

Student Learning 1.0: Three Strategies to Improve Student Learning

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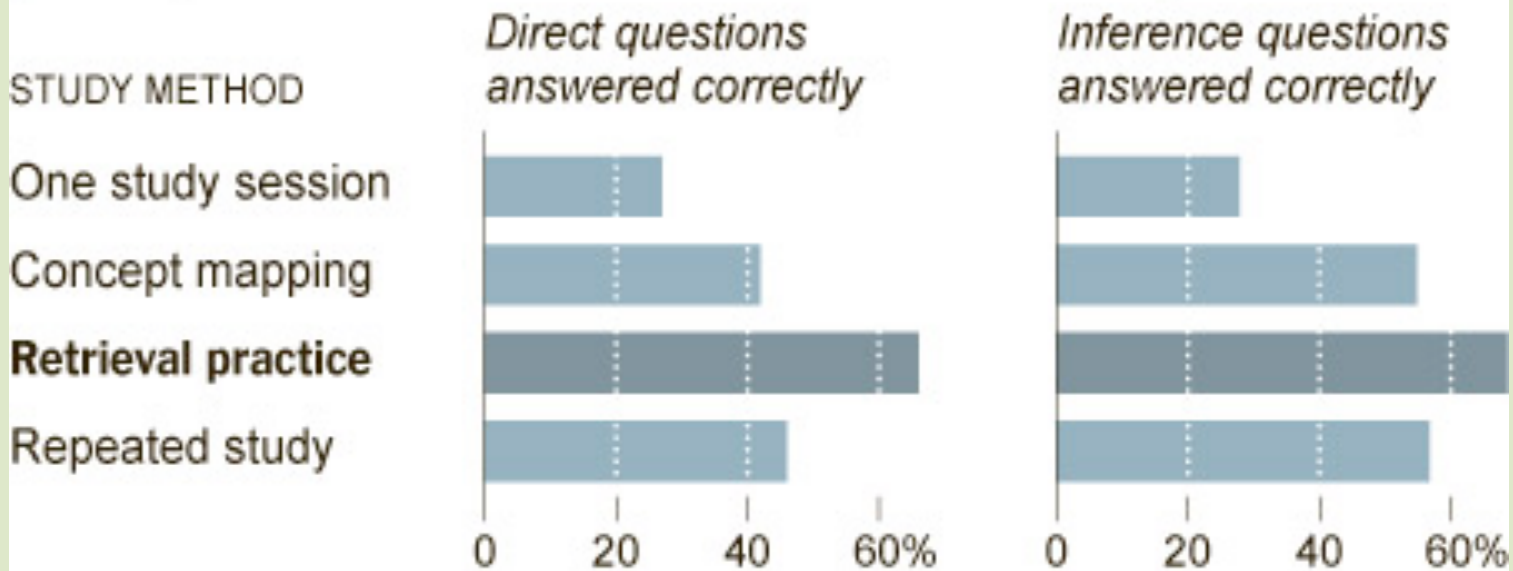
Three Strategies to Improve Learning

1. Retrieval Practice—students try to recall what they learned
2. Distributed Practice—students learn more when they distribute study over time rather than cram all at once
3. Worked Examples—students study *worked out* examples of problems

