Active Learning

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Learning Objectives for this session

• Describe the link between a learner’s misconceptions and active learning
• Assess if a classroom is learner centered
• Identify ways to apply active learning in the classroom
• Present arguments for the use of active learning
Transmissionist View of Learning

Instructor:

- “I know a lot about this topic, so I will transmit my knowledge to you by telling you about it”.
The transmissionist view of learning

• Learners are empty vessels to be filled with knowledge

• Instructor-centered

Smith et al., 2005
The typical outcome...
The constructivist view of learning

- People must grow their own knowledge structure from experience
  - we cannot put knowledge into students’ heads

Learner-centered!

www.tracingyourpast.co.uk
Moving from an instructor-centered to a learner-centered classroom

Begin with this drawing . . .

As a table, sketch what it would look like if it were learner-centered

5 minutes!
Transmissionist vs. Constructivist

**Instructor**

“I know a lot about this topic, so I will transmit my knowledge to you by telling you about it”.

**Facilitator**

“I know a lot about this topic, so I will create situations and present challenges for you so that you construct your own knowledge and understanding”.
How do learners construct their own knowledge?

Formative assessments allow both learners and instructors to gauge the learners’ progress during learning.
Backward Design

General Goals

Measurable Objectives

Summative Assessment (Exams)

Formative Assessment (Instruction)

Provided by active learning exercises
If a camera crew making a documentary on student misconceptions were to question your students at the end of your course or the end of your degree program, what would you be most embarrassed to find out that they didn’t know?

Talk to your neighbor.
Clickers: “the greatest teaching tool since chalk”
My experience with clickers is . . .

A. I have used them before
B. I know what they are but have never used them
C. I have no idea what a clicker is but would like to know more
The following is true with respect to the use of clickers in my country.

A. They are used in my country.
B. They are **not** permitted in my country.
C. I am not sure if they are permitted in my country.
Back to formative assessments!
Formative assessments have multiple roles in the classroom

1. Assessments help confront alternate conceptions/misconceptions

(Example method: clicker)
A researcher prepared three identical plates of radish seeds which were incubated under three different conditions:

1. Light, no water
2. Light, with water
3. No light, with water
Three identical plates of radish seeds are incubated under three different conditions, with results as shown. How will the dry weights of the three plates compare at the end of the experiment?

A) 1 < 2 < 3  
B) 1 < 3 < 2  
C) 1 = 3 < 2  
D) 3 < 1 < 2  
E) 1 = 2 = 3
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Bloom’s level?
Each year Emperor penguins migrate across Antarctica to their breeding grounds 50 miles away from the sea (and food). For over 2 months the male emperor penguins care for and incubate the eggs while the females return to the sea to feed. During this time, the male penguin can lose up to 50% of its biomass (by dry weight). Where did the majority of this biomass go?

A. The mass was converted to urine and feces and eliminated from the body
B. The mass was converted to energy and used up
C. The mass was converted into ATP molecules
D. The mass was released as CO₂ and H₂O
What is the evidence that active learning works?

The Educational Research, Measurement and Evaluation (ERME) program at the Lynch School
Clickers and Peer Interaction


Does active engagement of students during discussion with peers, some of whom know the correct answer, lead to increased conceptual understanding?

OR

Do students not in fact learn from the discussion, but simply choose the answer most strongly supported by neighbors they perceive to be knowledgeable?
Testing the value of peer discussion:

Students answer a clicker question individually (Q1).

Students talk to neighbors and answer Q1 again (Q1\textsubscript{AD} for Q1 “After Discussion”).

Students answer a different question individually (Q2). Q2 is asking about the same concept as Q1 (isomorphic).

![Graph showing average percentage correct for Q1 Individual with error bars, n=350 students (Genetics) 16 sets of questions]
Even when questions are initially difficult, students can answer correctly after discussion.

Very few students knew correct answer to Q1, but after discussion, many more answer correctly: students are constructing their own knowledge.


“Our results indicate that peer discussion enhances understanding, even when none of the students in a discussion group originally knows the correct answer.”

This study provides support for peer discussion, but more importantly it provides guidance for how faculty should deliver clicker questions!
You don’t need clickers – paper and fingers work just fine!

Socrative
Poll Everywhere
Mentimeter
InfuseLearning
Active Learning . . .

. . . is engaging
. . . can be challenging
. . . may reveal misconceptions
1. Formative assessments help confront alternate conceptions/misconceptions
2. Assessments help students distinguish between what they know and what they don’t know.
3. Assessments can aid construction of new knowledge
4. Assessments allow students and instructors to gauge students' progress during learning.
Active learning encompasses many different approaches:

- group work
- think-pair-share
- peer instruction
- inquiry-based learning
- technology-enhanced learning
- concept mapping
- clickers
- cooperative learning
- collaborative learning
- problem-based learning
- case-based learning
- creative others?
Research supports...
Evidence for the Efficacy of Active Learning in the Life Sciences

Armbruster, P., et al., Active Learning and Student-Centered Pedagogy Improve Student Attitudes and Performance in Introductory Biology. CBE - Life Sciences Education., 2009.
Caldwell, J.E., Clickers in the Large Classroom: Current Research and Best-Practice Tips. CBE - Life Sciences Education., 2007.
Casem, M.L., Student Perspectives on Curricular Change: Lessons from an Undergraduate Lower-Division Biology Core. CBE - Life Sciences Education., 2006.
Klappa, P., Promoting Active Learning through "Pub Quizzes"--A Case Study at the University of Kent. Bioscience Education,. 2009.
Marbach-Ad, G. and P.G. Sokolove, The Use of E-Mail and In-Class Writing To Facilitate Student-Instructor Interaction in Large-Enrollment Traditional and Active Learning Classes. Journal of Science Education and Technology,. 2002.
McInerney, M.J. and L.D. Fink, Team-Based learning enhances long-term retention and critical thinking in an undergraduate microbial physiology course Microbiology Education, 2003. 4: p. 3-12.
Nelson, J., et al., Cloning the Professor, an Alternative to Ineffective Teaching in a Large Course. CBE - Life Sciences Education., 2009.
Perez, K.E., et al., Does Displaying the Class Results Affect Student Discussion during Peer Instruction? CBE - Life Sciences Education., 2010.
91% of studies indicated a positive impact of active learning
A Recap of Key Concepts about Active Learning

• Students/learners are not empty vessels to be filled up

• In learner-centered classrooms, students are guided by a facilitator to engage and construct their own knowledge

• There are many tools for implementing active learning.

• There is overwhelming evidence that active learning is an effective method for student learning

• Create learning environments that reflect the process of science!
Lunch Break