Make It Stick: A short summary to make you want to read and use the book

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Presenters

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Make It Stick: The Science of Successful Learning

- Peter C. Brown – former CEO of AMC Theaters; philanthropist; book author - management/ novel/history from St. Paul, MN
- Henry L. Roediger III – James S. McDonnel Distinguished University Professor of Psychology at Washington University in St. Louis
- Mark A. McDaniel – Professor of Psychology and Director of the Center for Integrative Research on Cognition, Learning, and Education (CIRCLE) at Washington University in St. Louis

The principles of LEARNING from MIS

- To learn - Retrieve
- Space practice
- Incorporate reflection
- Organize by interleaving
- Avoid the illusion of knowing
- ~~Use elaboration and generation~~
- Embrace difficulty
- Cultivate a growth mindset
- ~~Forget about learning styles~~

Application of the Make It Stick principles will improve learning

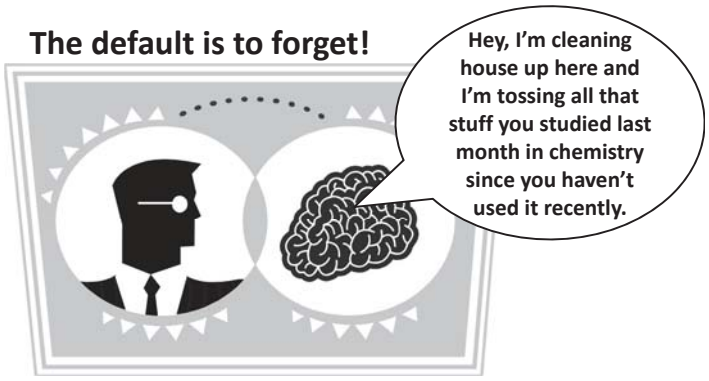
- If students apply these principles in their study planning, it will make their studying more efficient i.e. More productive for the time invested
  - And you can give them better study advice
- If teachers apply these principles in the design of instruction, it will improve the learning of the class as a whole

Objectives

- Upon completion of this session, you will:
  - Discuss at least 4 principles of learning from Make It Stick
  - Identify at least one principle that you will incorporate into a current or future course and develop the plan for doing so
  - Develop strategies for helping students incorporate Make It Stick principles into their study

To Learn – Retrieve!

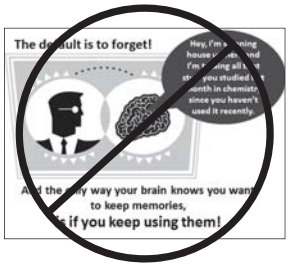
The default is to forget!



And the only way your brain knows you want to keep memories,

is if you keep using them!

WE MUST USE RETRIEVAL (recall) OF MEMORIES with feedback TO OVERCOME THE DEFAULT OF FORGETTING



The only studying or practice strategies that truly contribute to learning incorporate retrieval.

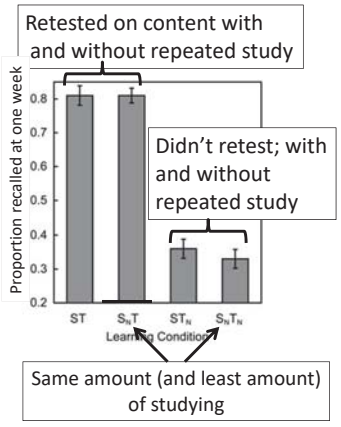
- **The common student practice of reading through lecture notes does not incorporate retrieval**
- **Even reading a textbook does not include retrieval**

After an introduction to the content via lecture or reading, "testing" is a more effective STUDY/PRACTICE strategy than re-reading/studying

This is called the testing effect

Testing is more effective than studying for learning

" **testing (and not studying) is the critical factor for promoting long-term recall.** In fact, **repeated study** after one successful recall **did not produce any measurable learning** a week later. In the learning conditions that required **repeated retrieval practice** (ST and S_NT), **students correctly recalled about 80% of the pairs on the final test."**



Karpicke JD, Roediger HL 3rd.The critical importance of retrieval for learning. Science 2008: 319: 966.

Advice to students to take advantage of the "testing" effect

Any activity that requires recall/retrieval AND provides feedback can produce the same effect – like flash cards; redrawing pathways

Students can quiz each other!

