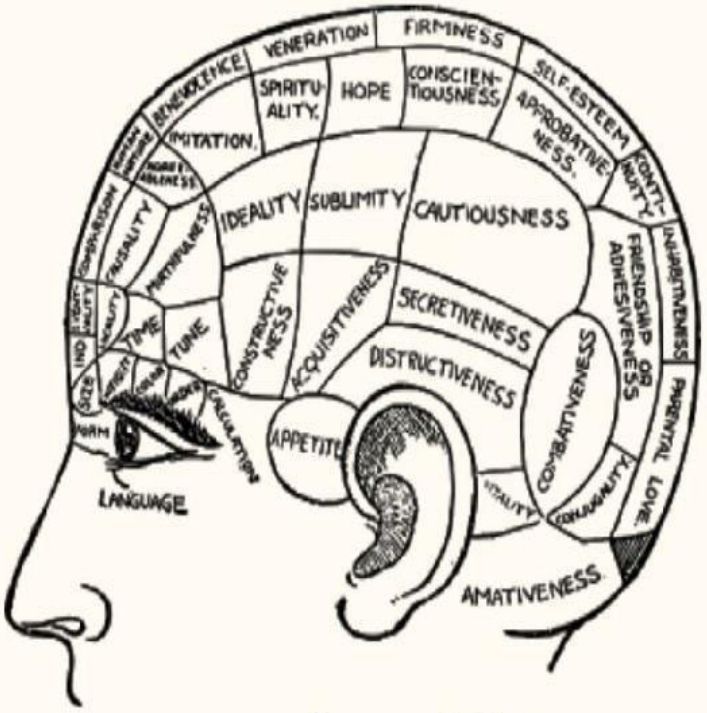
ADVANCED STRATEGIES FOR QUICKER COMPREHENSION, GREATER RETENTION, AND SYSTEMATIC EXPERTISE

super learning



peter hollins

Peter Hollins

Super Learning

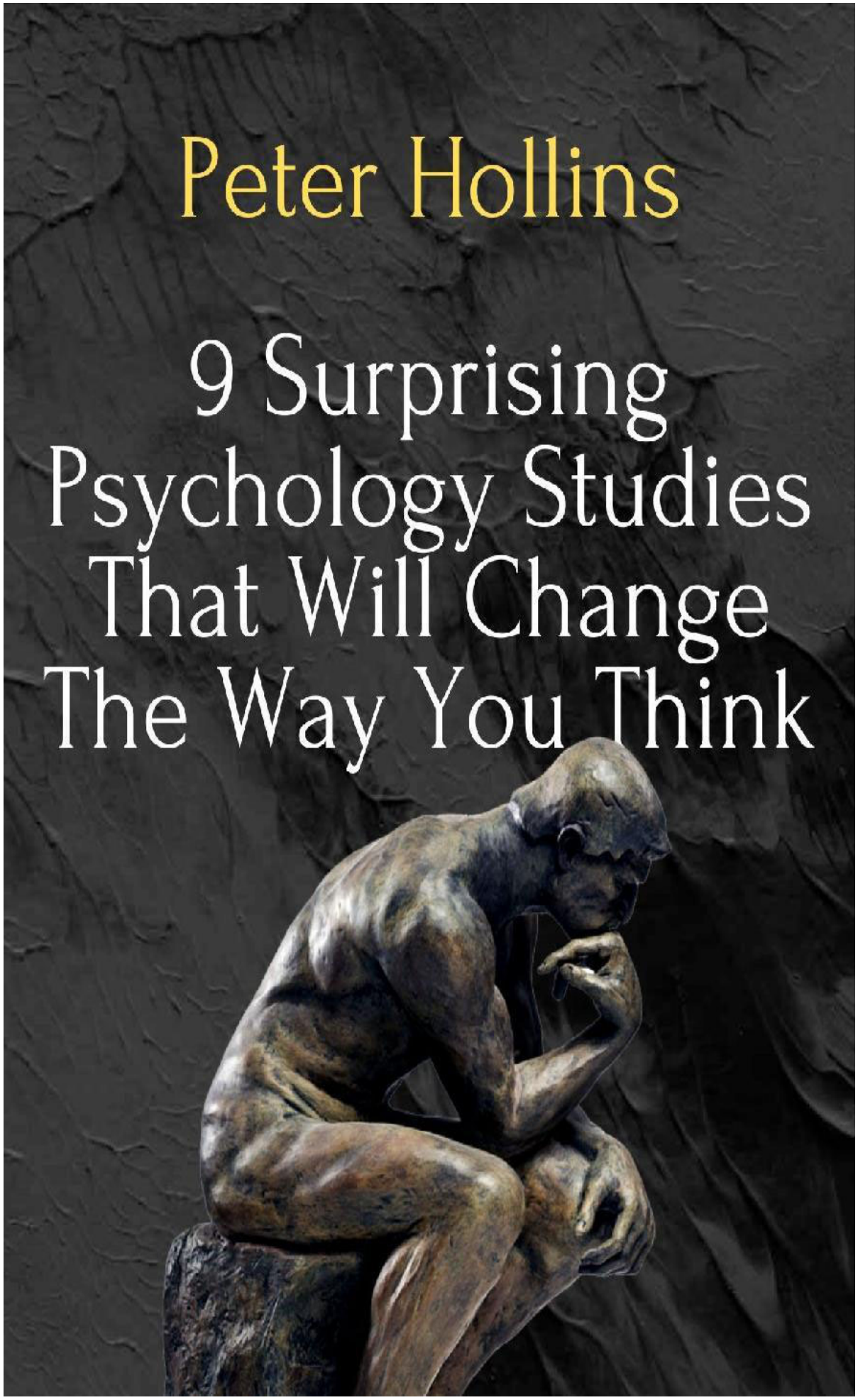
Advanced Strategies for Quicker Comprehension, Greater Retention, and Systematic Expertise

Super Learning:
Advanced Strategies for Quicker Comprehension, Greater Retention, and Systematic Expertise

By Peter Hollins,
Author and Researcher at petehollins.com

Peter Hollins

9 Surprising Psychology Studies That Will Change The Way You Think



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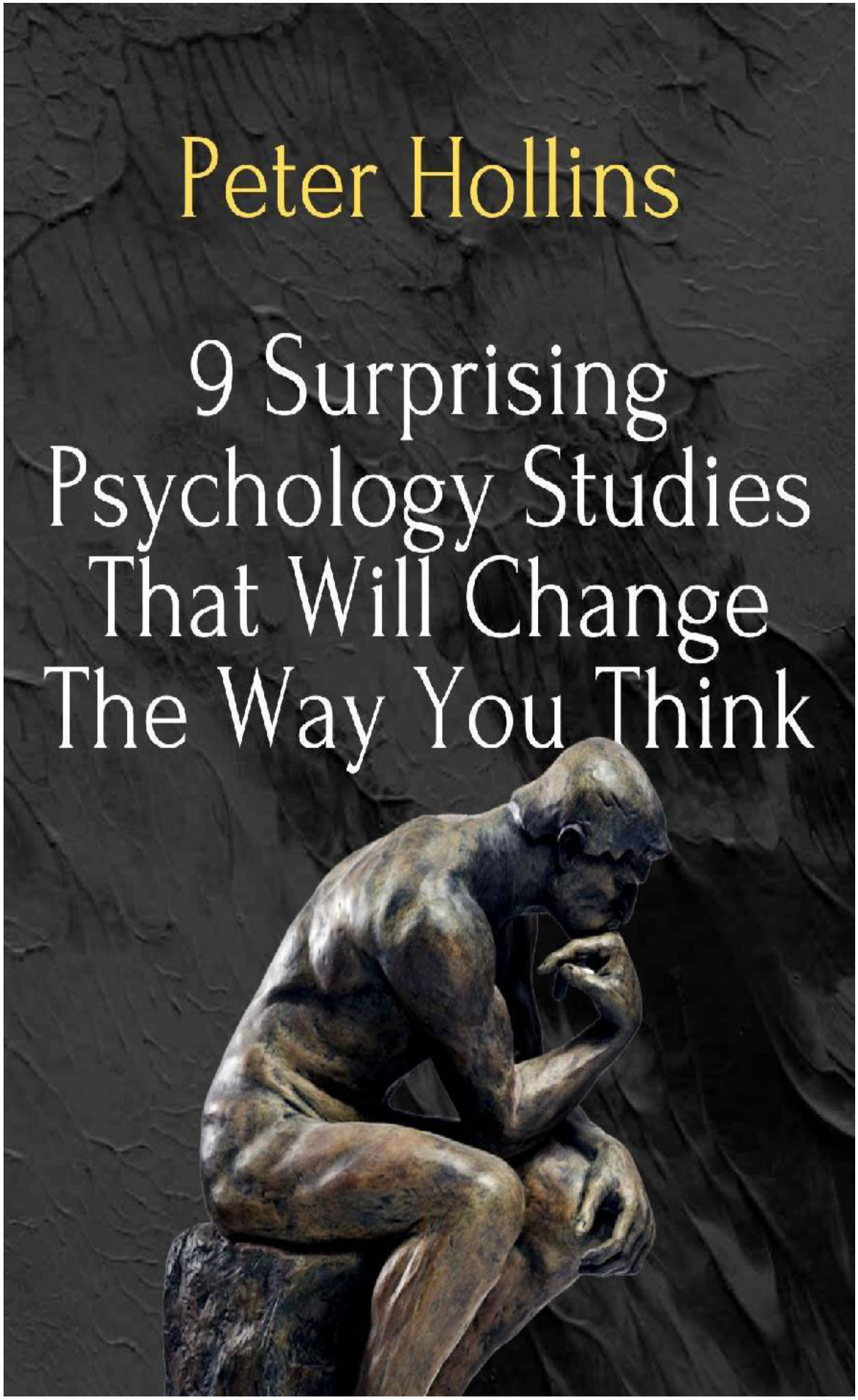

