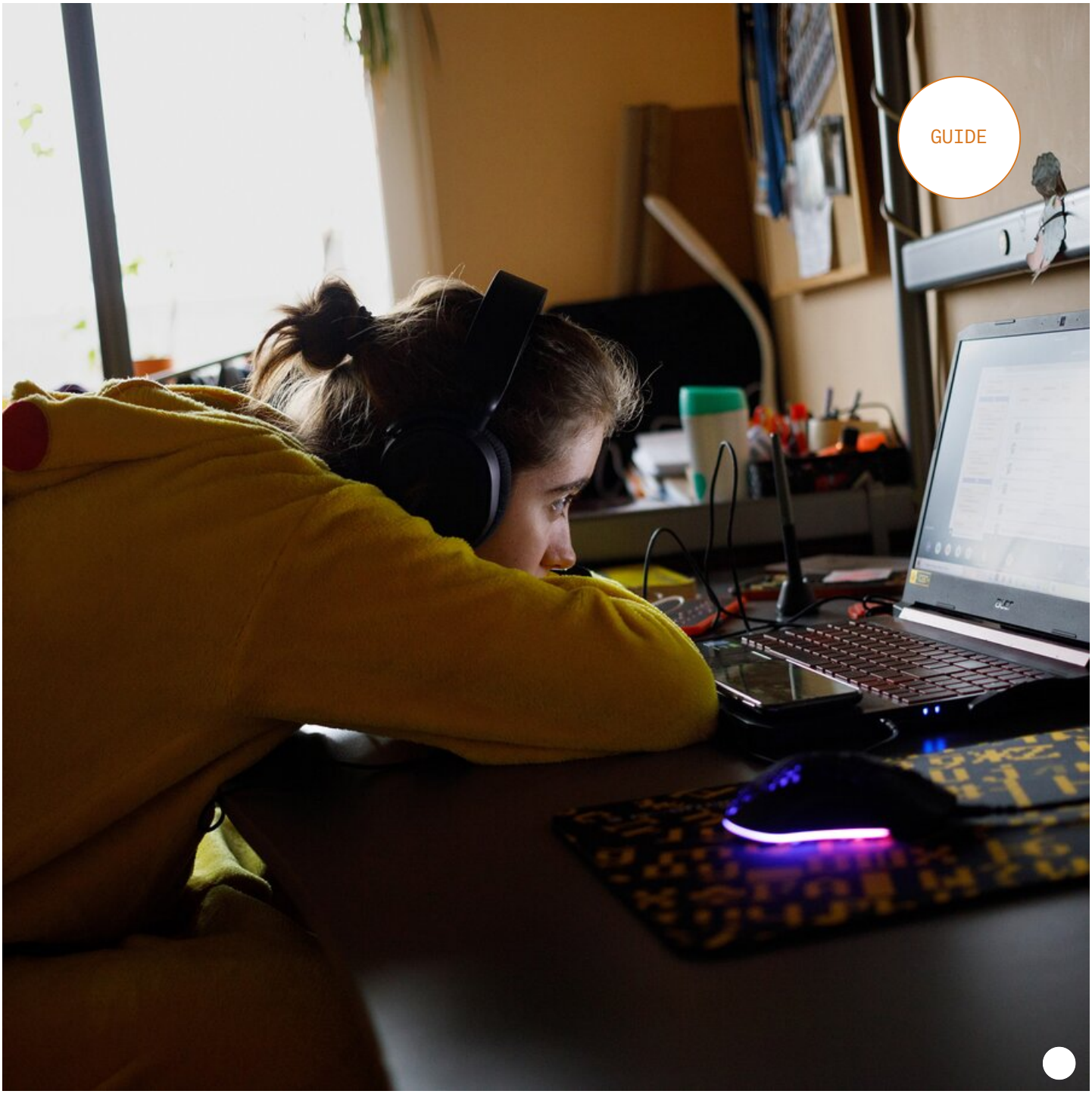


# How to study effectively

Forget cramming, ditch the highlighter, and stop passively rereading. The psychology of learning offers better tactics

by Paul Penn + BIO

## Need to know

It ain't so much the things we don't know that get us into trouble. It's the things we know that ain't so.

> – quotation from the 19th century, likely apocryphal

The year was 1993 and, aged 16, I was about to sit my Geography GCSE exam. This was an 'old school' style public examination, held in the school's gymnasium. A stifling odour of floor wax and dust hung heavy in the air. Victorian-era single desks featuring ink wells that had been utterly redundant for about three generations were arranged into rows with unerring precision. The silence was so unnatural and oppressive, it seemed to have a tangible density.

Nonetheless, I had crammed for this exam like a champion and was feeling confident. I took a deep breath, opened my examination booklet and glanced over the first page of questions. A gut-wrenching realisation quickly dawned on me, captured perfectly by a single piece of graffiti etched into the haggard surface of my desk. It read: 'Oh Sh*t! There goes college, 1992.'