Retrieval Practice--Taking a Test Can Improve Students' Learning

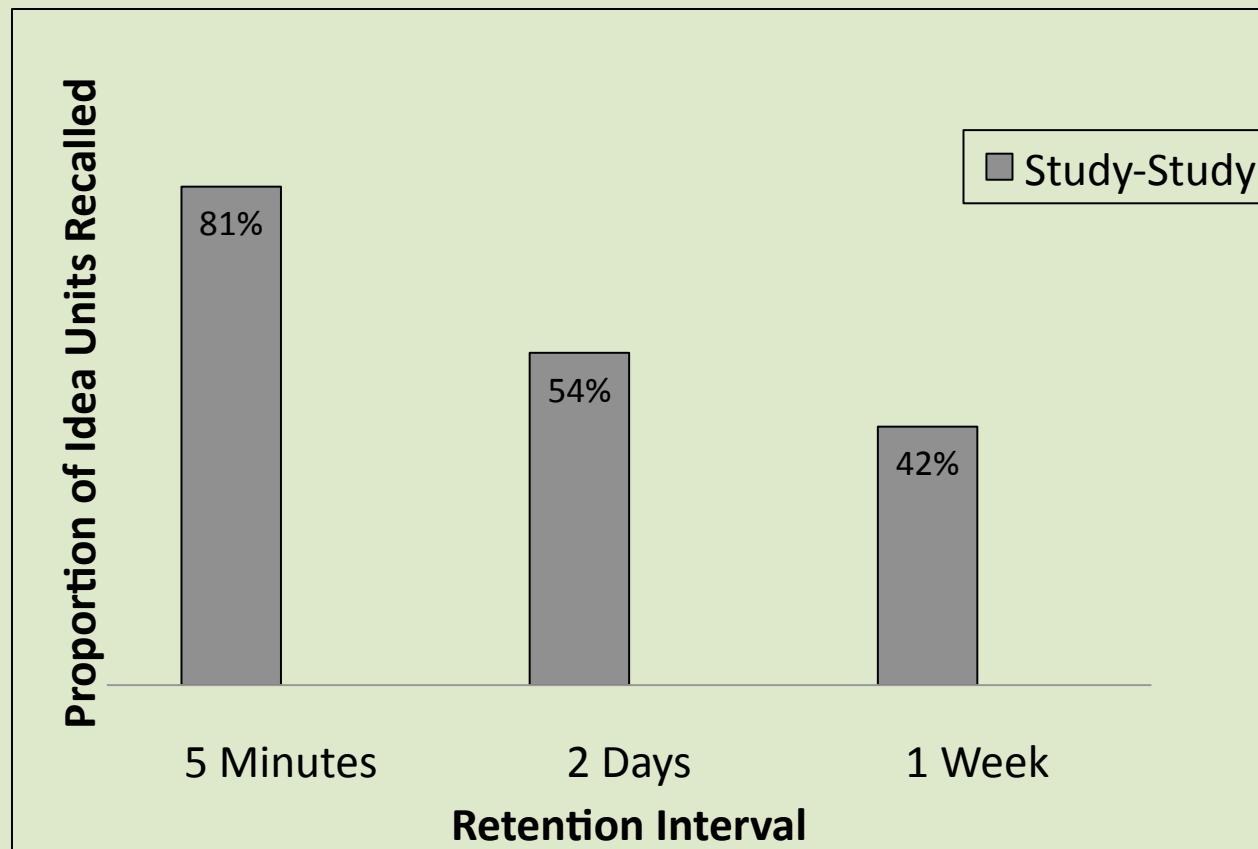
Learning Through Testing

Researchers asked college students to study a short science text using one of four study methods, then tested them a week later. The most effective study method combined two study sessions with retrieval practice, tests that asked the students to recall what they had read.

