Teaching to Prioritize Learning

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Yale-NUS, March 2016

With contributions from:
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Today’s Goals

• Relate fundamental research about learning to your teaching
• Exchange ideas about effective teaching approaches
• Help your students develop strategies to improve their studying and learning
What do you know about how your students learn?
Research provides a foundation for understanding how people learn.

Bransford et al, 2000

Ambrose et al, 2010
Research provides a foundation for understanding how people learn

Major conclusions:

1. Learning depends on students’ prior knowledge

2. Learning relies on a deep foundation of factual knowledge and a strong conceptual framework.

3. Students benefit from an ability to monitor their own learning (metacognition)
Try to remember this string of letters

gbrchaornmrghjbned
Try to remember this string of letters

iatealargeredapple
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
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<th>K</th>
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<th>N</th>
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<th>R</th>
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<tbody>
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<th>S</th>
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<td>1</td>
<td>4.5 x 40</td>
<td>8 x 60</td>
<td>M8</td>
<td>4.5 x 16</td>
<td>3.5 x 15</td>
<td>1</td>
<td>1</td>
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</tbody>
</table>

Tools not included
Werkzeuge nicht mitgeliefert
Herramientas no incluidas
Ferramentas não incluídas
Accessori non forniti
Gereedschap niet bijgeleverd
How is function of structure altered if cc breaks?
Fundamental Principles of Learning

- Interference
- Retrieval vs. Review
- Confirmation Bias
- Organization
- Context & Framework
A note about these psychology demos:

- Our demos are simplified exercises to illustrate fundamental principles of learning
- These principles hold up in more complex contexts
Fundamental Principles

Interference
Demo 1: Interference
Interference: A Consequence of Short-term Memory

Murdock, 1962
How can you apply knowledge of interference to your teaching?

[2 min]
Fundamental Principles

Interference

Organization
Demo 2: Organization
Hierarchical Organization

<table>
<thead>
<tr>
<th>Rare</th>
<th>Metals</th>
<th>Alloys</th>
<th>Minerals</th>
<th>Stones</th>
<th>Masonry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Platinum</td>
<td></td>
<td>Sapphire</td>
<td>Limestone</td>
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<td></td>
<td>Silver</td>
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<td>Emerald</td>
<td>Granite</td>
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<td>Marble</td>
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<td></td>
<td>Lead</td>
<td>Brass</td>
<td>Ruby</td>
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<td>Iron</td>
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</tbody>
</table>

Random: 19%
Organized: 65%

Bower, Clark, Lesgold & Winzenz, 1969
Also see Mandler, 1967
How can you apply knowledge of organization to your teaching?

[2 min]
Fundamental Principles

Interference

Organization

Context & Framework
Demo 3: Context & Framework
Bransford & Johnson, 1972

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No Context</strong></td>
<td>No</td>
<td>Context Before</td>
</tr>
<tr>
<td>Comprehension</td>
<td>2.30</td>
<td>6.10</td>
</tr>
<tr>
<td>Recall</td>
<td>3.60</td>
<td>8.00</td>
</tr>
<tr>
<td><strong>Maximum Score</strong></td>
<td></td>
<td>7.00</td>
</tr>
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</table>

Context After Partial Context
Build BOTH

Factual Knowledge

Conceptual Framework
What are the key conceptual frameworks in your field?

**Sciences:**
- Forms of energy
- Biodiversity
- Thermodynamics

**Social sciences:**
- Supply and demand
- Post-colonialism

**Humanities:**
- Philosophical world views
- Literary theory
How can you apply knowledge of context & frameworks to your teaching?

[2 min]
Fundamental Principles

- Interference
- Organization
- Confirmation Bias
- Context & Framework
Demo 4: Confirmation Bias

We better attend to and remember things that *confirm* our hypotheses.

 Enter your first sequence here:

[ ]  [ ]  [ ]  [ ]

Obeys the rule
Prior Knowledge

“Prior knowledge can either facilitate or interfere with new learning”

-Reaching Students, Chapter 3
How can you apply knowledge of confirmation bias to your teaching?

[2 min]
Fundamental Principles

Interference

Retrieval vs. Review

Confirmation Bias

Organization

Context & Framework
Demo 5: Retrieval and Review
4. Answer these final true/false test questions about operant conditioning:

Operant conditioning is a way in which behavior is shaped by its consequences.