Clearly, I hadn't been the only one whose confidence in their exam preparation was misplaced. However, it wouldn't be until I started teaching psychology some 12 years later that I fully understood why. Here's the bad news: research from psychology indicates that our ability to accurately monitor and evaluate our level of knowledge or skill (referred to as metacognitive ability) is often flawed. These flaws tend to give us an inflated perception of our knowledge and understanding, encouraging us to persevere with ineffective methods of studying that quietly, but persistently, undermine our efforts to learn. It's easy to demonstrate this by examining some preferred study practices and considering the misconceptions about learning that they reflect. Let's kick off things by looking at that perennial favourite: cramming.

> Cramming seeks to stamp things in by intense application immediately before the ordeal. But a thing thus learned can form but few associations.
> – from *Talks to Teachers on Psychology and to Students on Some of Life's Ideals* (1899) by William James

We've probably all done it at some point. The evening before the big exam, source materials sprawled out on the desk, a stockpile of energy drinks substituting for the intravenous caffeine line that would be so much more efficient (patent pending). Productivity is the order of the day, after all; it's cramming time. Sure enough, research confirms that cramming is a go-to strategy for many students. However, since the late 19th century, research in psychology has demonstrated that distributing your study time over a number of shorter sessions works better than cramming all the work into one marathon session. This is known as 'the spacing effect'. It's one of those rare findings in psychology that goes pretty much uncontested, which makes it even more perplexing that more of us don't take advantage of it.

Another routine approach to study is to repeatedly reread sources. It's not difficult to explain why students rely on this approach. If you read a piece of text repeatedly, that text will start to feel familiar. You will likely interpret this feeling of familiarity as progress. Unfortunately, this perception of progress is often illusory. It reflects a failure to consider a vital difference between study and exam conditions: things always seem easy when you have the answers in front of you. Inconveniently, most exams don't allow you that luxury.

A reliance on passively rereading material when studying also reflects a more fundamental misconception about the nature of memory. We often view memory as being akin to a somewhat unreliable camera; not so much an SLR, more one of those Victorian jobbies – the kind that required 30 minutes of exposure to capture a portrait, during which time the subjects had to remain utterly still or else the photo would be ruined. This reproductive notion of memory lulls us into thinking that successfully remembering a source boils down to the amount of exposure we give it and that interacting with that source will likely only 'interfere with the shot'. However, thinking of memory as if it worked like a recalcitrant camera is misleading and really unhelpful when you're studying.

Our memory doesn't passively reproduce a source: it actively reconstructs it according to our previous knowledge, experience and expectations. To stick with the photographic analogy, the workings of memory are more like the filters on a photo-editing suite than a camera. Using our memory effectively is less about maximising exposure to a new source than figuring out how to use our prior knowledge, experience and expectation filters to integrate that source with what we already know.

> Do not mistake activity with achievement.
> – a favourite maxim of the US basketball coach John Wooden

As you can see, then, the most common approaches to studying are often not what psychologists would recommend. I'm painfully aware that even when faced with evidence that study methods such as cramming and rereading are relatively ineffective, you'll probably still harbour an inclination to fall back on these habits. You might argue: 'Cramming has got me this far, so it can't be completely ineffectual.' You'd be right; it isn't *completely* ineffectual. However, there are far superior alternatives, especially if your goal is to retain what you're studying for any length of time. Had I studied properly for my geography exam all those years ago, I might now be able to remember more than just the names of four of the mechanisms of coastal erosion. (Not that this doesn't make me a blast to sit next to at dinner, you understand.)

So, having identified a few studying approaches that aren't all they're cracked up to be, let's consider some more effective alternatives. The approaches I'm about to advocate are good practice irrespective of what subject you are studying and do not require any

prior knowledge of psychology to implement. By making fairly basic changes to the way you study, you can improve your learning, follow the example of high-achieving students, and turn the process of studying from a chore that must be endured into an activity that can be enjoyed.

## What to do

### Space out your study sessions

As noted above, it's better to distribute the time you have available to study over a greater number of shorter sessions than it is to cram your studying into a single marathon session. In thinking about exploiting this 'spacing effect' in your own studying, you might wonder whether there is an optimal method of spacing out your study sessions. Is there an ideal number of sessions? Is there an optimal interval between sessions?

The good news is that simple guidelines on scheduling your study sessions are sufficient. In terms of the number of sessions you use, too few is more of a problem than too many. If you have 12 hours to dedicate to a topic, it's better to study over six two-hour-long sessions than it is to study over a couple of six-hour-long sessions. In terms of the length of intervals between your sessions, research indicates that longer intervals tend to be associated (up to a point) with better retention. However, since studying often takes place in a limited timeframe, you should prioritise the number of sessions over getting the longest possible inter-session intervals.

