make it stick - The Science of Successful Learning

A notebook and summary

Michael Obernhumer

6.3.2025

1 Learning Is Misunderstood

- Learning is deeper and more durable when it's effortful.
- *Rereading text* and *massed practice* of a skill or new knowledge among the least productive study strategies.
- *Retrieval practice* - recalling facts or concepts or events from memory (eg testing) - is a more effective learning strategy than review by rereading. Flashcards are a simple example.
- A single, simple quiz after reading a text or hearing a lecture produces better learning and remembering than rereading the text or reviewing lecture notes.
- Periodic practice arrests forgetting, strengthens retrieval routes, and is essential for hanging onto the knowledge you want to gain.
- When you space out practice at a task and get a little rusty between sessions, or you interleave the practice of two or more subjects, retrieval is harder and feels less productive, but the effort produces longer lasting learning and enables more versatile application of it in later settings.
- Trying to solve a problem *before being taught the solution* leads to better learning, even when errors are made in the attempt.
- Learning styles, for example an auditory or visual learners, are not supported by the empirical research.
- When you're adept at extracting the underlying principles or "rules" that differentiate types of problems, you're more successful at picking the right solutions in unfamiliar situations.
  - This skill is better acquired through interleaved and varied practice than massed practice.
- In virtually all areas of learning, you build better mastery when you use testing as a tool to identify and bring up your areas of weakness.
- Elaboration is the process of giving new material meaning by expressing it in your own words and connecting it with what you already know. The more you can explain about the way your new learning relates to your prior knowledge, the stronger your grasp of the new learning will be, and the more connections you create that will help you remember it later.
  - Warm air can hold more moisture than cold air; to know that this is true in your own experience, you can think of the drip of water from the back of an air conditioner
- Learning is stronger when it matters, when the abstract is made concrete and personal.
  - Pilot that trains how to react to an engine failure.
- It makes sense to reread a text once if there's been a meaningful lapse of time since the first reading, but doing multiple readings in close succession is a timeconsuming study strategy that yields negligible benefits.
- Mastering the lecture of the text is not the same as mastering the ideas behind them. However, repeated reading provides the illusion of mastery of the underlying ideas.

- Questions to ask oneself:
  - Could you look at a concept define it, and use it in a paragraph?
  - While you were reading, have you thought of converting the main points of the text into a series of questions and then later tried to answer them while you were studying?
  - Have you at least rephrased the main ideas in you own words as you read?
  - Have you tried to relate them to what you already knew?
  - Have you looked for examples outside the text?
- Most people fall victim to 2 liabilities:
  - a failue to know the areas where their learning is weak
  - a preference for study methods that create a false sense of mastery
- Mastery requires both the possession of ready knowledge (memorized facts) and the conceptual understanding of how to use it.
- One of the best habits a learner can instill in oneself is regular selfquizzing to recalibrate ones understanding of what one does and does not know.

2 To Learn, Retrieve

- Reflection can involve several cognitive activities that lead to stronger learning: retrieving knowledge and earlier training from memory, connecting these to new experiences, and visualizing and mentally rehearsing what you might do differently next time.
- Retrieval makes learning stick far better than reexposure to the original material does.
- To be most effective, retrieval must be repeated again and again, in spaced out sessions so that the recall, rather than becoming a mindless recitation, requires some cognitive effort.
- Students who take practice tests have a better grasp of their progress, spot gaps and misconceptions. Giving students corrective feedback after tests keeps them from incorrectly retaining material they have misunderstood and produces better learning of the correct answers.

3 Mix Up Your Practice

- The mixing of problem types, which boosted final test performance by a remarkable 215 percent, actually impeded perfomance during initial learning.
- Placing too much emphasis on variety runs the risk of underemphasizing repeated retrieval practice on the basics.
- Daily reflection, as a form of spaced retrieval practice, is probably just as critical in the realworld as quizzing and testing is in school.

- Scientists call the heightened performance during the acquisition phase of a skill “momentary strength” and distinguish it from “underlying habit strength.” The very techniques that build habit strength, like spacing, interleaving, and variation, slow visible acquisition and fail to deliver the improvement during practice that helps to motivate and reinforce our efforts.
- The simple act of spacing out study and practice in installments and allowing time to elapse between them makes both the learning and the memory stronger, in effect building habit strength.
  - The interval should be big enough so that practice doesn’t become a mindless repetition.
  - At a minimum, enough time so that a little forgetting has set in.
  - Sleep seems to play a large role in memory consolidation, so practice with at least a day in between sessions is good.
- Something as simple as a deck of flashcards can provide an example of spacing.
- The better your mastery, the less frequent the practice, but if it’s important to retain, it will never disappear completely from your practices.
  - Beware of the familiarity trap: the feeling that you know something and no longer need to practice it.