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Introduction

Learning has never come easy for me, which explains my standing as a mediocre student from kindergarten to twelfth grade and through college.

Even my parents seemed to intuitively know how learning challenged me, as they started to tell me about my "street smarts" and how good I was with my hands. I assumed this was just so they could find something to praise me about, because they didn't have the opportunity to do so with my grades.

It was never something I struggled with or felt bad about like other kids might. I suppose some might have seen other people at the top of the class and become frustrated and jealous. I just felt that everyone had something to contribute in their own way and that grades weren't necessarily a measure of my worth.

I know, that's pretty insightful for a child. But in many ways, it was also incredibly misguided.

It turns out I was right about grades not being important. Life *is* partially about whom you know, but once you get there, it starts becoming a meritocracy. The concept of learning—the ability to understand, recall, and use new knowledge—well, that's something that truly begins to matter and can make all the difference in your career, relationships, and happiness. In fact, it becomes the

backbone of where you end up, though you might get a leg up on where you start.

If you can learn quickly, you can effectively walk the walk before anyone catches on that you were bluffing the entire time. You can discover opportunities you would never see if you were stuck unable to understand something. And you generally have the ability to steer your life in whatever direction you want because your ability to learn is your only barrier to entry!

This was never more apparent to me than at my first job. I had a coworker named John, and I started a few weeks before he did. It soon become clear that he had lied on his resume and faked his way through his interview, because he had no idea what his duties were supposed to be or how to use the industry-standard software that we were all supposed to be proficient in.

At first, I was angry and wanted to see justice done. But then a funny thing happened—he was an *immensely* fast learner. He had Post-it notes all over his desk, had notepads full of notes, and he always seemed to be writing sets of three-step instructions for himself. It was impressive to see his drive toward learning, and within months, he was performing at right about my own level of proficiency with everything he had lacked before.

Sure, he may have faked his way in, but at this point, there was no practical difference between me and him. He had learned how to do our job in record time and stayed at the company for years afterward. You could call this a sobering epiphany for how I thought about the *processes* and *value* of learning.

Processes: It can't be that hard, and there must be tried and true systems people use to learn better. After all, the kids that had better grades than I did definitely weren't all smarter than me, right?

Value: Wow, learning can unlock so many doors. I had no idea. It applies to way more than work and probably to my hobbies and daily life, too. Learning will get me where I want to be.

So what exactly is learning (not a technical definition)? Learning is how you create the life you want. Learning is the only way to create a better version of yourself. Learning is one of the most fundamental skills you can possess because if you don't have it, how will your existence change or improve?

Welcome to *accelerated* where you can finally learn how to learn.

Chapter 1. Fertile Conditions to Learning

How do we learn?

It seems like such a simple question, but decades of scientific literature tend to disagree with that notion. We may simply consider learning an activity we just started engaging in as babies with no preparation. In our school years, we were the receptacles for a constant flow of information and experiences. And in most traditional settings, instructors measured how well we learned by how well we repeated the information back to them. We had no choice in the matter and simply went along with what was presented to us.

This data accumulation and regurgitation almost suggest that learning is an automated process that we can only monitor, not control. In truth, there are factors, limitations, and conditions that affect our ability to learn. Understanding these elements can help you avoid mistakes and accelerate your learning. This book uses scientific principles and methods that will help you learn in a way that works best for you.

All mental activities, including learning, are influenced by internal and external factors and conditions. Some factors we can control; others we have to overcome or work around. This first chapter discusses the scientific principles that drive our learning abilities and some of the best practices we can use to expand learning capacity. In other words, we must create fertile conditions for learning; otherwise, we are sabotaging ourselves.

You wouldn't try to learn to ski in a desert, would you?

The Human Attention Span

One of the first conditions to learning you must take into account is your attention span. Since 2006, the nonprofit group Technology, Entertainment and Design—universally known as TED—has produced a series of online videos featuring influential speakers and leaders from all walks of business and life. TED Talks have become a viral source of sharing ideas and spreading inspiration.

A big key to the success of TED Talks is their brevity: all of them are capped at 18 minutes. TED curator Chris Anderson explained, "It is long enough to be serious and short enough to hold people's attention. . . . By forcing speakers who are used to going on for 45 minutes to bring it down to 18, you get them to really think about what they want to say. What is the key point they want to communicate?"

The overwhelming majority of Hollywood movies run no longer than 150 minutes; in 2016, half of them ran two hours or less. Movies are easier to sit through because they're essentially passive: with the visuals taken care of, we don't have to use extra brain energy to imagine them. TED Talks, on the other hand, are more active, participatory, and dense, with few visual stimulants besides one person moving around on a stage. They have to be shorter. There are no accidents here; these stipulations are all intentional to cater to the human attention span and be as impactful as possible.

But TED Talks and movies both consume brainpower, though at different rates. At some point in the brain gets fatigued and has to take a break to recharge, whether it's through distraction or relaxation. Whether it's a one-hour lecture or a three-hour film, that mental weariness eventually sets in.

Studies have suggested that the attention span of a healthy adult is, on average, 15 minutes long. Other studies (Microsoft Corporation) assert that our immediate attention span—a single block of concentration—has fallen to an average of *8.25* That's less than that of a goldfish, which have been shown to be able to maintain focus for a near-eternity of nine seconds.

When we think about learning, we can't help but think about attention, and memory. You can only learn as much as you can pay attention to; therefore, much research in the area of learning and retention focuses on the aspect of time.

So, how long *can* you focus for? What's the optimal time to structure a study session, for example? Ellen Dunn of Louisiana State University's Center for Academic Success suggests between 30 and 50 minutes is the ideal length for learning new material. "Anything less than 30 is just not enough," Dunn said, "but anything more than 50 is too much information for your brain to take in at one time." After the completion of one session, you should take a five-to-ten-minute break before starting another.

In the 1950s, researchers William Dement and Nathaniel Kleitman found that the human body generally operates in 90-minute cycles, whether awake or asleep. This pattern is called the "ultradian rhythm." The start of each cycle is defined as a period of "arousal," ramping up to a mid-period of high performance before finally decelerating in a period of "stress." Understanding how the 90-minute rhythm cycle works in the context of the

greater 24-hour rhythm—the "circadian rhythm"—can help us predict how we'll function over the course of a day and how we can plan around it for peak performance.

All these examples and studies point to one primary strategy for improving our learning: breaking it down into smaller chunks of time because a flood of information will simply not make it into our heads. When you learn to work with your own in-built abilities and limitations, you not only learn better, but you also save yourself a lot of wasted energy, time and effort that wouldn't have brought you any closer to your goal.