It doesn't have to be a teacher-prepared TEST

Advice to students to take advantage of the "testing" effect

When using practice questions (like in review books) ALWAYS answer from memory first

Then check answers. But activate the retrieval process first.

Advice to students for incorporating retrieval into reading texts/notes

1. Read the chapter or a section of it (concentrating as you go)
2. Close the book and say out loud (or write down but saying is better) what you remember – be as specific as you can
3. Re-read the passage, close the book, and re-say what you remember….it should be more

Advantages – faster than taking notes, improved learning and retention of info as compared to underlining/highlighting; incorporates retrieval and feedback

Take advantage of the testing effect in instructional design – just a few ideas

- Incorporate low stakes, frequent quizzes with feedback
- Use pretesting to make students more receptive to the upcoming lesson
- Use in-class questions e.g. Clickers; 3x5 cards
- Even open-book questions can work IF students try answering the question before looking it up

Spaced Practice

Spaced Practice

- Massed practice does provide quick improvement (Think – cramming) but no sustained learning
- Repeated **shorter duration** practice sessions **spaced in time** from one another induce more long-term retention
- Must be spaced – forgetting is essential for new learning

Incorporating SPACED practice into instruction

- Comprehensive tests within a course – not just a comprehensive final
- Later assignments that rely on earlier content
- Sprinkle practice in shorter sessions over more days
- Schedule classes to have built in periods of forgetting (3 d/wk) – don't use instructional blocks
- Develop spiral curricula that split content in time
- Pre-tests on pre-requisites

Reflection

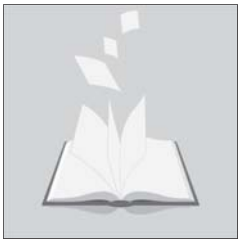
Reflection is a variation on practice

- It can involve:
  - Evaluation of past performance and planning for change
  - Anticipation of future performance i.e. rehearsing

Incorporating Reflection into instruction

- Direct students to reflect at intervals on their learning /past performance
  - What went well?
  - What could have gone better?
  - What other knowledge or experience does this remind you of?
  - What strategies might you use the next time to get better results or be more efficient?
- Help students learn to use mental rehearsal of technical tasks when they can't be in lab

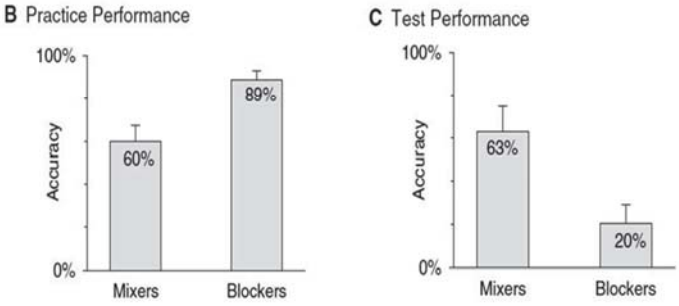
Interleaving



Interleaving

- Also known as Varied practice/Mixed practice
  - Opposed to Block Practice
- Example: If you wanted to learn skills A, B, & C.
  - How would most go about learning these skills?
- Block Practice: AAABBBCCC
- Varied Practice: ABCABCABC or ACBCABCBA

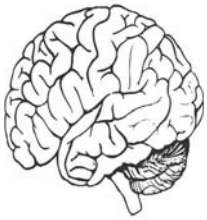
How effective is Interleaved Practice?



- Research "The shuffling of mathematics problems improves learning" by Doug Rohrer & Kelly Taylor

Recap

- Interleaving is the study of multiple subjects in a random order (varied practice)
- Massed practice may lead to higher practice performance, but creates significantly lower retention



Incorporating interleaving into your instructional design

- Create activities and/or quizzes that cover multiple subjects
- Add questions to current exams from previous units. (eg. Unit 1 questions on Unit 3 exam)
- Interleaved course scheduling.

Suggestions to students for interleaving their studying

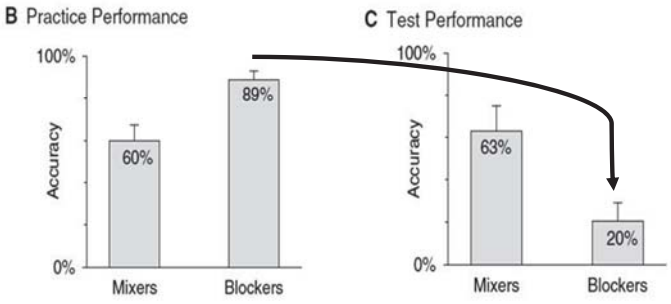
- In a given time period (E.g. 3 hours), study 45 minutes for one course then switch to another course for 45 minutes and come back to the first course in the remaining time

Illusion of Knowing

"Real knowledge is to know the extent of one's ignorance." -Confucius

Illusion of Knowing

- A mistaken feeling of confidence in material.



