A Primer on How People Learn: Implications for Teaching & Education Policy

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Session Objectives:

List key findings from cognitive research about how people learn

Describe how the testing effect impacts metacognition

Distinguish traits of expert and novice learners

Rank methods that help people learn best based on literature
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.

91% of studies indicated a positive impact of active learning
Three major findings:

1. Expert learners have the ability to monitor their own learning (metacognition)

2. Build both a deep foundation of factual knowledge AND a strong conceptual framework

3. Address students’ alternative conceptions using active learning
First Major Finding:
Expert learners have the ability to monitor their own learning.

This is referred to as metacognition.

For less experienced learners, frequent testing can enhance their metacognition.
Talk to your neighbor:

How do you know when you know something?

How do you know when your students know something?
Benefits of studying
vs
Benefits of testing

Roediger & Karpicke (2006)
Benefits of studying?

5 mins  5 mins  5 mins  5 mins
Study    Study    Study    Study

5 mins  5 mins  5 mins  5 mins
Study    ...    ...    Final Test
1 week   1 week

5 mins  5 mins  5 mins  5 mins
Study    ...    ...    Final Test

Roediger & Karpicke (2006)
Benefits of studying testing

Roediger & Karpicke (2006)

Rate: How much will you remember in one week’s time?
Likert scale: not very well to very well

Retention Interval

Proportion Recalled

5 mins | 1 week

Retention Interval

SSSS

STTT

Rating (1-7)

SSSS

STTT
Understanding memory

• Information is not stored like a literal video tape
  New information is related to old information

• Memories are not retrieved by hitting a ‘playback’ button
  Retrieval involves a reconstructive process (Bartlett, 1932)

• Retrieval itself has consequences for our memories
  Retrieval is a ‘memory modifier’ (Bjork, 1994)
Second Major Finding: People Need a Conceptual Framework to Effectively Integrate New Information

There is value to conceptual frameworks vs. knowledge alone.
The chessboard challenge

Adopted from How People Learn, & Chase & Simon 1973
Can you correctly place the 25 chess pieces?
Chess masters – Class A players – Beginners

Number of pieces correctly recalled vs. trial number.
Board #2

### Graph

- **Y-axis**: Number of pieces correctly recalled
- **X-axis**: Trials

**Lines**:
- **Blue**: Master
- **Red**: Class A
- **Green**: Beginner
The Nature of Expertise:

- Experts organize their knowledge into a framework

- Experts notice and remember large amounts of complex information in their discipline after short exposures to a new situation
Take a minute and try to learn the symbols associated with each of the numbers below

8 □
5 □
6 □
3 □
2 □
4 □
9 □
7 □
1 □
Draw the shapes associated with the individual numbers

6
1
4
9
How did you do?

6 □
1 □
4 □
9 □
Would it be easier if you knew the conceptual framework?
Seeing the framework in the material can make learning easier and more effective.
Third Major Finding:  
People have Alternate Conceptions  
(also called misconceptions)

These can be addressed with certain learning opportunities.
Science of Learning

Science of Learning

- Audio-visual
- Demonstration
- Discussion
- Lecture
- Practice
- Reading
- Teaching each other

Average Retention Rate of Content

Take Home Message:

The person doing the talking is doing the learning!
In this session we have:

- Listed key findings from cognitive research about how people learn
- Described how the testing effect impacts metacognition
- Distinguished traits of expert and novice learners
- Ranked methods that help people learn best based on literature
EXAMPLE: A Low Tech Individual Response system!
Use the cards provided to answer the following question-Blue for yes, Green for no.

Have you used an individual response system before?

A) Yes
B) No
For those of you who teach, approximately how large is the largest class that you teach?

A) 1-10
B) 11-25
C) 25-100
D) 101-500
E) 501-1500