructions, rotate groups often*

- Concept check
  - *Informally gather students to answer questions, vary output (discussion, share on board, turn-in worksheet)*

- Concept review
  - *Mixed ability groups, graded vs. ungraded*

- Concept mastery
  - *Homogeneous groups*
In my class: Groups at the Board [Concept Check]

- **Time:** ~15 minutes

- **Logistics:**
  - Each group is assigned a problem. Solve it!
  - When done, find another group with the same problem and check their work. Can you follow their reasoning? How does their work differ from your own? Did both groups reach the same conclusion?
  - If the group next to you is struggling, lend a helping hand. Remember, help by asking questions not by telling!
  - Find your seat and begin working on other problems while we wait for all the groups to finish.

- **De-brief class discussion**
Whatever ALP you choose, get feedback!

- Publicly and privately accept student feedback
- Formal feedback for long-term projects
Audience Questions
Final thoughts: Release of control by the faculty member

– How do you manage the **ebb and flow** of a classroom that is less in your control?

– How do you **develop a sense of taking risks**, being less in control is not necessarily a bad thing?