Active Learning 101
Why and How to Get Started

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CFI New Faculty Orientation
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“Learning is...”
Learning is...

**AREA OF INQUIRY**
- Factual knowledge
- Application

**CHANGE**
- Knowledge
- Context
- Retrieval

**METACOGNITION**
- Abilities
- Attitudes
- Feedback
- Progress
- Practice

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JMU Center for Faculty Innovation
A short quiz

**True or False:**

- **✗** Good learning makes us feel confident and clear.
- **✓** Learning can occur without intentional effort.
- **✗** You have to be interested and motivated to learn.
- **✗** Intelligent people learn more easily.
- **✓** Adapting instruction based on learning styles has no effect on learning.
- **✗** Rereading textbooks efficiently reinforces concepts and leads to greater mastery.

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“Adopting instructional practices that engage students in the learning process is the defining feature of active learning.”

-Michael Prince
Why active learning?

**Pre- vs. post- in physics**

- Mechanics Diagnostic
- Force Concept Inventory
- 62 courses (14 trad.) at multiple institutions
- 6542 students (2084)
- **Worst** active learning comparable to **best** traditional lecture


[http://www.physics.indiana.edu/~sdi/ajpv3i.pdf](http://www.physics.indiana.edu/~sdi/ajpv3i.pdf)
Why active learning?

Closing the gender gap

- Pre-test scores were 10% points higher for men
- Gap persisted with lecture
- Post-test results for cooperative classes were almost equal
- Requires more than just interactive lecture

E. Mazur, “The scientific approach to teaching: Research as a basis for course design,” keynote/plenary talk at the International Computing Education Research Conference (ICER), 2011.

http://mazur.harvard.edu/search-talks.php?function=display&rowid=1712
Why active learning?

Metaanalysis of 225 studies

- 158 studies (exams/CIs)
  - 0.47 SDs increase
  - 6% grade increase
- 67 studies (failure rate)
  - 33.8% ⇒ 21.8%

Why active learning?
Human cognitive architecture

Amassing

Information store

Long-term memory
Human cognitive architecture

- **Amassing**: Information store
- **Acquiring**: Borrowing/reorganizing

Long-term memory
Human cognitive architecture

- **Amassing**
  - Information store

- **Acquiring**
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- Long-term memory
Human cognitive architecture

- **Amassing**
  - Information store

- **Acquiring**
  - Borrowing/reorganizing
  - Randomness as genesis

Long-term memory
Human cognitive architecture

Amassing
- Information store

Acquiring
- Borrowing/reorganizing
- Randomness as genesis

Interaction
- Narrow limits of change

Working memory

WM Capacity:
- 4-7 items (2-3 novel)
- 20 seconds maximum
Human cognitive architecture

Amassing
- Information store

Acquiring
- Borrowing/reorganizing
- Randomness as genesis

Interaction
- Narrow limits of change

Central executive

Auditory loop

Visual-spatial
Human cognitive architecture

- **Amassing**
  - Information store

- **Acquiring**
  - Borrowing/reorganizing
  - Randomness as genesis

- **Interaction**
  - Narrow limits of change
  - Environmental linking
Far transfer

Apply the Pythagorean theorem to the above triangle to find the value of $x$.

In a baseball diamond, the distance between each base is 90 ft. Which of the following is true about the shortest distance between 1st and 3rd bases (the red line shown above)?

1. It is less than 90 ft.
2. It is between 90 and 120 ft.
3. It is greater than 120 ft.
Human cognitive architecture

Which of these principles of human cognition best explains why active learning is more effective than traditional lecture?

A. Information store
B. Borrowing and reorganizing
C. Randomness as genesis
D. Environmental linking
Types of knowledge

Biologically Primary

Biologically Secondary

Additive Rules
\[ \Delta A + \Delta B = \Delta C \]
\[ \Delta B + \Delta C = \Delta A \]
\[ \Delta C + \Delta A = \Delta B \]

Quantifier Rules
\[ \Delta A - \Delta B = \Delta C \]
\[ \Delta B - \Delta C = \Delta A \]
\[ \Delta C - \Delta A = \Delta B \]

Exponential Rules
\[ (\Delta A)^n = \Delta B \]
\[ (\Delta B)^n = \Delta C \]
\[ (\Delta C)^n = \Delta A \]

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Retrieval fluency

Principles of effective learning

What works: (TIPPEDE)
- Testing as calibration
- Interleaved/spaced practice
- Pre-learning foundation
- Pre-instruction problem solving attempts
- Elaborative encoding
- Deliberative effort

What doesn’t: (PRIMaL)
- Passive observation
- Rereading texts
- Intuitive judgments
- Massed practice
- Learning style adaptations

Assessment jigsaw

Read your description and answer the following:

• How does it work?
• When is it good to use?
• What is the effort and impact?
• How does it align with TIPPED principles?
Closing Reflection