Illusion of knowing

- Repeated exposure to material ≠ knowing the material
- Massed practice (cramming) leads to an illusion of knowing the material.

Which Penny is Correct?

Illusion of knowing

- How often have we been exposed to a penny in our life-time?
- Has this repeated exposure solidified in our memory the details of the penny?

A

What is the take home message about the illusion of knowing?

- Rereading material is one of the most inefficient ways of studying.
  - Just because one has been exposed to the material several times, does not mean s/he knows it.
- Practicing interleaving will feel less productive, and could possibly result in lower 'practice scores', but ultimately better exam performance.
- Avoid the illusion of knowing by spacing, quizzing, interleaving and practicing retrieval.

EMBRACE DIFFICULTY

Every great and deep difficulty bears in itself its own solution. It forces us to change our thinking in order to find it.
–Neils Bohr

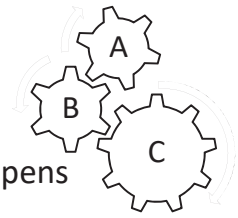
3 Reasons Students Don't Understand This

Deep, Lasting Learning Requires Hard Work

- Encoding
  - Making the beginnings of a brain change- "memory traces"
  - Short term memory
- Consolidation
  - Strengthening the traces- "solidifying and revising"
  - Long term memory building
- Retrieval
  - Periodic practice allows knowledge to stay will us
  - Use it or lose it, at least until a certain amount of practice occurs

HARD Retrieval Practice is GOOD Practice

- Reconsolidation occurs
- Mental models develop
- Mastery widens and deepens



HARD Retrieval Practice is GOOD Practice

- Understand concepts and how they go together
- Use of the knowledge is more versatile
- Struggle builds memory!

Don't go overboard…

- The concept of "desirable" difficulties- Bjork and Bjork

What do we say to our students to encourage them to work hard?

"It turns out that learning that is harder, more effortful, is deeper and durable. So don't be afraid of the struggle. Hard work pays off!"

" This stuff is supposed to be hard. It was hard for me when I had to learn…"

No matter how much "talent" you have…

NOT

A GROWTH MINDSET

Words that describe brain function/intelligence

- *Plastic*
- *Mutable*
- *Adaptable*

What is a growth mindset?

Believing that your intellectual ability isn't fixed but depends on you to a large degree

Read the work of Carol Dweck and her colleagues

One of Dweck's experiments:

The brain, effective study techniques and MEMORY

The brain, effective study techniques and EFFORTFUL LEARNING CHANGES THE BRAIN

What does that look like in our classrooms?

- We <u>model</u> appreciating challenges and we <u>give</u> our students challenging work.
- We <u>expect</u> that it will take our students hard work and discipline to get there.
- We work on "<u>learning goals</u>", not "performance goals."

What do we say to students?

"Know that you CAN learn this stuff, whatever it is. Research shows that you can. BUT your attitude towards the material is really important!"

"If you've already decided that you will fail that test, then you already have, even though it is weeks away. Change the way you are thinking about this!"

"You are more in control than you think. Learning is NOT something that happens to you. It's something that you do!"

Before the summary...the post-test (with feedback)

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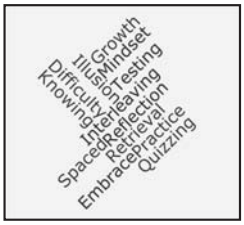
The Make It Stick principles are very interwoven.

Instructional design with study strategies based on these principles will improve student learning.



Get it. Read it. Do it. Recommend it to students.

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Bonus content

How far apart should practice sessions be spaced?

"On the basis of the overall patterns of durability and efficiency, our prescriptive conclusion for students is to practice recalling concepts to an initial criterion of 3 correct recalls and then to relearn them 3 times at widely spaced intervals."

Optimizing schedules of retrieval practice for durable and efficient learning: How much is enough? Rawson KA; Dunlosky J. Journal of Experimental Psychology: General, Vol 140(3), Aug 2011, 283-302.