### Alternate between studying similar topics

We often believe that it's best to 'block' topics when studying – to allocate a period of time for one topic, and to conclude a review of it before moving on to the next one. However, contemporary research has consistently indicated that alternating between different topics (referred to as 'interleaving') can be more effective, especially for topics that are similar in nature and might otherwise be easily conflated.

As an example, if you were learning about psychoactive drugs (for a friend, of course), you'd probably want to look at different classes of drugs: eg, stimulants, depressants and hallucinogens. Broadly speaking, you could deal with these topics in one of two ways: blocking or interleaving. The blocking approach would involve studying each class of drug sequentially; you would conclude your review of stimulants in their entirety before moving on to depressants and then hallucinogens. Alternatively, you could interleave the classes of drugs by organising your studying around categories of information within them. For example, their definitions, exemplars, mechanism of action and profile of

psychological effects. Interleaving would involve first looking at a definition for each class of drug, before moving on to an example from each class, followed by their respective mechanisms of action, and then finally their profiles of psychological effects.

Here's a general rule of thumb you can follow in figuring out whether it might be better to block or interleave your study efforts. Research indicates that interleaving seems to bias your attention towards looking for *differences* between topics. Therefore, it's most effective when you're studying topics that are similar (and require more effort to distinguish from each other). It's also effective under conditions where you have discretion about assigning information to a category, as might be the case if you were classifying works of art. In contrast, blocking seems to focus your attention on looking for *similarities* between topics. Therefore, it's best used for topics that can be easily distinguished and/or when category membership has been predetermined, such as would be the case if you were learning about elements of the periodic table.

### Focus on constructing your own understanding of a topic, not reproducing someone else's

In the 'Need to Know' section above, we noted that memory is fundamentally reconstructive, as opposed to reproductive, in nature. If you rely on passively rereading your course materials, you'll tend to end up using your memory to try to reproduce the author's understanding of the subject rather than generating your own. So, what is the best catalyst for generating your own understanding of what you read? The answer is to question what you read as you're reading it. By responding to your own questions, you are forcing yourself to think about how to explain the subject matter in your own words and with reference to your previous knowledge and experience.

You can use an approach called elaborative interrogation to systematically incorporate the process of questioning into your reading. This technique involves annotating your sources with questions that require an explanatory response from you. You can provide this response verbally, initially using your sources for assistance. Do this iteratively with the aim of eventually not needing to consult your sources at all during the process of responding to your questions.

In using elaborative interrogation, try to focus on explanation as much as you can; your aim is to make the information as meaningful to you as possible. Phrasing your questions so they begin with 'why' or 'how' will help you do this, as will thinking about concrete examples of more abstract concepts. For example, you might annotate this section with the question: 'Why is responding to your own questions conducive to the reconstructive nature of memory?'

### Make retrieval practice an integral part of your studying

Given that the purpose of studying is to prepare for an exam of some kind, it's ironic that we tend to favour approaches such as rereading over testing our ability to retrieve information from memory (retrieval practice). Testing is not just a way of measuring learning; it can also be a powerful mechanism *of* learning. This is another one of those findings in psychology that is so robust as to now be considered axiomatic. It's referred to as the testing effect.

Contrary to how it might feel, both success and failure to retrieve information are helpful for your memory. Both outcomes serve to calibrate confidence in your perception of your knowledge. This is invaluable information in orienting your studying so that it is based on evidence of progress rather than guesswork! When studying, it's not what you think you know that matters, but rather what you can prove you know. Strange, isn't it? You probably always thought of tests as your nemesis and studiously tried to avoid them. Yet that whole time, you could have used them as a tool of learning.

You should not make the mistake of dismissing retrieval practice as a cynical exercise in 'learning to a test'. Its usefulness is not limited to scenarios where you know what questions will be featured in a forthcoming exam. Nor does its effectiveness depend upon congruence between the content or format of your retrieval practice and the exam you eventually take. Furthermore, the benefits of retrieval practice are not simply limited to facts; they also extend to concepts and the transfer of knowledge from one domain to another.

You can incorporate retrieval practice organically into your studying by using the read, recite, review (3R) approach. This involves reading a short passage of text, putting the source to one side and trying to recall the information in your own words, before checking your recall against the source for factual accuracy. You repeat these steps until you are satisfied with your ability to capture the meaning (not words) of the source material in question. If you type out your attempts to recite information from your sources rather than just verbally recall them, you'll be organically producing notes that capture your understanding of the material.

### Don't just highlight material, think about it

By this point you will have gathered that interaction with your sources is important in studying effectively, but you should know that not all types of interaction are created equal. For example, highlighting text is a method that's widely used by students. Ostensibly, this seems like a perfectly sensible thing to do when studying. Explicitly identifying the most important parts of a source *should* help focus your attention by filtering out less relevant material and reducing the burden on your memory.

