From Lecture to Active Learning

Rewards for all, and is it really so difficult?

David Pengelley

Oregon State University
New Mexico State University
www.math.nmsu.edu/~davidp
Overview

• Thoughts about lecturing and classroom time
• Scientific evidence and reactions
• What is meant by “active learning”
• Alternatives (includes escaping the lecture/textbook trap!)
• Inertia
• Rewards
• Will this work?
• How much time does it take?
• Discussion
Lecturing Has Been Standard for 500 Years!

- Inspiration vs. Learning
  - Television
  - Videorecorded lectures
- “I understand perfectly when you lecture, but then I can’t solve problems at home.”
I want my students to be
• Active in class and at home
• DOING [mathematics]
• Exploring and finding their own multiple ways to solve problems
• Creative and having fun
• Experimenting, conjecturing, proving, and generalizing

Learning Is Not a Spectator Sport!
Classroom Time Is Precious

Do you want your students to spend it on
• First contact with new material
  * OR *
• Higher level activity?
Evidence

• S. Freeman et al, Active learning increases student performance in science, engineering, and mathematics, *Proceedings of the National Academy of Sciences* 111 (2014)

• Meta-analysis of 225 studies of undergraduate education across all STEM areas
Evidence

- Active learning improves grades, reduces failure among undergraduates in STEM areas.
- 55 percent more students fail lecture-based courses than classes with at least some active learning.
Recent Reactions

- National Science Foundation press release (2014): “Enough with the lecturing”
- “Active learning”: Reduce or eliminate lecture, and devote substantial classroom time to student involvement in work that receives immediate feedback from other students and from the instructor.
Alternatives?

- My conclusion (evolution starting 25 years ago): Lecture is the least effective means of teaching
  - Inefficient
  - Obsolete (video)
Alternatives?

We underestimate our students’ abilities: Our job is to challenge in the right ways, to achieve potential.
Inertia

- I-(We)-You
- We teach as we were taught (but we weren’t typical, largely self-taught)
- Both instructors and students are extremely comfortable with lecture
- “How could I cover the material in the syllabus if I didn’t lecture?” Trapped!
- We are not responsive to scientific evidence
- It takes effort to change (more work first time)
- Motivated more by personal reward, interest
Rewards for All

• Higher quality interactions with students; more rewarding in class
• Fewer exams to grade
• Less need for office hour time
• More rewarding homework marking
• No more time spent by me overall
• Syllabus less rushed; more coverage: students cover versus instructor covers; reduce cram-exam-forget; more even workload; less stress for all; avoid burnout
• Student responses
Case Studies

• 20 year evolution, started in Calculus I, II
• MATH 191,192,210,275,279,291,331, 332,411,430,452,453,455,459,541, 542,561
• Materials: Textbooks, projects, primary historical sources
Alternatives to lecture

- “Flipped/inverted classroom”: video lecture, in-class group work (worksheets)?
- But still may be passive; still must make lectures and/or worksheets; still some first contact in class
- Instead: Eliminate lecture, replace with active student preparation for class
Alternatives to lecture

Goal:
1. Students read, and write responses
2. Students do preparatory work before class
3. In-class, group work and presentations build on top of preparation
4. Post-class harder homework, higher level

I-(We)-You → You-You-Y’all-We-You
Alternatives to lecture

HW A,B,C rolling assignments
• A: Read, write responses to my questions for l.d. courses, write questions for l.d./u.d.; I read, mark quick +,✓, -, to prepare for class
• B: Prepare warm-up problems
• In-class: Briefly discuss reading responses; Gp. work on warm-ups, present, discuss. Hand in B: quick +,✓,-
• C: Post-class, a very few harder problems: grade A-F (no points)
Questions: Will this work?

Will students really read and write in preparation for class?
Students don’t/won’t read in advance

THE TRAP

Instructor lectures
Questions: Will this work?

• Will students really read and write in preparation for class?
• Students will read/write, hand it in. Part of grade; see value, become enthusiastic about it
• Motto: Never lecture on material students can read.
Questions: Will this work?

- Will students prepare warm-up problems before class?
- Yes. Part of grade, day one, peer and instructor pressure, presentations, see value
- Parts A,B,C must be a very large part of course grade (≥60%); less examining
- Harmony between learning and evaluation
# Logistics

Homework parts are *assigned* in rolling trios

*(Described in more detail on my website)*

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