Learning Over Short Bursts of Time

When you train your body's muscles, you put then under a load and make them work; they undergo tiny, microscopic tears and damage at the cellular level, but then, once they repair, they are much stronger than they were before. The brain is not a muscle, but we can think of attention as a muscle that can be trained—we need to pace ourselves. Overtraining only exhausts us, but building in periods of rest actually makes us stronger.

By segmenting our learning activities according to blocks of time, we give the brain enough time off to reset and reenergize and enable ourselves to retain more information over longer periods. It's therefore a good idea to start a new learning routine by simply setting up a schedule.

Long-term At the beginning of a semester, online course, or research project, block out your schedule to set up a studying regimen. You can do this easily with a free online calendar program from virtually all Internet providers or with a paper calendar or whiteboard.

Consider what times of day you tend to get the most accomplished—some of us start the day in high-performance mode, while others are classic night owls. Just make sure to leave ample time for sleep and eating. In fact, there is a scientific basis for whether you are more productive at night or in the morning, summed up by the terms "morning larks" and "night owls."

If you're really tuned in to your brain and body, you can get a bit more granular with your scheduling by applying the 90-minute cycle to the calendar—for instance, 90-minute blocks that account for breaks and fatigue. This requires a little more careful introspection and monitoring, but if you can narrow down an even more specific time when your performance abilities are higher, you can fine-tune your learning agenda even further.

Learning blocks. You can adapt the 30–50-minute study session as dictated by the LSU study for your own purposes. Remember that 30 minutes is enough to make the study session substantial and that going over 50 puts undue pressure on your brain. So within your weekly time block, make sure to schedule an attendant break after your core learning time.

Again, adjust to what you know your system can handle: maybe it's 50 minutes with a 10-minute break or 45 minutes with a 15-minute break. The study session can go down all the way to 30 minutes if absolutely necessary. You can use the renowned Pomodoro clock, which is commonly used for work productivity—25 minutes of activity followed by five minutes of total removal from that activity. The specific amount of time is not set hard and fast; whatever it is, it just needs to be a time frame easy enough for you to stick through on a regular basis.

Just ask yourself how you might cater to the attention span of a goldfish or even a child. Our adult minds are not so different as we might like to think.

Concepts Before Facts, Understanding Before Memory

Researcher Roger Säljö found in 1979 that we tend to view the act of learning in several ways, but it can generally be boiled down into two rough categories: *surface* learning and *deep* learning. Surface learning relates to gaining knowledge, facts, and memorization; deep learning refers to abstracting meaning and understanding reality. We'll be returning to this distinction throughout this book, as we explore different learning approaches and techniques.

The use of the words "surface" and "deep" might imply that the latter is better in all situations than the former, but that's not always true. Some subjects are best learned by memorization rather than additionally searching for some "meaning" to contextualize those concepts. In fact, your brain naturally uses both processes. If I gave you a list of 30 random items and asked you to remember them, it probably wouldn't help to ransack your brain trying to find a pattern or relationship between each item. It would waste your time when the task at hand is simple information retention.

But more often than not, rote memorization serves to isolate facts rather than connect them. It establishes facts as single pieces of information, and without a grounding context or relationship to a greater concept, it doesn't anchor what you learn. Sometimes this is fine, but as a consequence, what you learn slips out of your short-term memory quite easily.

The overwhelming majority of things that can be learned have some kind of pattern—hidden or obvious. These patterns, typically, are what you most care about learning. Without these patterns, frankly, what you learn wouldn't be useful anyway. Patterns make concepts useful. Without them, facts have very limited or temporary relevance and would therefore not be important to study in the first place. After all, this is the exact way that the human brain has evolved over thousands of years—only data that is meaningful and relevant to survival is absorbed, retained and understood.

A typical course of study contains a mix of big ideas with a few details. In that setting, it's always the best idea to start with the big ideas—the overarching concepts that link the little details together.

The primary reason is that many small details take on a random quality at first, but when seen through the lens of the larger concept, they fit together and form a context. That makes them easier for the brain to recognize and remember. What you are essentially doing is laying out a map of the entire conceptual area, so that you can better navigate a path though it without getting lost.

In fact, you can often forgo a lot of memorization, because the concepts themselves frequently serve to explain the facts. Instead of attempting to memorize by rote means, following the concept through to its conclusion will reveal the facts as you go along. Like subheadings in an outline, they fall into place under the appropriate headings—it's a logical progression. If you understand the governing principles around something, the facts follow organically. In this way, understanding and deep comprehension are always going to yield a better quality of learning than simply memorizing the superficial details without ever connecting them to one another.

For example, if you were studying the history of Miranda rights in the United States, you could memorize all the key players: the Supreme Court Justices, the lawyers, and the names of the plaintiffs and defendants. You could memorize the dates in the case. You could memorize the vote counts from all the courts involved in the suit and the appeals. You could memorize the names of cases that came afterward. You could even write down the contents of the Miranda rights ("You have the right to remain silent," etc.). Sounds a bit boring, right?
None of those facts would have any relevance by themselves, and we'd have no reason to keep them in memory. (In fact, I'm sure you've already forgotten some of them, even though you've just read them!) Emphasizing the larger concepts surrounding the Miranda rule—defendants' rights, police procedure, or landmark Supreme Court cases—help to funnel the facts as they come up. A bigger narrative helps contextualize these facts and makes them *mean* something. In this context, the brain is more likely to retain the information it actually needs to know about the subject. You would be able to essentially predict the facts with a reasonable degree of accuracy once you understand the underlying concepts and how they interact. True, you may not have "memorized" certain information, but when necessary, you can logically work your way through the question and arrive at the same answer as if you had memorized it.

This is known as *concept* It shows us how to categorize and discriminate items according to certain critical attributes. It entails pattern recall and integration of new examples and ideas. And rather than being a mechanical technique of grinding memorization, concept learning is something that must be constructed and cultivated.

Using Concept Learning in Daily Applying the concept method to learning and developing new skills, even outside of the classroom or study hall environment, can help derive new meaning and, by logical extension, even improve how we perform certain tasks or jobs.

Cooking is an easy example. Standard practice is that learning a new recipe involves following a list of ingredients and a set of instructions. If you're making a tomato sauce for pasta, you can look up a popular recipe on the Internet and have it nearby as you prepare it. You can repeat this exercise as often as you like, and eventually you'll probably know the steps well enough to repeat it without a guide.

But understanding the *point* of each step isn't something that comes through in the instructions. They generally don't say *why* you sweat onions and garlic first, *why* you bring the sauce to a boil, or *why* you let it simmer for a time. Understanding that sweating the onions and garlic builds a flavor base, that boiling the sauce distributes the ingredients, and that simmering them bonds the flavors together gives you a better handle on the process of your preparation.

Most importantly, understanding those concepts makes it easier to recognize and use the techniques in other, completely different dishes: soups, chili, gravy, and even basic broth and stock. Going even further, learning the particulars of the exact scientific processes could open the door to cooking *entirely* different foods that aren't liquid-based—in other words, any food you can think of. If you simply know which flavors tend to conflict and which tend to complement, you'll be way ahead of the chef who memorizes recipes.

You can also adapt and adjust if things don't go according to plan; because you understand why a certain step exists, you can

come up with an alternative if necessary, get creative, or troubleshoot a problem. You become one of those people that doesn't need a recipe, because you know more than how to read a recipe—you *understand* what it means to make good food.

This template is sneakily easy to replicate. A small business owner figuring a tax budget is better served knowing the concepts of taxation and how they're distributed. A musician who understands how rhythm works in the context of a song better knows how to program a drum machine. A chess player gets more mileage from comprehending the differences between overall strategies rather than learning where each piece can move. Even a clothes launderer makes fewer mistakes and ruins less clothing by learning how cold and hot water affect colors in variant ways. You get the idea.

In fact, certain kinds of education and ways of learning are so general and transferrable that you could be proficient in a skill you've never encountered before, simply because you *know how to* You can learn the particulars of any task and even perform it suitably a few times. But knowing the principles and ideas that link them together is a more effective way to retain those facts or skills. When the time comes to learn something new, you may very well be able to frame that new knowledge with concepts you've already nailed down.