However, the literature on the effectiveness of highlighting makes for unhappy reading, especially if you own a stationery shop. On the rare occasions where a study has shown

highlighting to have a positive effect on learning, it's not been the act of highlighting per se that is behind the effect. Rather, it's the thinking behind what is being highlighted – why the highlighted information is significant – that counts. Indeed, research indicates that the people who report using highlighting most frequently tend to do it the least effectively and get the least benefit from its use. I know it's nice to think that a highlighter works like an optical scanner with a direct connection to your long-term memory, but it is no substitute for mentally engaging with the text.

## Key points

- You can't rely on intuition about how well your studying practices are working for you. Intuitive judgments of learning are often inaccurate and tend to produce an inflated perception of progress.
- Avoid defaulting to habitual, passive approaches to studying such as rereading and highlighting sources. These do not take advantage of the reconstructive nature of memory, and make it more tedious and less effective.
- Systematic engagement with the meaning of your source material is the key to successful studying.
- Rather than cramming your studying into an extended session before the exam, it's much more effective to distribute the time you have available for studying over a larger number of shorter sessions.
- When you are studying similar topics that might be easily confused, it's a good idea to interleave your studying – to alternate between the topics during your study sessions. This can help you identify the differences between the topics and reduce the chances of them being conflated.
- You should view self-testing as an integral part of your studying. One way to do this is the read, recite and review (3R) method: read a section of text, set it aside as you try to recall its content in your own words, and then check your recall, repeating as necessary.

## Learn more

> Ever tried. Ever failed. No matter. Try again. Fail again. Fail better.
> – from the novella 'Worstward Ho' (1983) by Samuel Beckett

When exams are on the horizon, it's understandable that you want quick and easy results from your efforts to study. We've noted that one reason that relatively ineffective approaches to studying remain popular is because they are often straightforward to implement and give a favourable (if often illusory) impression of learning.

In contrast, the approaches I'm advocating in this Guide do take a little more effort and thought to implement. Initially, they will also seem to provide less reassuring signs about your progress. Your initial efforts at retrieval practice are very likely to indicate that your grasp of your source materials isn't as firm as you had thought. You will probably find this rather disconcerting and might even take it as evidence that your efforts aren't working. But, in fact, the exact opposite is true: you are studying more effectively and are more likely to retain what you study in the long term.

You might be tempted to use technology, such as mobile phone applications, to ease your burden when studying. I would suggest caution in this respect. The very device you're using to access that application is also a portal to a world of online friends, shopping, funny cat videos and an array of other instantly gratifying ways to procrastinate. You probably won't be massively surprised to learn that multimedia multitasking is really not helpful to your efforts to study. Don't worry, I'm not about to advocate that you ditch your trusty PC and study using a stone tablet and chisel. However, I would suggest that you disable any of the alerts you might normally get from social media, email or any of your installed applications when you're studying. These will serve only to distract you and take you away from the task at hand.

The lesson from the past few decades of research in cognitive psychology is that studying (and learning generally) is a bit like visiting the gym: if you want the best results, you have to sweat a bit. The methods advocated above create 'desirable difficulties'; they trade a bit of short-term pain for long-term gain. It is the expectation that learning should be easy and error-free, and the conflation of good short-term performance with longer-term learning, that is harmful.

The fruits of effective studying might be a little harder-won than you would have liked, but don't think this means that they invariably take much longer to obtain. Research into the study habits of high- and low-achieving students suggests that the former don't spend much more time studying per se. Rather, they spend more time doing things such as organising and thinking about their source material, in addition to articulating it in their own words. Effective studying is more a question of how you study than how much of your life you devote to it.

## Links & books

If you are interested in finding out more about how research from psychology can help you learn effectively, then you can visit and subscribe to my YouTube channel, which offers free and accessible video-based advice on studying.

The HippoCampus Podcast provides a regular source of conversations with scientists and practitioners about optimising learning.

The Bjork Learning and Forgetting Lab at the University of California, Los Angeles has an extensive list of downloadable publications on the application of cognitive psychology to learning.

The Effortful Educator provides accessible blog posts on applying cognitive psychology in the classroom that will be of particular interest to teachers.

If you found this article interesting, I'm sure you'd also enjoy my book, *The Psychology of Effective Studying: How to Succeed in Your Degree* (2019). It's available as a paperback or ebook, and is suitable for students of all degree disciplines and anyone else interested in how psychology can help them learn, communicate and collaborate more effectively.

Educators interested in finding out how they can use principles from cognitive psychology in the design of their online courses might like to take a look at the book *Active Learning Online: Five Principles That Make Online Courses Come Alive* (2020) by Stephen Kosslyn, professor of psychology emeritus at Harvard University.

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