

Active Learning for Calculus Problem Sections

UTD CTL: 7th Annual Workshop on Teaching

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From vectors to Divergence Theorem

- Fall 2022: 250 STEM majors
- 5 Lecture Sections [2x75mins, \approx 50 students]
- 8 **Problem Sections** [1 hr 50 mins, 30 students]
- 4 Graduate Teaching Assistants (GTA's)
- 9 **Undergraduate Learning Assistants (ULA's)**
- **Tight coordination** centered on problem sessions

Overarching Goal:

Well organized management of student learning

Lectures: Slow Math

Focus on conceptual understanding

- Weave together conceptual threads over semester
- Via development of 3D math visualization skills
- Emphasis on making meaning
- Enables problem solving

Lecture Goals:

Prepare students for the problem sessions

Vital for development of theory in STEM courses

What is Active Learning?

We use Active Learning in the MATH 2415 Problem Sessions.

With Active Learning students:

- 1 Engage in mathematical reasoning
- 2 Solve problems with their fellow students
- 3 Explain their thinking to each other & the GTA/ULA¹

¹Undergraduates are **pre-verbal** mathematicians

Active Learning Problem Sessions

- Open **Concept Quiz** due prior to session
- Students:
 - Work in small groups of 3-4 at white boards
 - Solve do-able **challenging scaffolded** problems that reinforce concepts
 - Photograph their solutions
- GTA's & ULA's:
 - Can't hold white-board markers
 - Mostly ask **probing** questions
 - Can answer "yes" or "no"
 - Model student responses: "*So you are saying....*"

The room is buzzing with conversation!

Why Do Active Learning?

Feedback from student evaluations:

“The problem sessions, too, were much better than any I’ve had in the past. They were relaxed, engaging, and helpful to my comprehension.”

“The problem sections were much more productive with the students working problems in groups as opposed to another lecture from the TA.”

“The structure of the problem sessions is the best I’ve ever seen. You get to learn by working with others. Allowing us to explain material with a TA’s guidance is highly beneficial.”

Why Do Active Learning?

From a ULA's application:

*I took Math 2415 in my first semester here at UTD. I am now a senior and the active learning math lab for this course remains the most helpful math lab I've had. **The ULA's I had were incredible, they opened my eyes to math being a subject that one can reason about....** I'd really like to help other students fall in love with math like I did through active learning.*

Challenges/Requirements for AL

- 1 **Short video explaining the why & how of AL**
- 2 **Essential:** 5-10% of course grade for participation
- 3 **Essential:** Student : Teacher < 20 : 1. **ULA's!!**
- 4 You need rooms with lots of white boards!
- 5 **Caution:** $\approx 1\%$ of students can't work in groups
- 6 Works best with continuous training of GTA's & ULA's

**The first two weeks are always chaotic,
but then things settle down.**

Undergraduate Learning Assistants

ULA's are unpaid volunteers who work for fun!

- Most are former MATH 2415 students
- Pre-med, Math/Physics/Eng, UTeach
- Often National Merit Scholars [Can get CV credit]

What ULA's bring to the table:

- Enthusiasm + content knowledge + leadership skills
- Excellent math communication skills
- Superior social skills
- Role models: know what it takes to succeed
- Increase diversity of instructional team

Weekly instructional team meetings

- 1 What worked last week, what issues came up?
- 2 Team generates constructive solutions
- 3 Discussion of problems for this week
- 4 Clarify learning goals
- 5 Process enhances equitable outcomes

Ensures we all have a consistent story.

All improvements originated in these meetings!

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Fellow Instructors

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Neha Makhijani, Changsong Li, Rabin Dahal, Baris
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$\mathcal{O}(10^2)$ **GTA/ULA's**, $\mathcal{O}(10^3)$ **students over last decade**