Learning heuristics is very similar to the act of concept learning (Barsalou, 1991, 1992). Heuristics describes a pattern of thought or behavior that organizes categories of information and the relationships among them. It takes our preconceived notions or ideas of the world and uses them as a means for interpreting and classifying new information.

For example, there are ways you might act at a birthday party that you wouldn't at a funeral (and, we'd hope, the other way

around). The “codes” you follow for how you’d handle and behave in each situation, and any other occasions, are ordered within a heuristic. Establishing and understanding the heuristic rules for whatever you’re about to learn is always helpful.

Another great way to learn concepts is the Feynman technique, which we’ll discuss in a later chapter.

Aim to Be Frustrated (Yes, Really)

In competitive situations, we tie accomplishment with success: winning, positive outcomes, and finding solutions. But in learning, a key component in achievement is It's counterintuitive, but embracing the right kind of failure may be one of the key elements to taking your learning to the next level.

"Productive failure" is an idea identified by Manu Kapur, a researcher at the National Institute of Education in Singapore. The philosophy builds on the learning paradox, wherein *not* arriving at the desired effect is as valuable as prevailing, if not more.

Kapur said that the accepted model of instilling knowledge—giving students structure and guidance early and continuing support until the students can get it on their own—might not be the best way to actually promote learning. Although that model intuitively makes sense, according to Kapur it's best to let students flounder by themselves without outside help.

Kapur conducted a trial with two groups of students. In one group, students were given a set of problems with "scaffolding"—full instructional support from teachers on-site. The second group was given the same problems but received no teacher help whatsoever. Instead, the second group of students had to collaborate to find the solutions.

The "scaffolded" group was able to solve the problems correctly, while the group left to itself was not. But without instructional support, this second group was forced to do deeper dives into the concepts by working together. They generated ideas about the

nature of the problems and speculated on what potential solutions might look like. They tried to understand the root of the problems and what methods were available to solve them.

The two groups were then tested on what they had just learned, and the results weren't even close. The group without teacher assistance *significantly outperformed* the other group. The group that did not solve the problems discovered what Kapur deemed a "hidden efficacy" in failure: they nurtured a deeper understanding of the structure of the problems through group investigation and process.

The second group may not have solved the problem itself, but it learned more about the aspects of the problem and the ideas behind it. Going forward, when those students encounter a new problem on another test, they're able to use the knowledge they generated through their trial more effectively than the passive recipients of an instructor's expertise.

Consequently, Kapur asserted that the important parts of the second group's process were their miscues, mistakes, and fumbling. When that group made the active effort to learn by itself, it retained more knowledge needed for future problems.

Three conditions, Kapur said, make productive failure an effective process:

Choose problems that "challenge, but do not frustrate."

Give learners the chance to explain and elaborate their processes.

Allow learners to compare and contrast good and bad solutions.

Struggling with something is a definite condition that leads to learning, though it requires discipline and a sense of delayed

gratification.

Helping Children to . . . Fail?

The notion of productive failure can also be seen in strategies for child-raising. Does intentionally letting our children fail actually make learning easier for them?

Judith Locke of the Queensland University of Technology said that "over-parenting" might keep our children safe and supported but could impede their growing processes. Locke observed that children raised in a state of helplessness were destined to lead anxiety-ridden adulthoods. Parents who were overly responsive to their children's needs restricted their children's ability to solve problems on their own and hampered the development of emotions they need to cope with future setbacks and failures.

In a way, we over-parent We push ourselves not to fail, work too hard to achieve the desired outcome, and get frustrated when we get stuck or fall short. How can we, so to speak, let failing work for us?

Get your brain into "growth" mode. When we believe that we have all we need to accomplish whatever we want, we're setting ourselves up for disappointment when our process goes awry. This is because we think our abilities are fixed—if we can't succeed based on what we already know or can do, we never will. That makes our disappointments more profound and corrosive.

So at the beginning of a project that seems unfamiliar, we need to tell our brain that we're in learning mode. We need to establish that one of our main takeaways will be new not just an immediately successful outcome. Reframe your expectations to make the learning as important as the important, if possible.

Document your process. Companies use "paper trails" (literally or digitally) to determine points or events that altered an outcome. When you're in the weeds of a new project, keeping your own trail will help you learn new knowledge and refine your processes for future efforts.

In addition to whatever tools you're using for a project, set up a diary or journal for what you discover on the way. Set this diary up any way you want, whether it's a paper notepad, word processing or text software, the audio recorder on your smartphone, or whatever your preference. Document your process the way a chef would write down the steps of a recipe or a detective would remark upon evidence in an investigation.

These notes can be the kernels of knowledge that will come in handy in future situations—even if what you're using them for now ends in failure. The ideas they generate might seem small, especially if they end up not working. But when we use these kernels to solve future problems, their value increases. You may not notice any insight on a day-to-day basis, but when you compare weeks or months of progress, the difference may be startling.

Use your failures to plan next steps. If you've documented your process and diagnosed where something went wrong, then turn those evaluations into plans apart from your project.

For example, let's say you're planting a vegetable garden for the first time, noting the steps and techniques you use along the way, and when it's time to harvest, some of your plants didn't come out the way they were supposed to. Was it because you used the wrong soil? Use your resources to find out *why* that soil was wrong and what it needs to look like. Was the failed plant too

close to another? Learn techniques for maximizing placement within a small space.

Or in a slightly more common situation, let's say your sales results fell short of projections. If you found a mistake that led to an over-estimate, locate online information on how to set up your spreadsheet to avoid those errors. If your sales "game" was off, seek out workshops that can help improve your pitch or increase your interpersonal skills with clients. If you just didn't have enough clients, learn how to make your professional network broader and more potent.

Expect, but don't succumb to, frustration. Chances are you'll come across a moment or two of defeat in your process, along with the temptation to give up. You may even sense this before you start, which can lead to crippling anxiety that can hover over your work.

Anticipating frustration in advance is just good planning—but you also have to plan how to deal with it. Sketch out an idea on how to alleviate frustration when it happens—most often, this will be taking a break from the situation to recharge and getting some momentary distance from the problem. Quite often, the mere act of pausing allows for objectivity to seep in, letting you see the hang-up more clearly. But in any case, it will abate the most immediate anxieties you're feeling and give you the chance to approach the issue from a more relaxed frame of mind.

Why are we even bothering to tackle preconditions to effective learning? Because many people dive right into learning without understanding what works on a psychological and even physical level. Many others think that effective learning is measured by the number of hours spent on a task, but we all have our limitations, and working within those bounds will only accelerate

your learning. You can't outwork your attention span or commitment to rote memorization.

Takeaways

Accelerating learning means working with the pre-existing, inbuilt mechanisms we all already possess. When we work with rather than against the brain, we can get the most from our learning experiences, and enjoy learning more.

An unavoidable fact is that the human attention span is limited. We need to respect the limits of our attention and plan learning accordingly—i.e. by digesting new information is smaller, more manageable chunks.

A good length of time for any learning period is more than 30 minutes, less than 50. Too short and you won't be able to get into any depth, and too long and your cognitive powers will begin to fatigue.

To use your time wisely, plan ahead and designate times in your schedule for specific learning blocks.

Use concept learning to guide you: as you learn, prioritize understanding and comprehension over rote memorization, i.e. concepts before facts. When you have a deep rather than surface appreciation of information, you anchor new ideas in context and make it easier to remember and apply them.

Deliberately engage in productive failure. Know that failure can actually be a valuable source of information, if embraced correctly.

Challenge yourself without frustrating yourself, and make sure that when you work (and fail) you give yourself the chance to look closely at *why* things happened as they did. Ask yourself why you failed and think about how you could have done better.

Cultivate a growth mindset, where you set ego aside and assume that learning is uncomfortable sometimes. Failure is a part of learning, so embrace it when it happens. Use your failure to inspire you to make new plans for going forward, and shape your next steps.

"Expect frustration, but don't succumb to it." With the right mindset, "failure" is something that brings you closer to success, not further from it.

Chapter 2. Memory Retention

Memory, of course, is heavily related to learning. People are seldom said to have learnt something if they can't really remember any of it! This is why so many techniques and methods around learning focus on recall. As with other aspects of our cognition, however, we can drastically improve our memory if we take the time to understand its optimal function, and how we can support this for better learning.

