The Science of Memory: What We Know, and How to Help Students Study Better

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Learning Styles? Learning Pyramid?





Source: National Training Laboratories, Bethel, Maine

Random Controlled Trials



Guess!

- distributed practice
- elaborative interrogation
- highlighting (or underlining)
- imagery use for text learning
- interleaved practice
- keyword mnemonic
- rereading
- practice testing
- self-explanation
- summarization



Technique	Utility
Elaborative interrogation	Moderate
Self-explanation	Moderate
Summarization	Low
Highlighting	Low
The keyword mnemonic	Low
Imagery use for text learning	Low
Rereading	Low
Practice testing	High
Distributed practice	High
Interleaved practice	Moderate

The Science of Memory







Image: Times Higher Ed

"Brain-Based" Publications

- Brown, P, Roediger, H., & McDaniel, M. (2014). *Make It Stick: The Science of Successful Learning*. Harvard University Press.
- Dunlosky, J, Rawson, K., Marsh, E., & Nathan, M. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, 14, 4-58.
- Karpicke, J and Roediger, H. (2008). The critical importance of retrieval for learning. *Science*, 319, 966-968.
- Sousa, D. (2011). *How the Brain Learns*. Corwin Press.

Principles

A N

S

W

E R Principles

Attention Ν S W Ε R



ATTENTION

Image: https://www.canstockphoto.com/illustration/five-finger.html

- Dollar bill
- Dice
- Tricycle
- Four-leaf clover
- Hand
- Six-pack
- Seven-up

- Octopus
- Cat lives
- Bowling pins
- Football team
- Eggs
- Friday
- Valentine's day



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What about multi-tasking?





Image: Getty



Photo: Brett Jordan

How long can the average first year student pay attention?

5 minutes 10 minutes 15 minutes 30 minutes 60 minutes



Time



Attention

Time



Principles

Attention Novelty S W Ε R



Photo: Robert Harding / MasterFile



Safe Environment







Man Tries to Hug a Wild Lion, You Won't Believe What Happens Next!

EARTH PORM - 1620 COMMENTS





Principles

Attention Novelty Spacing W E

R

Image: Scantron.com





Why do students cram?



Image: Getty



Interleaved (Mixed) Practice



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Interleaving



Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, *14*(1), 4-58. Spacing Effect + Interleaving =

?

Spacing Effect + Interleaving =

Ongoing Cumulative Testing

Principles

Attention Novelty **S**pacing Why E R

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Context

- Concept maps
- Mind maps
- Flow charts
- Examples
- Elaboration



Image: Leidy Klotz

Principles

Attention Novelty **S**pacing Why **E**motion R



http://audrageras.com

EMOTION

JK Rowling's revenge: Harry Potter author reveals she based one of her most evil characters on a teacher she hated at school

- JK Rowling said hated character was based on a teacher from school days
- She did not reveal the identity of woman who inspired Dolores Umbridge
- · But she said she disliked the teacher on sight because of twee accessories



Image: Murray Close

What can YOU do to create positive emotions in class?



Image: <u>Averett.edu</u>

Principles

Attention Novelty **S**pacing Why Emotion **Retrieval**





Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, *14*(1), 4-58.



Image: Melany Sarafis



Image: Getty



Image: Kriemer / Shutterstock

Interrupting the Forgetting Process



Interrupting the Forgetting Process



Retrieval:



http://www.worldsciencefestival.com/2014/09/so-you-think-recognize-penny/

Retrieval:



Nicholas Carr, The Shallows (2011)



Principles

Attention Novelty **S**pacing Why **E**motion **R**etrieval



Changes to Syllabi

- Policy against laptop use (?)
- Set context for why this class is important and relevant to their future
- Link students to study skills materials (see below)
- Humanize and introduce the instructor to increase approachability and likability

Changes to Course Design

- Cumulative assessment structure
- Frequent quizzes
- Include unannounced quizzes
- Intentional interleaving within quizzes
- Implement flipped (or "scrambled") design

