

Interactive Teaching & Active Learning

Best Practices for Teaching and Learning



Outline

1.

2.

3.

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Juggling is as easy as...

$$(F + D)H = (V + D)N$$

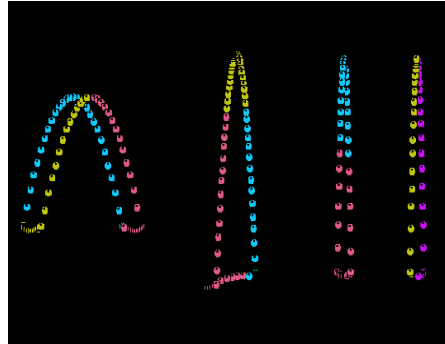
F = time ball is in the air

D = time ball is in a hand

V = time hand is vacant

N = number of balls

H = number of hands



Students learn...

10% of what they hear

30% of what they see

60% of what they hear and see

80% of what they hear, see & do

100% of what they hear, see, do, smell, feel,
taste, ... , and purchase on credit

Ronald A. Berk, Professors are from Mars, Students are from Snickers

Goal

To illustrate how to incorporate various **active learning** techniques in a course to increase **understanding** and **transfer**.

Learning Objectives

- **Apply** relevant research on active learning to your teaching.
- **Discuss** the impact of active learning exercises in the classroom and **evaluate** the time requirements for different active learning strategies.
- **Develop** activities and/or techniques that will help students achieve the learning outcomes in your course.

Discussion Questions

- **interactive teaching techniques** have you used or experienced?
- What are the **pros** and **cons** of those interactive techniques?

Benjamin Bloom's Findings on Instructional Methods

Conventional

-
-

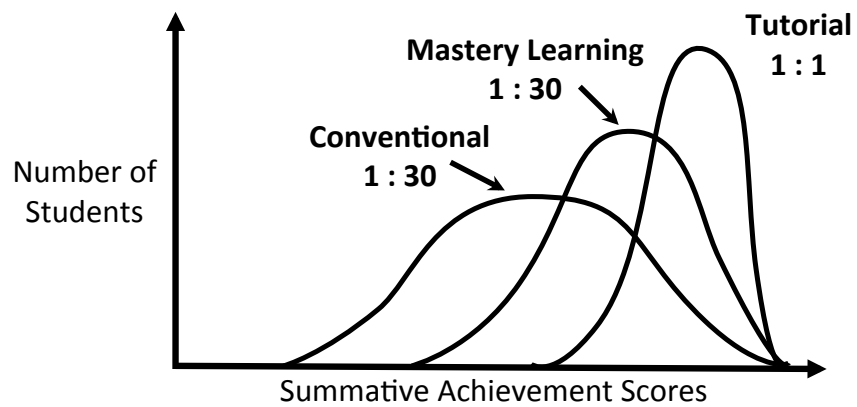
Mastery Learning

-
-

Tutorial

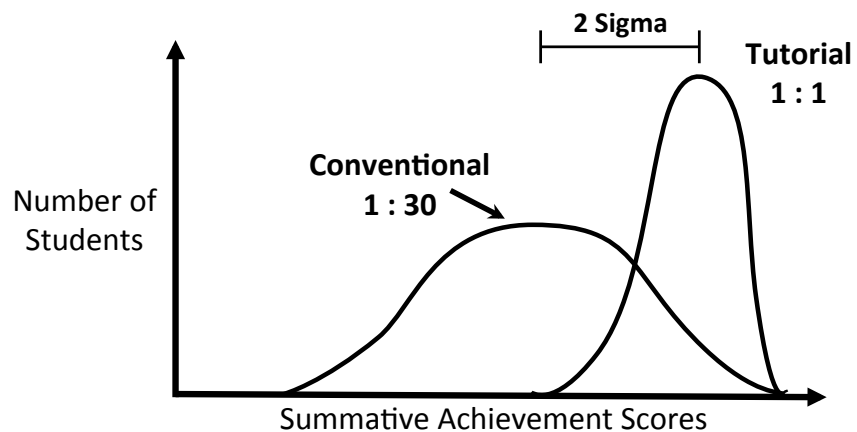
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Benjamin Bloom's Findings on Instructional Methods



Bloom B., (1984) *Educational Researcher* 13:4-16.

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Bloom's 2-Sigma Findings

Under the one-on-one instruction method, **MOST** students have the potential to reach a high level of learning.

Bloom B., (1984) *Educational Researcher* 13:4-16.

Why is **one-on-one** teaching so effective?

Reasons

Pros

-
-
-

Cons

-
-
-

Active Learning is...

“...interactive engagement of students in **heads-on** (always) and **hands-on** (usually) activities, which yield immediate feedback through discussions with peers and/or instructors.”