If memory is a storage system that exists within specific neural pathways, then learning is about changing neural pathways to adapt one's behavior and thinking to the emergence of new information. They depend on each other because the goal of learning is to assimilate new knowledge into memory, and memory is useless without the ability to learn more. Many memory techniques exist, but they all truly function on the contents of this chapter.

Memorization is how we store and retrieve information for use (essentially the process of learning), and there are three steps to creating a memory. An error in any of these steps will result in knowledge that is not effectively converted to memory—a weak memory or the feeling of "I can't remember his name, but he was wearing purple . . ."

Encoding

Storage
Retrieval

Encoding is the step of processing information through your senses. We do this constantly, and you are doing it right now. We encode information both consciously and subconsciously through all of our senses. If you are reading a book, you are using your eyes to encode information, but how much attention and focus are you actually giving it? The more attention and focus you devote to an activity, the more conscious your encoding becomes —otherwise, it can be said that you subconsciously encode information, like listening to music at a café or seeing traffic pass you by at a red traffic light.

Many people mistakenly think they have a "bad memory" when it may be more accurate to say that it's a question of attention. Such a person might forget the name of someone they just met, not because they have a faulty memory, but because they simply weren't paying much attention when they were introduced—but they do remember in great detail the adorable dog on a lead walking past at just that moment.

How much focus and attention you devote also determines how strong the memory is and, consequently, whether that memory only makes it to your short-term memory or if it passes through the gate to your long-term memory. If you are reading a book while watching television, your encoding is probably not too deep or strong. Similarly, you are more likely to remember something that has strong emotional significance for you when compared

with something that doesn't really concern you beyond the intellectual level.

Storage is the next step after you've experienced information with your senses and encoded it. What happens to the information once it passes through your eyes or ears? There are three choices for where this information can go, and they determine whether it's a memory that you will consciously know exists. There are essentially three memory systems: sensory memory, short-term memory, and long-term memory.
The last step of the memory process is which is when we actually use our memories and can be said to have learned something. You might be able to recall it from nothing, or you might need a cue to bring the memory up. Other memories might only be memorized in a sequence or as part of a whole, like reciting the ABCs and then realizing you need to sing to remember how it goes. Usually, however much attention you devoted to the storage and encoding phases of memory determines just how easy it is to retrieve those memories. Most of the learning process isn't necessarily focused on retrieval—it's concentrated on the storage aspect and what you can do to force information from sensory and short-term areas into long-term ones.

Think about when you cram for a test. You want information you experience to be in your brain for perhaps 24 hours, which means it has to exist beyond short-term memory and certainly beyond sensory memory. You might not care if you remember this information about the French Revolution at the end of the year, so you will reach a level of attention and focus that will push

the information into the hazy area between short- and long-term memory. In reality, what's happening is that you will rehearse the information enough to make a very faint imprint on your long-term memory. But after that, the impression fades pretty quickly.

Accelerating your learning, in a sense, is the same as improving your memory capacity and how absorbent your memory is—the more sponge-like, the better. It's also about giving you conscious control over the steps of the process that normally run automatically. If you know how and why your memory works, you can squeeze the most out of it!

Forgetting

However, learning is both the process of improving memory while also getting better at *not* Why do we forget? Why can't we remember this fact? How did we ever let something slip from our brains?

As you have read, forgetting is usually a failure or shortcoming in the storage process—the information you want only makes it to short-term memory, not long-term. The problem isn't that you can't find the information in your brain; it's that the information wasn't embedded strongly enough to begin with. This may have happened partly because you never cemented the memory by recalling it again and again; i.e., you didn't strengthen those tentative neural connections and your brain, seeing that they weren't really needed, let them go.

Sometimes it's easier to think about forgetting as a failure in learning. There are generally three different ways you retrieve or access your memories:

Recall
Recognition
Relearning

Recall is when you remember a memory without external cues. It's when you can recite something on command in a vacuum—for

example, looking at a blank piece of paper and then writing down the capitals of all of the countries of the world. When you can recall something, you have the strongest memory of it. You have either rehearsed it enough or attached enough significance to it so that it is an incredibly strong memory within your long-term memory. You go into your brain's storage, find exactly what you're looking for, and reproduce it in full.

Of course, because recall represents the strongest level of memory, it's also typically the toughest to achieve. It would generally require hours of rehearsal or study to get anywhere close to this level. However, once we acquire information this way, the benefit is that it's a lot harder to un-learn or forget. When we study, we want information to enter this realm, but we will usually settle for the next type of memory retrieval.

Recognition is when you can conjure up your memory in the presence of an external cue. It's when you might not be able to remember something by pure recall, but if you get a small clue or reminder, you will remember it. For example, you might not be able to recall all of the capitals of the world, but if you got a clue such as the first letter of the capital or something that rhymes with it, it would be fairly easy to state it. This "jogs your memory" enough that you can carry on once you get started.

When we cram information, recognition is typically what we end up with. This is also how mnemonics and similar memory devices work. We know we aren't able to definitively store and recall so many pieces of information without a massive amount of rehearsal, so we work on chunking information into easily recognizable cues. With the right cue, we are pointed in the right

direction and can gradually access memories stored a little less concretely.

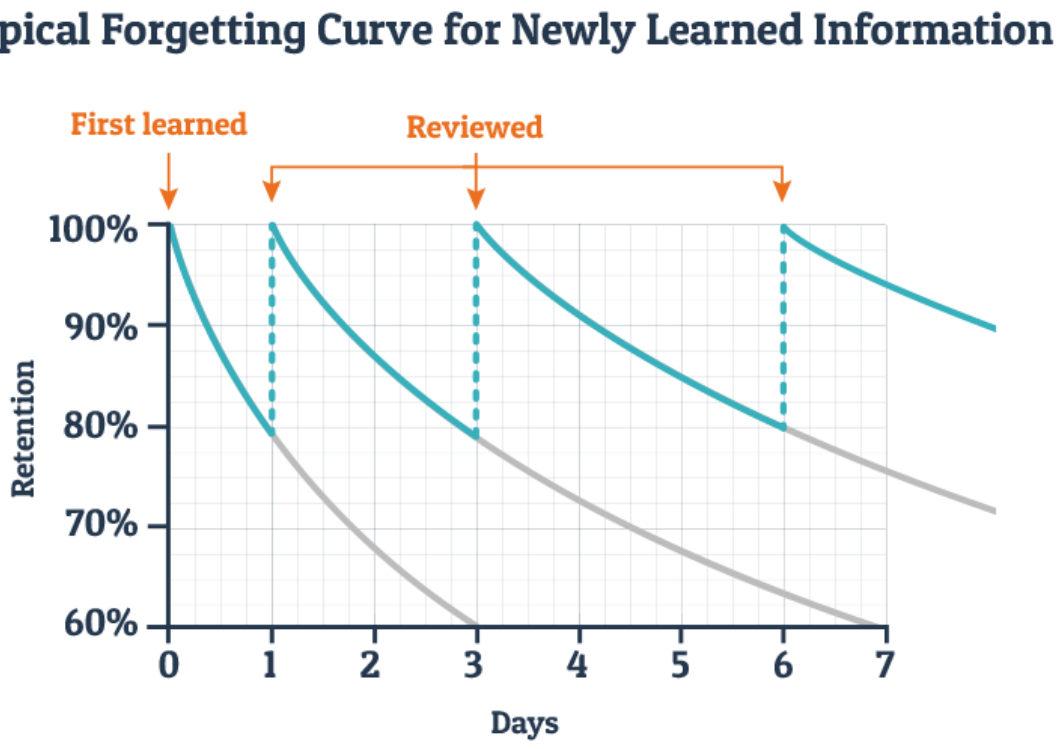
Relearning is undoubtedly the weakest form of recall. It occurs when you are relearning or reviewing information and it takes you less effort each subsequent time. For example, if you read a list of country capitals on Monday and it takes you 30 minutes, it should take you 15 minutes the next day, and so on. Unfortunately, this is where we mostly lie on a daily basis. We might be familiar with a concept, but we haven't committed enough of it to memory to avoid essentially relearning it when we look at it again.

