Applying Research on Learning to Improve Teaching

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The Cognitive Science Perspective
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- Emotion
- Retrieval Practice
- Metacognition
- Spacing
- Active Learning
- Motivation

Cognitive Science Research on Learning and Memory
Which one is the real penny?
What will your students remember?

Long-Term Memory for Information Taught in a Child Development Course

- A Students
- B and Below

Percent Retention vs. Retention Interval in Years

Ellis et al., *Contemporary Educational Psychology*, 1998
The Benefits of Testing

The Benefits of Retrieval Practice

- **Participants** - 80 Purdue University undergraduates
- **Materials** - A 276-word science text on Sea Otters
- **Design** – Four learning condition groups:
  - Group 1 - Study once (read passage once)
  - Group 2 - Repeated study (read passage four times)
  - Group 3 - Concept mapping (generate graphical scheme)
  - Group 4 - Retrieval practice (free recall content of passage)

- **Also**: Prediction of learning after one week
- **Final Test**: 1 week delay -- Verbatim and Inference questions

Verbatim Question:
What does sea otter fur consist of?
(Answer: Sea otters have a double-layered fur, with a coarse outer layer and a finer inner layer)

Inference Question:
What would be the consequences of removing sea otters from their environment?
(Answer: There would be a lack of protection of kelp and seaweed, because fewer otters would eat the invertebrates that destroy kelp and seaweed. The presence of more invertebrates would change the ecosystem.)
Test Results After 1-Week Delay

- **Verbatim Questions**
  - Study
  - Repeated Study
  - Concept Mapping
  - Retrieval Practice

- **Inference Questions**
  - Study
  - Repeated Study
  - Concept Mapping
  - Retrieval Practice
Results – Student’s Predictions

![Bar Chart: Metacognitive Predictions]

- Study
- Repeated Study
- Concept Mapping
- Retrieval Practice

Judgment of Learning
Metacognitive Results – Student’s Predictions

![Graph showing metacognitive predictions and inference questions. The x-axis represents different learning activities: Study, Repeated Study, Concept Mapping, Retrieval Practice, and the y-axis represents judgment of learning ranging from 0.0 to 0.8. The graph indicates that students tend to overestimate the effectiveness of study and repeated study, while more moderate predictions are made for concept mapping and retrieval practice.](image-url)
Recommendations for using Retrieval Practice

- Create opportunities for students to retrieve information
- Using testing and quizzing to improve learning
- Teach students about judging their own learning
Retrieval Practice – Key Ideas

“Research on retrieval practice suggests a view of how the human mind works that differs from everyday intuition.”

“Retrieval is not merely a readout of the knowledge stored in one’s mind; the act of reconstructing knowledge itself enhances learning.”

Karpicke and Blunt, Science, 2011
What is the “Spacing Effect”?

Learning Gap

Test Delay

Time
Recent Research on Spacing

Cepeda et al., *Experimental Psychology*, 2009

**Learning Gap**
- Learn facts or object names
- Learning gap of 0, 1, 7, 28, 84, or 168 days

**Test Delay**
- Review facts and object names
- 6-month delay
- Final Test

**Time**
Recent Research on Spacing

The graph shows the percent correct recall over the learning gap in days. The blue line represents facts, while the red line represents objects. The graph indicates that the percent correct recall for facts increases significantly over the first few days of the learning gap, peaks, and then remains relatively stable. In contrast, the percent correct recall for objects increases more gradually and also remains stable after an initial increase. This suggests that spacing out learning intervals can enhance retention, especially for facts.
Recent Research on Spacing

Cepeda et al., *Experimental Psychology*, 2009

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**Time**

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Recommendations for using Spacing

Exposé students to key facts at least twice

Longer spaces between learning episodes may result in longer-term retention

Consider the use of cumulative exams to promote spaced study
1. Determine what you want your students to know over the long-term.

2. When teaching, include opportunities for retrieval practice.

3. Present key information at least twice with long gaps (on the order of months) between presentations.
A Little Retrieval Practice...

Which one is the real penny?
Recommended Reading


For Additional Ideas and Assistance

Visit The Teaching Center Web site:
http://teachingcenter.wustl.edu

Schedule a teaching consultation:
Gina Frey, Ph.D.
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Concept Mapping