



Study Smarter, Not Harder

The 20-minute reality check on how learning actually works — the two techniques that beat every other study method, and the popular ones that don't. Every claim tied to its study.

WHAT'S INSIDE

The science of learning, in pointers

In 2013, five cognitive scientists ranked ten common study techniques by how well they actually work — and the results overturned how most students study. This mini gives you the honest map in 20 minutes.

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THE ONE IDEA TO HOLD THE WHOLE WAY

The techniques that feel most productive while you do them — highlighting, rereading — are often the least effective. The ones that feel like a struggle are doing the real work. Comfort is not a signal of learning.

What actually works — the ranked evidence

- **The landmark review:** Dunlosky, Rawson, Marsh, Nathan & Willingham (2013) tested ten popular study techniques against the same evidence bar, across different learners, materials and test types.
- **Only two reached HIGH utility:** practice testing (self-quizzing, flashcards, past papers) and distributed practice (spacing study over time).
- **The rest ranked lower:** elaborative interrogation and self-explanation scored MODERATE; summarizing, highlighting, keyword mnemonics, imagery and rereading scored LOW.
- **The uncomfortable twist:** the two most-used student methods — highlighting and rereading — landed at the very bottom of the ranking.
- **A decade later:** retrieval and spacing got even stronger; interleaving (originally "moderate") passed a 787-student randomized trial in 2020. The bottom never recovered.

REALITY CHECK

"Highlighting and underlining did little to boost performance... they may even hurt by drawing attention to single items rather than connections." — Dunlosky et al., 2013

Retrieval practice: pull, don't put in

- **The testing effect:** retrieving information from memory improves long-term retention more than restudying it for the same time — even with no feedback.
- **Rereading feels like progress** because the text looks familiar. That's recognition, not recall — and recognition collapses the moment the book closes.
- **Your gut is wrong:** students consistently predict rereading will help more than testing. They're consistently wrong — and at a 5-minute delay, restudy even wins by a hair. Testing pulls ahead once real time passes.
- **Four ways to retrieve:** brain dumps (write everything you remember, then fill gaps), turn notes into questions, attempt past papers early, and always attempt before checking the answer.

PRO INSIGHT

The best signal you're doing this right is mild discomfort. If a session feels smooth and reassuring, you're recognising, not retrieving.

CHAPTER 02 · CONTINUED

The evidence: 13% forgotten vs 56%

Roediger & Karpicke (2006), "Test-Enhanced Learning" (Psychological Science): students either restudied a passage or took recall tests with no feedback. Everyone was tested a week later.

56%

forgotten — repeated study
only

26%

forgotten — study + one test

13%

forgotten — repeated testing

- **It beats even "deep" studying:** Karpicke & Blunt (2011, Science) found one session of retrieval scored ~80% on a delayed test vs ~36% for elaborate concept mapping — more than double.

REMEMBER

Same material, same study time — a completely different outcome a week later. The gap only shows up once real time passes.

Spaced repetition: the forgetting curve

- **Ebbinghaus's forgetting curve (1885):** roughly 60–70% of new information is lost within 24 hours if you never revisit it — steep at first, then levelling.
- **Cramming loses to the curve:** but every time you review just as recall starts to fail, the curve resets and flattens. Space reviews right and a handful of short sessions beats hours of massed study.
- **How big should the gap be?** Cepeda, Pashler, Vul, Wixted & Rohrer (2006) pooled 317 experiments, 839 assessments, in *Psychological Bulletin*: the ideal spacing is roughly 10–20% of your retention interval.
- **In practice:** a test in 1 week → review ~1 day apart. A test in 1 year → review ~1 month apart.

ANKI'S ALGORITHM (SM-2)

Each successful recall pushes the next review further out: ~1 day → 6 days → 15 days → 37 days → 90 days. Miss a card and the interval collapses back to a short gap.

The practical version: the 1-3-7-14-30 ladder

DAY	WHAT YOU DO
Day 1	Learn it, then do a first brain dump the same day
Day 3	Self-test before the memory fully fades
Day 7	Recall again — what survives is becoming durable
Day 14 & 30	Two more spaced passes to lock it in

- Honest caveat:** these exact numbers aren't from one single trial — they're a heuristic that approximates the expanding intervals Cepeda and SM-2 both point to.
- Non-negotiable rule:** every spaced pass must be active recall (Chapter 2) — never a reread.

KEY TAKEAWAY

No app? A simple manual ladder captures most of the benefit. The two highest-utility techniques from Chapter 1 — retrieval and spacing — combine directly into this one system.

Interleaving: mixing beats blocking

- **Interleaving:** mixing different problem types within a session (ABCABC) instead of drilling one to exhaustion first (AAABBBCCC). An exam always mixes questions — blocking never trains you to choose the right method.
- **Pain now, gain later:** Rohrer & Taylor's math experiments found mixed practice lowered in-session accuracy (60% vs 89% blocked) — yet the interleaved group scored 63% on the delayed test vs just 20% for the blocked group.
- **It survived a real classroom trial:** Rohrer et al. (2020) ran a randomized controlled trial of 787 students across 54 classes and found a large effect, $d \approx 0.83$.
- **How to do it without chaos:** group 3–4 confusable topics from the same subject, shuffle the problem set, and force yourself to name the method before solving.

WATCH OUT

Interleaving works best after you understand each type at a basic level. Learn a method once in a small block first, then start mixing.