Changes to Lesson Plans

- Cold-call on (some?) students without raised hands
- Use first and last minutes of class wisely
- Make students guess before giving answers
- Do not distribute PPT slides
- Present lectures in chunks and include attention resets
- 280 Interactive Techniques (CATs): <u>http://bit.ly/interactivetechniques</u> (example on next slide)

http://bit.ly/interactivetechnigues

- 104. <u>Pair-Share-Repeat</u> After a pair-share experience, ask students to find a new partner and debrief the wisdom of the *old* partnership to this *new* partner.
- 105. <u>Teach-OK</u> The instructor briefly explains a concept. The teacher then says "teach!", and the students respond "OK!" Students then form pairs and take turns re-teaching the concept to one another.
- 106. Wisdom of Another After any individual brainstorm or creative activity, partner students up to share their results. Then, call for volunteers of students who found their partner's work to be interesting or exemplary. Students are sometimes more willing to share in plenary the work of fellow students than their own work.
- 107. Secret-Write and Reveal Students individually write down a guess on a prompt given by the teacher, but keeps the answer hidden from partner. Then, everyone reveals and discusses why they had different answers.
- 108. <u>Human Flashcards</u> Students take turns calling out terms they were expected to memorize, and demand an answer from their partner.
- 109. <u>Storytelling Gaps</u> One partner relay a story that summarizes learning in the chapter so far, but leaves out crucial fine information (such as dates that should have been memorized). The partner listens and records dates silently on paper as the story progresses and then updates the first person.
- 110. Do-Si-Do Students do partner work first, then sound off by twos. All of the 2's stand up and find a new partner (the 1's are seated and raise their hands until a new partner comes), then debrief what was said with the first partner. Variation: Later, all the 1's come together in a large circle for a group debrief, while the 2's have their own circle.
- 111. Forced Debate Students debate in pairs, defending either their preferred position or the opposite of their preferred position. Variation: Half the class takes one position, half the other. The two halves line up, face each other, and debate. Each student may only speak once, so that all students on both sides can engage the issue.

But what about students' burden?



Image: Economic Times



https://www.learningscientists.org/

See especially the downloadable posters: <u>https://www.learningscientists.org/s/</u> <u>All-Color-Posters-gsaw.pdf</u> Principles



Study Skills Tips

https://bit.ly/Yee-Study-Skills







- 24. Always take notes, even in classes that don't seem to demand it. There is a wellknown phenomenon called the "illusion of mastery" that occurs when students hear an expert explain advanced concepts. During the expert's explanation, students have no questions and thus may not take notes, but many struggle to recreate the skill, logic, or knowledge once away from the expert. Resist the temptation to assume it will be equally obvious later, and record notes during the lecture.
- 25. **Balance note-taking and careful listening**. Because the brain can't truly do two things at one time, any time you spend writing notes will mean reduced attention to the continuing lecture. But notes are important not only for later studying; they also help with starting the process of storing memories. The mere act of taking notes on things that you see, hear, and think creates associations in the brain, and since memories are associative, the taking of notes will improve recall over just listening even if the notes are not looked at later (but they <u>should</u> be looked at!)
- 26. **Take notes for studying, not for comprehensiveness**. Instead of taking notes that try to capture EVERYTHING, aim to take notes which can encourage later recall. That might mean a focus on concepts and definitions, or perhaps formulas. Faculty seldom pack all relevant information into the lectures; the reading covers many important ideas as well. Your job is to record the connections, context, and connotations that are not obvious in the reading. Of course, you need to have done the reading ahead of time!
- 27. **Take notes FAR beyond what's displayed on screen**. Simply capturing the displayed words accurately will often not be enough to jar your memory about the crucial steps, relationships, and concepts discussed while these words were displayed. Take notes that capture the lecture and discussion as well as the slide content.