This is what happens when we are new to a topic or we've forgotten most of it already. When you're in the relearning stage, you essentially haven't taken anything past the barrier of short-term memory into long-term memory. From your brain's perspective, this kind of information is simply not important, relevant or repeated enough to warrant more space in your memory.

The Forgetting Curve

Not only are we fighting weak encoding or storage in our quest for learning, we are also fighting the brain's natural tendency to forget as soon as possible.

This is encapsulated by the *forgetting* a concept pioneered by psychologist Hermann Ebbinghaus. Below is a picture of the forgetting curve, courtesy of Wranx.com.



This shows the rate of memory decay and forgetting over time if there is no attempt to move information into long-term memory. If you read something about the French Revolution on Monday, then you'll typically remember only half of it after four days and retain as little as 30% at around a week's time. If you don't review what

you've learned, it's very likely you will only retain 10% of what you learned about the French Revolution.

However, if you review and rehearse it, you can see in the graph above how you will retain and memorize more over time. You will bump the retention level back up to 100%, and then the graph will start to become shallower, indicating less decay. It's as though you are teaching your brain, "This is important. I keep needing to know this, so remember it."

The goal is to make the forgetting curve shallower—to make it resemble a horizontal line as much as possible. That would indicate very little decay, and doing that requires constant review and rehearsal.

Ebbinghaus found patterns for memory loss and isolated two simple factors that affected the forgetting curve. First, the rate of decay was significantly blunted if the memory was strong and powerful and had personal significance to the person. Second, the amount of time and how old the memory was determined how quickly and severely it decayed. This suggests there is little we can do about forgetting other than to come up with tactics to assign personal significance to information and rehearse more often.

As you can see, forgetting isn't as simple as having something on the tip of your tongue or rummaging through the stores of your brain. There are very specific processes that make it a near-miracle we actually retain as much as we do. You're probably also noticing that improving your memory is as much about good encoding and attention as it is proper rehearsing and recall.

Being able to recall information is always the goal, but more realistically, we should be shooting for recognition and to learn how to expertly use cues and hints in our daily lives. I may not be able to recite the lyrics of my favorite songs, but I can sure remember them if I hear the melody. If I become expert at managing cues for myself, I can work around the unavoidable limits of my memory.

The study cycle

Another way to work with the brain and the inbuilt mechanisms of memory is to use what's called the study cycle. Rather than one technique, this approach is about using a series of different techniques in a particular order, for a particular duration, to maximize learning. In fact, the principles behind the study cycle could explain why tactics such as retrieval practice and spaced repetition work so well.

The cycle consists of five sequential steps to follow. It will help you cement new material and, as you do so, you'll build a deeper sense of confidence in yourself as you gain knowledge and build on each new development. The cycle is also great for keeping yourself organized and motivated. Often, when we sit down to simply "study," the intention is so vague that we only waste time and miss out on an opportunity to really learn well. But with a structured, flowing study cycle, we know where we stand—and we can apply the steps to any coursework we like.

The steps are preview, attend, review, study, and assess... and then the cycle is repeated.

The first step is to Don't just dive in; rather, begin by trying to get a broad overview of what you're doing, in what context, and why. See the big picture. What this looks like will depend on you and the subject you're studying.

For example, if you're reading through an important chapter in a textbook, you might need to start with some skimming, i.e. read through the main headings and subheadings, scan any pictures and diagrams with their titles, look at any summaries at the end, data such as graphs or tables, and bolded sections or pull quotes that have been highlighted as important. This way, you prime and cue your learning.

If your studies are taking a less traditional form, you might still like to begin by going through the material quickly to get an overview. Look through a piece of music quickly and note the time signature, the tempo, the key, and get an idea of the melody. If you're going through some academic journal articles, go through the abstracts first and broadly see what the research question, methodology and conclusions were in each before reading in detail.

The next step is to i.e. pay attention. Crucially, the preview section helps you direct *where* your attention goes (that is, onto the most important concepts), but in the second step, you need to apply that attention fully. Here, you want to be as focused and aware as possible. Don't just sit in a lecture passively, or watch a tutorial video without taking notes.

Read or watch This means you engage with the data coming in. Make notes, ask questions (who, what, where, when, why, how), and have a "dialogue" with the material. Jot questions in book margins and find out how to answer them. Make summaries or simplified diagrams—and use as many of your senses as possible

when you encode this new information. When you generate your own study aids and explain the concepts to yourself, you'll comprehend better, and retain more.

For step 3, we Just as we previewed, now we look again and see what ground we've covered, and what material has been absorbed. Just the act of revisiting what you've taken in reinforces it further. At the end of your study session, stop and take stock. Look again through your notes and summaries, and perhaps even answer some questions you had at the beginning of the session.

You are in essence skimming again, but this time, instead of seeing the big picture of what you are going to learn, you do a quick survey of what you have learnt. Drill a few new concepts, revisit the main themes, and just take a moment to let everything sink in. If you practice retrieval immediately after learning some new data, you are teaching your brain not only to file away important information, but to cement a path via which you can search for and recall that data later on.

Step 4 is to The material is there, now you need to make sure it's taking root in your brain, permanently. The key to this? Repetition. For around 30 to 50 minutes, go over concepts, definitions, problems or ideas, reinforcing your understanding. Pay attention to those parts that are most difficult for you, but remember to keep seeing each unit in relation to the whole. Here, you can draw on all the previous steps to sit with the material and encode it into your brain.

The last step is to Here, you want to check how well the process is going. Check how much you've retained, but also ask yourself how well your study techniques are working. Try some tests or worked problems and appraise your performance and memory. Based on the outcome, adjust your approach next time.

You'll know you've properly absorbed the material when you are able to confidently teach the concepts to another person, and feel that you comprehend enough to reproduce it or score well on a test. On the other hand, you might do well with the material but wish to change the study approach, for example spending more or less time on different steps, or using a different active reading technique.

When you're done, you start again with step one!

Retrieval Practice

So how can we use this knowledge about our memories to be more effective learners? There is one major technique that applies the fickle nature of memory: *retrieval*

We typically consider learning something we absorb—something that goes *into* our brains: the teacher or textbook spits facts, data, equations, and words out at us, and we just sit there and collect them. It's merely accumulation—a very *passive* act.

This kind of relationship with learning returns knowledge that we don't retain for very long because, even though we *get* it, we don't *do* much with it. For best results, we have to make learning an *active* operation.

That's where retrieval practice comes into play. Instead of putting more stuff *in* our brains, retrieval practice helps us take knowledge *out* of our brains and put it to use. That seemingly small change in thinking dramatically improves our chances of retaining and remembering what we learn. Everyone remembers flashcards from childhood days. The fronts of the cards had math equations, words, science terms, or images, and the backs had the "answer"—the solution, definition, explanation, or whatever response the student is expected to give.

The idea of flashcards sprouts from a strategy called *retrieval* This approach is neither new nor very complicated: it's simply recalling information you've already learned (the back of the flashcard) when prompted by a certain image or depiction (the front).

Retrieval practice is one of the best ways to increase your memory and fact retention. But even though its core is quite simple, actually using retrieval practice isn't quite as straightforward as just passively drilling with flashcards or scanning over notes we've taken. Rather, retrieval practice is an active skill: truly struggling, thinking, and processing to finally get to the point of recalling that information without clues—much of what we've discussed already in this book that accelerates learning.

Pooja Agarwal researched pupils taking middle school social studies over the course of a year and a half ending in 2011. The study aimed to determine how regularly scheduled, uncounted quizzes—basically, retrieval practice exercises—benefitted the ability to learn and retain.

The class teacher didn't alter their study plan and simply instructed as normal. The students were given regular quizzes—developed by the research team—on class material with the understanding that the results would *not* count against their grades.

These quizzes only included about a third of the material covered by the teacher, who also had to leave the room while the quiz was being taken. This was so the teacher had no knowledge of what subjects the quizzes covered. During class, the teacher taught and reviewed the class as usual, without knowing which parts of the instruction were being asked on the quizzes.

The results of this study were measured during end-of-unit exams and were quite dramatic. Students scored one full grade level higher on the material the quizzes covered—the one-third of what the whole class covered—than the questions *not* asked on the no-stakes quizzes. The mere act of being occasionally tested, with no pressure to get all the answers right to boost their overall grades, actually helped students learn better.

