Transitioning a 300-student IPLS course to Team-Based Learning

Physics 132: *What is Light? What is an Electron?*

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1. The Course:

Unit I – The fundamental nature of light and electrons (Quantum Mechanics)
- Wave-particle duality
- Conservation of energy / scattering
- Particle in a box
- Spectroscopy

Unit II – How light and electrons move (Geometric Optics)
- Ray diagrams
- Optical instruments

Unit III – How light and electrons interfere (Physical Optics)
- Interferometers
- Double slit experiments

Unit IV – How having change impacts how electrons, interact (Electrostatics)
- Electric field
- Electric potential

Unit V – Applications of electrons moving together (Circuits)
- Resistors
- Capacitors
- Neuron

Unit VI – Magnetic forces and the nature of light waves
- Magnetic fields
- Light as self-propagating EM wave

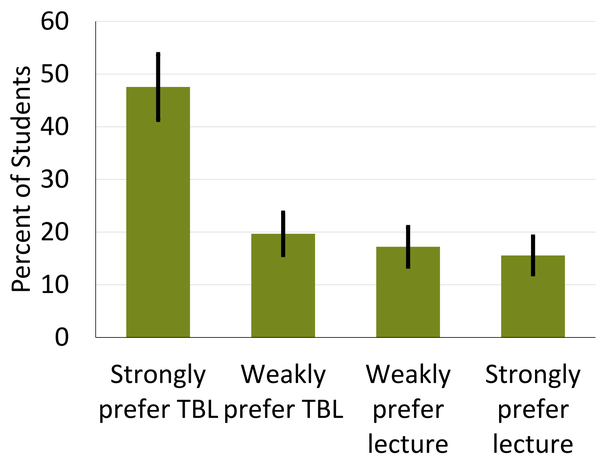
- Physics 132 is the second in a two-semester IPLS sequence[1]
- Taught in two sections of ~250 students each

- 50min 3x/week
- 2 GTAs and 4 UTAs
- Separate lab for 2hrs each week

2. Why Transition to Team-Based Learning (TBL)?

- Physics 132 has been in a Team-Based-Learning mode since fall 2015

- Spring 2017 – I taught with active lecture
- Students who had me for both strongly preferred TBL



3. Primary Challenge: Teams in a Room Ill-Suited to TBL

Problem: Student buy-in

Solution: Allow students to "opt-in" to teams
- Describe additional benefits and expectations of team participation on first day
- Students then elect to be on a team or not
- No "changing your mind"
- No team quizzes → all online

Benefits: How being on a team was beneficial
- Preferential seating
- Explained benefit of working with others
  - Many already saw from 131
- Group workload – teams only needed to turn in one of the following
  - 7% of grade is scavenger hunts: students need to find and describe applications of course concepts in their other courses or everyday life
  - 8% of grade is exam corrections: students were required to explain why they got two multiple choice problems incorrect and justify the correct answer

Responsibilities: What being on a team entailed
- Students expected to be committed to their team-mates
  - Attend
  - Help during class
- Peer evaluation of performance

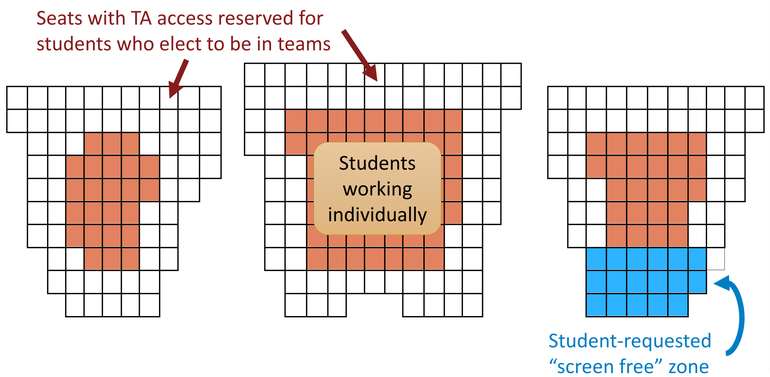
What worked: 75% of students elected to be on a team
- Those groups that did form cohesive teams reported benefitsaadf on Student Responses to Instruction

Challenges: Some students seem to have only internalized benefits but not additional responsibilities
- Much less cultural pressure to attend class
- More focus from students on taking notes than participating with team-mates
- Perhaps be more explicit with the expectations of team participation?

Problem: Team size
- Michalesen et al recommend teams of 5-7 (use 5 in 131)[2]
- 5-student teams seems awkward in lecture hall

Solution: Teams of 4
- Still no "roles"
- Students choose where and how to sit
  - 2x2
  - 4 in a row

Challenges: One less committed team-member seems significantly detrimental
- Effect not observed in 131
- Seems to be less social pressure to attend in a lecture hall



4. In-Class Activities

Think-pair-share with ABCD cards[3]
- Works well for all students: both in teams and individuals
- Well suited to the space
- Limited to multiple choice questions

Lap whiteboards
- An effort to expand beyond multiple choice
  - Solving problems
  - Drawing diagrams
- Based upon great success in 131 with wall whiteboards
  - Seems to have stronger group problem solving
  - Less working problems individually
- Less willingness to use in 132
  - Expectations of the room?
  - Fewer TAs to help pressure?

Twitter/Scraps of Paper
- Goal of course is to be able to write about the ideas
- Twitter: less effective than hoped[4]
  - Students were reluctant to join
  - Could not enforce participation without grading
- Writing on scraps of paper
  - Social pressure: you cannot leave the room
  - Still can scan responses
  - Put responses on document camera

Manipulation of 3-D Models
- Many topics are intrinsically 3-D ← magnetism
  - All students struggle with 3-D manipulation
  - We expect students with visual impairments will particularly struggle
- Universal Design for Learning: make something that will help ALL students[5]
- Manipulation of 3-D models
  - Have a class set or students can print their own
- Currently have: $\vec{B}$ from I and $\vec{F} = q\vec{v} \times \vec{B}$

5. Summary

- Students seem to have a preference for TBL
- A lecture hall has limitations:
  - Team size
  - Access to TAs
- A lecture hall induces certain expectations counter productive to TBL:
  - To simply take notes
  - Attendance is not required
- Work in progress!

[1] Dawn C. Meredith, and Edward F. Redish. "De- and Re-Constructing Introductory Physics for the Life Sciences." Accessed April 6, 2015. http://arxiv.org/abs/1304.1895.
[2] Larry K. Michaelsen, Arletta Bauman Knight, and L. Dee Fink. *Team Based Learning: A Transformative Use of Small Groups in College Teaching*. Sterling, VA: Stylus, 2004.
[3] Edward Prather. "Are You Really Teaching If No One Is Learning?" Colloquium presented at the Science, mathematics, and comptuer education colloquium, University of Nebraska, Lincoln, September 25, 2009. https://youtu.be/NCUyIh3Pssl.
[4] Mark Sample. "A Framework for Teaching with Twitter." The Chronicle of Higher Education. *ProfHacker* (blog), August 16, 2010. http://www.chronicle.com/blogs/profhacker/a-framework-for-teaching-with-twitter/26223.
[5] Michele Turre, Marisha Marks, Marcie Savoie, and Kelsey Hall. "The Universally Accessible Classroom." UMass Amherst, January 11, 2017.