From recall to understanding

- **Elaborative interrogation:** for every fact, ask "why is this true?" — linking new facts to what you already know builds extra retrieval routes. Rated MODERATE by Dunlosky 2013.
- **Self-explanation:** a meta-analysis of 64 studies found prompting self-explanation improved learning by about 0.55 SD across ages and domains.
- **The Feynman technique:** explain a concept in plain language as if to a 12-year-old. Wherever you stumble or reach for jargon, that's a knowledge gap you didn't know you had — return to the source and re-explain.
- **Dual coding:** pairing meaningful visuals with words improved transfer-test scores by +89% across Mayer's ~11 experiments — but only when the visual carries meaning, not decoration.

PRO INSIGHT

The Feynman technique isn't a separate method — it bundles retrieval, gap-diagnosis and elaborative re-encoding in one wrapper. That's why it punches above its weight.

The debunked list: five popular myths

- **Learning styles are a myth:** Pashler, McDaniel, Rohrer & Bjork (2008) found "no adequate evidence base" for matching teaching to a "visual" or "auditory" learner — re-confirmed repeatedly since.
- **Highlighting & rereading:** create an illusion of fluency — familiar text feels "known," but no retrieval effort happened, so the gains fade fast.
- **Multitasking (with a caveat):** Ophir et al. (2009) found heavy media-multitaskers worse at task-switching — but replications have been mixed. Junco (2012) found GPA dropped ~0.12 points per extra 93 minutes/day on social media.
- **The 10,000-hour rule is oversimplified:** Macnamara, Hambrick & Oswald (2014) meta-analyzed 88 studies — deliberate practice explained only ~12% of performance variance on average, and just ~4% in education.
- **Speed-reading hits a wall:** Rayner et al. (2016) confirmed a hard speed–comprehension trade-off — the fovea can't widen. Real speed comes from vocabulary and background knowledge.

Why the myths feel true

26%

variance from practice —
games (chess)

4%

variance from practice —
education

1%

variance from practice —
professions

Source: Macnamara, Hambrick & Oswald (2014), meta-analysis of 88 studies.

Share of performance explained by deliberate practice, by domain.

- **The pattern behind every myth:** each one makes studying feel easy, fast or effortless. Real learning usually involves a little effortful struggle — that discomfort is the mechanism, not a warning sign.

TIP

A good rule of thumb: if a technique makes studying feel easy and fluent, be suspicious.

Focus & memory

- **Pomodoro, honestly:** the exact 25-minute interval isn't empirically derived — Cirillo picked it by personal trial. But time-boxing and planned breaks are well-supported; match block length to the task (25–45 min for drilling, 90–120 min for deep work).
- **Phone "brain drain":** Ward et al. (2017) found working memory was best with the phone in another room — but a 2022 replication failed to reproduce it. Put it in another room anyway; it's a free, zero-downside move.
- **Music with lyrics** impairs reading and verbal memory via the "irrelevant sound effect" — even when it feels motivating. Instrumental or silence for verbal work.
- **Method of loci ("memory palace"):** Dresler et al. (2017, Neuron) found six weeks of training gave memory-naïve adults athlete-like gains lasting 4+ months.
- **Sleep isn't optional:** sleep deprivation cuts your ability to form new memories by ~40% (Walker). A full night beats an all-nighter of extra study.

Exam execution: the playbook

- **Beat test anxiety in 10 minutes:** Ramirez & Beilock (2011, Science) — students who wrote freely about exam worries for 10 minutes right before the test scored significantly higher, largest effect for the most anxious students.
- **Pre-test routine:** sleep, don't cram (the night before) · a brisk 20-minute walk (morning of) · a retrieval warm-up, not rereading (30 min out) · reappraise nerves as readiness (at the door).
- **Guessing strategy:** no negative marking → answer everything. With negative marking → guess only after eliminating 1–2 options; blind guessing on a $-\frac{1}{4}$ penalty is roughly break-even.
- **"First instinct" is a myth:** research on answer changes shows revisions are more often right than wrong when made for a reason — change with a reason, keep without one.
- **Run a post-mortem:** sort every mistake into knowledge gap, careless, misread or timing. Only knowledge gaps need more studying — feed them into your spaced review.

Your study system

- **Build spacing into the calendar:** every topic recurs on the 1-3-7-14-30 ladder — never scheduled just once. Start each block with retrieval before taking in anything new.
- **Realistic blocks:** 50–90 minutes with real breaks, matching Kleitman's ~90-minute basic rest-activity cycle — not a 10-hour marathon you'll abandon by Wednesday.
- **If-then plans work:** Gollwitzer & Sheeran (2006) meta-analyzed 94 tests, 8,000+ participants — implementation intentions produced a medium-to-large effect, $d \approx 0.65$, on reaching goals.
- **The weekly review (30 min, non-negotiable):** check what's due for spaced review, run error analysis on the week's mocks, and re-plan the coming week.
- **Tune it to your goal:** UPSC/JEE/NEET-scale exams lean hardest on spacing — huge volume, long retention interval make it decisive.

START SMALL, START TODAY

Set up a flashcard app and write one if-then plan tonight. A tiny system you run beats a perfect one you never start.

YOU'VE GOT THE MAP. NOW BUILD THE SYSTEM.

This was the 20-minute version. The full guide is the whole journey.

You now know more about learning science than most students ever will. The complete **Study Smarter, Not Harder** guide takes every chapter above and gives you the full evidence hierarchy, diagrams, and exam-ready systems.

- **All 8 chapters** — every technique above, fully illustrated and expanded.
- **The full evidence-at-a-glance table** — every claim traced to its study and key number.
- **Tuned systems by goal** — school, UPSC/JEE/NEET, professional certifications, language learning.
- **The complete FAQ & glossary** — the eight questions every learner asks, answered.
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