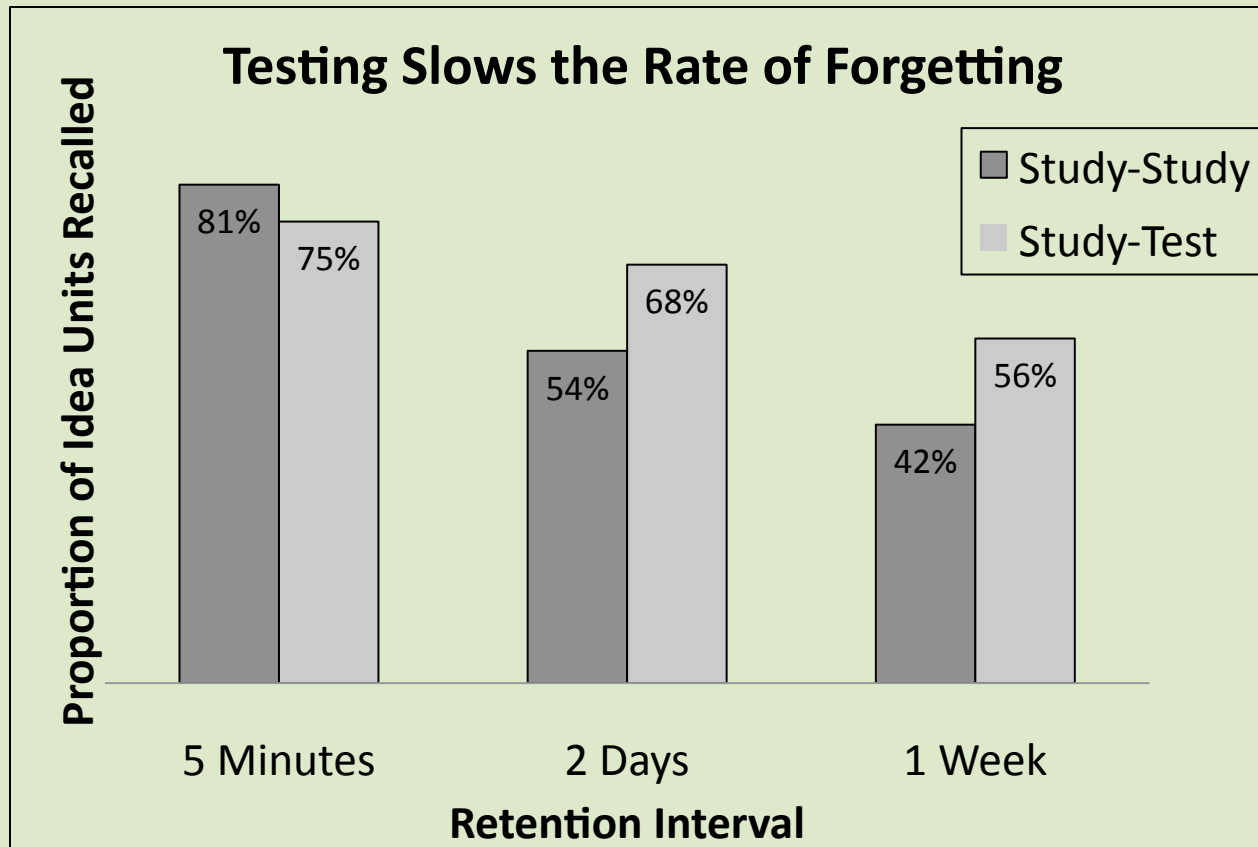


Source: Science

Test Effect



Test Effect



Guidelines for Taking Advantage of the Test Effect

- *Retrieval Practice* = recalling what you already learned—not re-studying what you learned and also it is not studying tests.
- Effect is strongest with short answer tests, weaker with multiple choice. And when students get feedback.
- Might have to convince students to exert effort. They believe retrieval practice is not as effective as additional studying or other study methods.
- When to use? Where would this fit in your classes, e.g., well placed quizzes. Overuse may dilute student effort.
- Encourage self testing in students, individually and in groups

Distributed versus Massed Practice

Massed practice = study material in one setting,
e.g., cramming

Distributed practice = allocate study over
separate sessions

Spacing Effect

Distributing study time over several sessions leads to better memory of the information than trying to learn the material in a single session.

Evidence for Spacing Effect

Consistent and strong effect on learning, e.g., average score of students in spaced practice is greater than 67% of students in massed practice

Cool Study of Long Term Retention

Students learned 50 Spanish vocabulary words.

3 groups of students, each practiced 7-8 sessions

Interval between study sessions	% Words Recalled after 8 Years	Multiple Choice Test after 8 Years
Few Minutes	6	71
One Day	8	80
One Month	15	83

Classroom Applications?

- Identify key ideas for distributed study
- Design homework assignments that distribute practice
- Discourage cramming and promote distributed practice
- Try to identify segments or chunks that can be practiced via different methods, e.g., discussion, quizzes, self-testing

Worked Examples

FIGURE 9-6
Performance on
learning and
transfer for two
instructional groups

<i>Group</i>	<i>Learning</i>		<i>Transfer Test</i>	
	<i>Time (in Seconds)</i>	<i>Effort Rating</i>	<i>Percent Correct</i>	<i>Effort Rating</i>
Learning by doing	1406	4.50	28%	6.10
Learning from examples	625	3.30	62%	5.20

Source: Adapted from Paas, F. G. W. C., & van Merriënboer, J. J. G. (1994). Variability of worked examples and transfer of geometrical problem-solving skills: A cognitive load approach. *Journal of Educational Psychology*, 86, 122–133. Copyright © 1994 by the American Psychological Association. Adapted with permission.

Guidelines for Worked Examples

- Expert-reversal effect—worked examples are good in the initial stages of learning but may be detrimental after students have learned the concepts and procedures
- Transition from worked examples to full problems (fading)
- Include self-explanation questions with worked examples
- Supplement worked examples with effective explanations

Findings

- Can lead to faster learning and better transfer to new situations
- Elaborated explanations of steps better than short explanations
- Good problem solvers explain the steps of the solution to themselves (self explanation)
- Fading
- Comparing examples

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TEST-ENHANCED LEARNING

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WORKED EXAMPLES

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THE END

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