Agarwal's study also provided insight on what kind of questions helped the most. Questions that required the student to actually recall the information from scratch yielded more success than multiple-choice questions, in which the answer could be recognized from a list, or true/false questions. The active mental effort to remember the answer, with no verbal or visual prompt, improved the students' learning and retention.

Using Retrieval Practice in Our Lives

The principal benefit of retrieval practice is that it encourages an *active* exertion of effort rather than the passive seepage of external information. When we learn something once and then actually *do* something else to reinforce our learning, it has more of an effect than merely reviewing notes or re-reading passages in books. The knowledge that we store in our memory is activated when it's called out. Retrieval practice stimulates that movement and makes it easier to learn and retain new understandings. If we pull concepts *out* of our brain, it's more effective than just continually trying to put concepts The learning comes from taking what's been added to our knowledge and bringing it out at a later time. We mentioned flashcards at the top of this section, and how they're an offshoot of retrieval practice. But flashcards are not, in and of themselves, the strategy: you *can* use them and still not be conducting true retrieval practice.

Many students use flashcards somewhat inactively: they see the prompt, answer it in their heads, tell themselves they know it, flip over to see the answer, and then move on to the next one. Turning this into however, would be taking a few seconds to actually recall the answer and, at best, say the answer out loud before flipping the card over. The difference seems slight and subtle, but it's important. Students will get more advantages from

flashcards by actually retrieving and vocalizing the answer before moving on.

In real-world situations—where there's usually not an outside teacher, premade flashcards, or other assistance—how can we repurpose what we learn for retrieval practice? One good way is to expand flashcards to make them more "interactive."

The flashcards in our grade-school experiences, for the most part, were very one-note. You can adapt the methodology of flashcards for more complex, real-world applications or self-learning by taking a new approach to what's on the back of the cards, as suggested by writer Rachel Adragna.

When you're studying material for work or class, make flashcards with concepts on the front and definitions on the back. After completing this task, make another set of cards that give "instructions" on how to reprocess the concept for a creative or real-life situation. Here's an example:

"Rewrite this concept in plain English."

"Write a movie or novel plot that demonstrates this concept."

"Use this concept to describe a real-life event."

"Describe the *opposite* of this concept."

"Draw a picture of this concept."

The possibilities are, as they say, limitless in how you can seek retrieval. Using these exercises extracts more information about the concept that you produce yourself. Placing them in the

context of a creative narrative or expression will help you understand them when they come up in real life. Our memories are fickle, and they like to play tricks on us by design, but they can be molded to our advantage in learning more quickly.

Spaced Repetition

This method is directly aimed at dealing with beating forgetting. Spaced repetition—otherwise known as distributed practice—is just what it sounds like.

The reason it is such an important technique in improving your memory is that it battles forgetting directly and allows you to work within the bounds of your brain's capabilities. Other techniques, no less important, are about increasing encoding or storage—remember the three parts of memory are encoding, storage, and retrieval. Spaced repetition helps the last part, retrieval.

In order to commit more to memory and retain information better, space out your rehearsal and exposure to it over as long of a period as possible. In other words, you will remember something far better if you study it for one hour a day versus twenty hours in one weekend. This goes for just about everything you could possibly learn. Additional research has shown that seeing something twenty times in one day is far less effective than seeing something ten times over the course of seven days.

Spaced repetition makes more sense if you imagine your brain as a muscle. Muscles can't be exercised all the time and then put back to work with little-to-no recovery. Your brain needs time to make connections between concepts, create muscle memory, and

generally become familiar with something. Sleep has been shown to be where neural connections are made, and it's not just mental. Synaptic connections are formed in your brain, and dendrites are stimulated.

If an athlete works out too hard in one session like you might be tempted to in studying, one of two things will happen. The athlete will either be too exhausted, and the latter half of the workout will be useless, or the athlete will become injured. Rest and recovery are necessary to the task of learning, and sometimes effort isn't what's required.

Here's a look at what a schedule focused on spaced repetition might look like.

Monday at 10:00 a.m. Learn initial facts about Spanish history. You accumulate five pages of notes.

Monday at 8:00 p.m. Review notes about Spanish history, but don't just review passively. Make sure to try to recall the information from your own memory. Recalling is a much better way to process information than simply rereading and reviewing. This might only take twenty minutes.

Tuesday at 10:00 a.m. Try to recall the information without looking at your notes much. After you first try to actively recall as much as possible, go back through your notes to see what you missed, and make note of what you need to pay closer attention to. This will probably take only fifteen minutes.

Tuesday at 8:00 p.m. Review notes. This will take ten minutes.

Wednesday at 4:00 p.m. Try to independently recall the information again, and only look at your notes once you are done to see what else you have missed. This will take only ten minutes. Make sure not to skip any steps.

Thursday at 6:00 p.m. Review notes. This will take ten minutes.

Friday at 10:00 a.m. Active recall session. This will take ten minutes.

Looking at this schedule, note that you are only studying an additional seventy-five minutes throughout the week, but that you've managed to go through the entire lesson a whopping six additional times. Not only that, you've likely committed most of it to memory because you are using active recall instead of passively reviewing your notes.

You're ready for a test the next Monday. Actually, you're ready for a test by Friday afternoon. Spaced repetition gives your brain time to process concepts and make its own connections and leaps because of the repetition.

Think about what happens when you have repeated exposure to a concept. For the first couple of exposures, you may not see anything new. As you get more familiar with it and stop going through the motions, you begin to examine it on a deeper level

and think about the context surrounding it. You relate it to other concepts or information, and you generally make sense of it below surface level.

All of this, of course, is designed to push information from your short-term memory into your long-term memory. That's why cramming or studying at the last minute isn't an effective means of learning. Very little tends to make it into long-term memory because of the lack of repetition and deeper analysis. At that point, it becomes rote memorization instead of the concept learning we discussed earlier, which is destined to fade far more quickly.

When you set out to learn something, instead of measuring the number of hours you spend on something, try instead to measure the number of times you revisit the same information after the initial learning. Make it your goal to increase the frequency of reviewing, not necessarily the duration. Both matter, but the literature on spaced repetition or distributed practice makes clear that breathing room is necessary.

It's true that this type of optimal learning takes up more time and planning than most of us are used to. However, if you find yourself short on time, you can still use it strategically.

To cram for a test, exam, or other type of evaluation, we don't need material to make it to our long-term memory. We just need it to make it slightly past our working memory and be partially encoded into our long-term memory. We don't need to be able to

recall anything the day after, so it's like we only need something to stick for a few hours.

You might not be able to do true spaced repetition if you are cramming at the last minute, but you can simulate it in a small way. Instead of studying subject X for three hours only at night, seek to study it one hour each three times a day with a few hours between each exposure.

Recall that memories need time to be encoded and stick in the brain. You are doing the best imitation of spaced repetition you can with what you have available. To get the most out of your limited studying time, study something, for example, as soon as you wake up, and then review it at noon, 4:00 p.m., and 9:00 p.m. The point is to review throughout the day and get as much repetition as possible. Remember to focus on frequency rather than duration.

During the course of your repetition, make sure to study your notes out of order to see them in different contexts and encode more effectively. Also, use active recall versus passive reading. Don't be afraid to even intersperse unrelated material to reap the benefits of interleaved practice. Make sure to focus on the underlying concepts that govern the information you are learning so you can make educated guesses about what you don't remember.

Make sure that you're reciting and rehearsing new information up to the last minute before your test. Your short-term memory can hold seven items on its best day, so you might just save yourself

with a piece of information that was never going to fit into your long-term memory. It's like you're juggling. It's inevitable that you'll drop everything, but it could just so happen that you're juggling something you can use. Make use of all types of memory you can consciously employ.

Spaced repetition, as you can see, approaches learning from a different perspective—in practicing retrieval and shooting for frequency as opposed to duration to improve memory. Even in situations where you don't have as much time as you'd like, you can use spaced repetition to cram for tests and overall just get more information into your brain—again, by focusing on frequency and not duration. When you spread out your learning and memorizing over a longer period of time and revisit the same material frequently, you'll be better off.