Richard Hake, Professor Emeritus, Department of Physics (Indiana University)

Active vs. Interactive Learning

When students are **actively learning**, they:

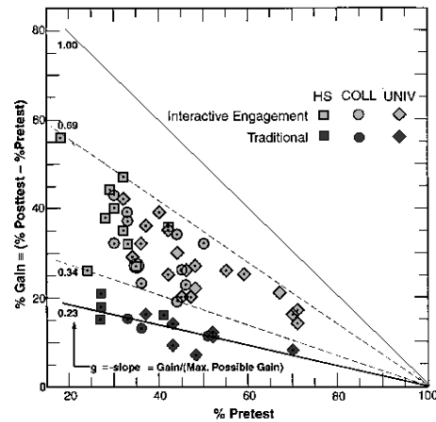
- think
- write
- predict
- calculate
- classify

Active vs. Interactive Learning

When students are **interactively learning**, they may start with active learning, but also:

- discuss
- persuade
- collaborate
- argue

Courses with Active Learning have Increased Learning Gains



Hake R. (1998) *Am. J. Phys.* **66**: 64-74.

Active Learning Methods

Activities can be grouped by time scales:

- < 2 minutes
- 2 - 5 minutes
- 5 - 20 minutes

< 2 Minute Activities

1. Do you have a question? (**10 seconds**)
2. Pose a question and give students time to think about it (**30 seconds**)
3. MUD cards (**1-2 minutes**)

2 - 5 Minute Activities

1. Compare or contrast
2. Reorder the steps
3. Support a statement
4. Reach a conclusion
5. Paraphrase the idea
6. Correct the error
7. Complete a sentence starter
8. Select the best response

Effective Quick Think Activities

- Respond in an anonymous manner
- Collect responses rapidly
- Generate student discussion
- Reveal student misconceptions
- Supported by students

A

B

C

D

Socrative

1. Navigate to **m.socrative.com**
2. Join room number 202247

Example Question #1

When did World War II occur?

- a) 1914-1918
- b) 1939-1945
- c) 1941-1945
- d) 1950-1953

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What level of Bloom's Taxonomy is this question?

Example Question #2

If living cells similar to those found on earth were found on another planet where there was no molecular oxygen, which cell part would most likely be absent?

- a)
- b)
- c)
- d)
- e)

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Example Question #3

Consider a drug, HA, that is active only in the deprotonated (A-) form. The pKa of the drug is 4.0 and the pH of blood is 7.4. **Select the correct statement below.**

a)

the bloodstream.

b)

Most of the drug will be in the inactive (HA) form in the bloodstream.

c)

The ratio of A- to HA will be approximately 1:1 in the bloodstream.

d)

More information is needed to predict the ratio of A- to HA in the bloodstream.

Example Question #3

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- b) Most of the drug will be in the inactive (HA) form in the bloodstream.
- c) The ratio of A- to HA will be approximately 1:1 in the bloodstream.
- d) More information is needed to predict the ratio of A- to HA in the bloodstream.

Example Question #4

Based on research at NASA, what was the approximate net global change in temperature between 1880 and 2000?

- a) + 2 °C
- b) + 0.7 °C
- c) + 0.05 °C
- d) - 0.05 °C
- e) - 0.7 °C

Hansen J. et al., *PNAS* (2006) 103:14288-14293.

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In-Class Concept Questions

Peer discussion improves student performance on in-class concept questions.

Smith et al., (2009) *Science*. **323**: 122-124.

5 – 20 Minute Activities

1. Long discussions and/or demonstrations that focus on:
 - Multiple-choice questions
 - Open-ended questions
2. Participatory activities

An Example 5 - 20 Minute Activity

When tapped, do you think the thicker block will display a tone that is:

- a) higher than,
 - b) lower than, or
 - c) the same as
- the thinner block?

Polya, (1965)

Questions

- What were the teaching elements?
- Why was this activity done this way?

Demonstration Protocol

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- the board
- Perform the demonstration
- Review the answer

Open-Ended Activity (5 - 20 minutes)

Your task is to determine:

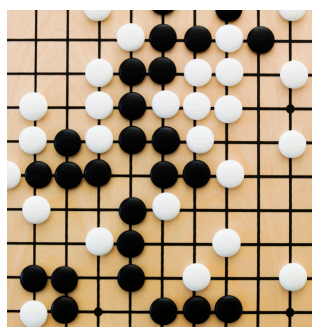
- Why their hammers keep breaking in this manner.
- What can be done to prevent this.



Open-Ended Activity (5 - 20 minutes)

Vacancy diffusion

- Students are the atoms on a 2-D lattice.
- Apply “jump” rules to fill vacancies in the lattice.



Pair-Share Activity

Select two activities on the Active Learning Strategies handout and discuss for each activity:

1. course in your discipline to facilitate a specific learning objective?
2. What are the expected time requirements, both in class and in terms of preparation time?
3. What are the potential benefits or pitfalls of the activities (and how could you evaluate these)?

Think-Pair-Share Activity

1. What active learning strategies could you use to:
 - objectives?
 - provide you and your students with information on whether students have met the learning objective?
2. What are the potential pros and cons of the activities?

Summary

1. Benefits of one-on-one teaching
2. Active Learning methods
 - < 2 minutes
 - 2 - 5 minutes
 - 5 - 20 minutes