True or False

Classical conditioning is a way to promote or inhibit a behavior by pairing it with a positive or negative stimulus.

True or False

Gambling is an example of operant conditioning.

True or False
Operant conditioning is a learning process in which behavior is sensitive to, or controlled by, its consequences. For example, a child may learn to make a cute face to get their parents to give them something they want, or a child might learn to avoid touching a hot stove. In contrast, classical conditioning causes an otherwise neutral stimulus (sight, sound, event, etc.) to signal a positive or negative consequence. For example, the sight of a colorful wrapper comes to signal "candy", causing a child to salivate, or the sight of the dentist’s office comes to signal an unpleasant experience, causing the heart to start pounding. (Adapted from Wikipedia)

Study Question

Are the following examples of classical or operant conditioning (or neither)?

a) A child won’t touch a hot stove because it hurt her last time she did.
   ____________________________.

b) The stove makes a hissing sound so she jumps away from it.
   ____________________________.

c) A child whines to get out of going to the dentist’s office.
   ____________________________.

d) A child likes the dentist because he is nice to her.
   ____________________________.

Study Question

Are the following examples of classical or operant conditioning (or neither)?

a) A child won’t touch a hot stove because it hurt her last time she did.  
   Operant Conditioning

b) The stove makes a hissing sound so she jumps away from it.  
   Classical Conditioning

c) A child whines to get out of going to the dentist's office.
   Operant Conditioning

d) A child likes the dentist because he is nice to her.
   Neither
You just experienced reading and remembering a passage of text containing information on a single topic.

What percentage of factual information in the text do you think you could correctly recall after 7 days if you took one of the following study approaches:

1. No further studying

2. Repeated study (review): re-read text three more times immediately thereafter, 5 min. each time

3. Spend 25 min. creating a concept map with text in hand

4. Retrieval: Spend 10 min. writing down everything you remember. Read text again for 5 min., and write down everything you remember a second time for 10 min.
Retrieval Practice

A

Verbatim Questions

Proportion Correct

0.8

0.7

0.6

0.5

0.4

0.3

0.2

0.1

0.0

Study

Repeated Study

Concept Mapping

Retrieval Practice

B

Inference Questions

Proportion Correct

0.8

0.7

0.6

0.5

0.4

0.3

0.2

0.1

0.0

Study

Repeated Study

Concept Mapping

Retrieval Practice

How can you apply knowledge of review vs. retrieval to your teaching?

[2 min]
Retrieval Practice

Students are poor judges of successful study strategies

Applying these principles

Instructions for groups:

1. Discuss ways to apply your assigned principle to your teaching

2. Choose 2-3 applications to share with the full group

You have 7 minutes, start now
Metacognition

Awareness or analysis of one’s own learning or thinking processes.

(Merriam-Webster, 2012)
Strategies for enhancing student metacognition:

- Often part of active learning
- Feedback (1 minute paper, midcourse evaluation)
- Exam wrappers or other follow up
- Learning paragraphs, summary sheets

(Mary Pat Wenderoth, U. of Washington)
Learning Paragraphs

• Respond to question posted on web
• Due before class

Learning 4/28/08

What is the one concept that is the most challenging to master? Please also explain why it is challenging for you.
Learning Paragraphs

Example End-of-Semester Question:
How has reflecting on your learning each week influenced your learning?

Results:
• 85% noted a positive influence on learning
• Students stopped for a moment in their busy worlds.

Mary Pat Wenderoth, U. of Washington
Example of Framework: Summary Sheets
Three major conclusions:

1. Learning depends on students’ prior knowledge.

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

3. Enhance students’ ability to monitor their own learning (metacognition).
Many Factors Affect Learning

- Working Memory Limits
- Interference
- Context & Framework
- Confirmation Bias
- Retrieval vs. Review
- Attention & Motivation
- Stress & Emotion

Stress & Emotion: Phelps, 2006; McEwen & Sapolsky, 1995
Attention & Motivation: Craik et al., 1996
Today’s Goals

• Relate fundamental research about learning to your teaching

• Exchange ideas about effective teaching approaches

• Help your students develop strategies to improve their studying and learning
Additional resources/references