Takeaways

Learning relies on memory, and memory is in turn an interplay between two processes: storing and retrieving information. There are three main steps: encoding, storing and retrieval.

How well we **encode** material (i.e. cement it into our minds) depends on the degree and intensity of attention we pay it, as well as the senses through which we encounter it, and our associated emotions.

When we **store** memories, we do so either as transient sensory memory, short-term memory or more long-term memory.

Retrieval is when we return to stored memories and pull them out again, either with a cue or helpful sequence, or without one. We can retrieve information in a few ways: recall it directly (no cues, this is obviously preferable), recognition (remembering something after a cue or prompt, and relearning, which is the least effective and lasting method.)

Forgetting is a normal state of affairs, and occurs on a "forgetting curve." Every time we rehearse, however, we refresh this memory, and the subsequent forgetting trails off at a less steep curve. The goal is to rehearse until the curve eventually flattens, and the rate of decay slows enough for you to say, "I've permanently learnt this."

The study cycle is a process to follow to maximize your learning process given the way memory works. The steps are: preview, attend, review, study and assess, and then begin the cycle again. In a study session, it's best to flow through each step consciously —establishing context, paying attention, actively reading and engaging, drilling the material and then taking time to assess how well the process went afterwards.

Retrieval practice is the art of practicing what most cements memories—retrieving them. It is an active process and instills memory firmly.

Spaced repetition is most effective for practicing retrieval and countering forgetting. Deliberate practice, too, can help you

control what you're practicing, and how this can enhance your learning and knowledge over time.

Chapter 3. Active Learning Techniques

Whether your school days are long past you or you can still remember those stuffy, boring classrooms like they were yesterday, you can probably think of a few teaching techniques your teachers inflicted on you with greater or lesser success. So many of us embark on any new study endeavor by returning to these old tactics without thinking about whether they work for us, or indeed ever worked for our teachers. We might assume the more conventional approaches are the ones to use—but are they really the best?
Researcher John Dunlosky and his associates conducted a thorough review of techniques and models related to learning in 2013. They examined 10 different methods, chosen because they were "relatively easy to use and hence could be adopted by many students." You'll probably recognize all of them as techniques that you've tried in the past with varying degrees of success.
Dunlosky's team rated each technique according to how well they were suited for the goal of learning and retention. As might be expected, the five models the team determined were *poor* for learning proved to be, arguably, the most commonly used and recognized:
Summarization. In this model, students are asked to write their own summaries of text to be learned. The point of summarization is to "identify the main points of a text and capture the gist of it while excluding unimportant or repetitive material." Dunlosky's team claimed summarization is a skill that only works if the student was already trained in how to do it.

For the majority of students *without* that training, the technique couldn't be executed and wouldn't be effective. In other words,

summarization might be effective, and in theory it is, but you are probably doing it wrong. In this case, doing it wrong only wastes your time and energy, and might even give you a false sense of understanding and progression.

Highlighting. This long-standing, universally popular technique simply consists of marking pertinent text with a brightly colored ink marker or by underlining. The researchers found that highlighting might help a little if students were using it on an extraordinarily difficult text, but overall, they saw highlighting as a detraction from learning, as it doesn't help students draw additional meaning or inference from the study material. If you lean heavily on highlighting, it might be time to ditch it as a crutch and learn to read more actively.

Mnemonics. A practically ancient practice, mnemonics is the invocation of mental callbacks or shorthand—images, songs, phrases, or acronyms—to recall facts or information already learned—for example, using the phrase "Super Man Helps Every One" to identify the Great Lakes (Superior, Michigan, Huron, Erie, Ontario) or using pictures of objects in learning a foreign language.

It seems to make a great deal of sense, and mnemonics can be used with success in limited areas. But researchers found that while it may help us quickly access memory of keywords, the potential of achieving "durable learning" from mnemonics was quite low. This might be connected to what we discussed with the relationship between rote memorization and concept learning—as long as mnemonics encourage only surface learning, they can't compete with deeper understanding and comprehension.

Imagery use for text learning. A more abstract use of mental invocation than mnemonics, this device encourages students to conjure an image—mentally or on paper—to represent paragraphs or blocks of text they read. The brain is essentially asked to recruit more senses and encode data in more ways than one, connecting ideas.

The researchers found this use of imagery "promising," although more study on the topic was needed. Overall, they determined that the benefits of imagery use were limited to memory tests and text that already lent itself over to image creation or memory recall. As with many other techniques discussed here, it often comes down to whether you know what you're doing or not!

Rereading. Dunlosky's team found that although rereading and reviewing text was extremely common and easy to execute, it was only somewhat effective, and mainly when rereadings of the text were spaced apart. They also maintained there wasn't compelling evidence that rereading had any effect on students' knowledge, abilities, or deep comprehension of the topic.

Have you ever just read through something in a completely passive way, your eyes trailing along without anything really sinking in? Reading can seem like an obvious thing to do, but it may mean next to nothing when you consider how easy it is to read without any genuine, deep connection with the concepts on the page in front of you.

While these five techniques weren't without certain advantages—either their ease of use or their effectiveness when students knew how to use them found their efficacy in retaining deep understanding, thoroughness, and applicability somewhat narrow and frequently subject to certain conditions. They held some value in superficial meaning or memorization, but far less in comprehension.

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

Above are the results of Dunlosky's study. Even though many methods have been debunked as ineffective, there was concrete evidence for the efficacy of other methods. Unsurprisingly, the difference between the two groups was the amount of *active* processing involved. At this point in the book, this should not be a surprise to us.

Five *Effective* Techniques

The other five strategies Dunlosky's team covered were deemed as the best for learning and retention:

Practice testing

Distributed practice

Elaborative interrogation

Self-explanation

Interleaved practice

We've already discussed *practice testing,* otherwise known as retrieval practice, in Chapter 2. That's when you are looking at a blank piece of paper and are prompted to generate information without any further cues. *Distributed practice,* otherwise known as spaced repetition, was also covered there, both as an extension to how our memory works.

In this section, we'll discuss the remaining techniques, and, more importantly, how you can start using them in your own study sessions.

Elaborative Interrogation

Many prominent thinkers have expressed a common sentiment over the years: if you cannot easily explain an idea to a five-year-old, then you don't truly understand the concept. A 2014 paper in the journal *Memory and Cognition* by Nestojko et. al. explained how "expecting to teach" improves a person's ability to retain and organize new information. Trying to explain what you have learnt to a real or imagined audience is helpful, but it may actually be the anticipation of having to teach in the future that forces your brain to adopt a particularly receptive and focused state of awareness.

The researchers' study was simple: students asked to learn a passage in order to complete a test later on performed worse than students asked to learn the same passage specifically with the intention of teaching it to someone else. The latter students were better able to recall main points and details, and the information they retained was better organized.

The trick may lie in adopting a more active stance to what you're taking in. How many times have you read a paragraph, eyes glazed over, scanning the words on the page but not really taking in any of their meaning? Expecting to teach may prime your mind and get you to read more actively, looking for key points and clues to important information. As you read, your brain is already actively assembling a mini-curriculum in your mind.

There are variations on this principle. "Elaborative interrogation" is the act of making a thorough explanation for why a certain fact is the case. Investigated by educational psychologist Michael Pressley and colleagues since the mid-'90s, this technique has plenty of promise as a way of learning details and facts—even confusing ones. Rather than merely learning what is true, you force yourself to explain the reasons for it being true. By slowing down and asking your brain to truly understand, you bypass the need for rote memory and retain the concept at a deeper level.

Importantly, this doesn't just mean accessing and memorizing an explanation, but creating one yourself; it's the *process* that enables better understanding. What's great about this is that the more prior knowledge you have, the better this method works, because you have more mental "scaffolding" to build on when learning something new.

This technique may entail nothing more complicated than regularly asking "why?" Sometimes we think we understand something, but when asked to outline it clearly (literally speaking it aloud, if possible), we reveal to ourselves the gaps in our knowledge. If you get something right, explain how you arrived at your answer, or think about how you would outline the process for a fellow student. By understanding the steps and method, you give yourself a better chance of repeating them in future when you solve a similar problem.

Self-explanation is a related technique, and also depends on the most available resource you have: the things you already know.

Self-explanation uses prior knowledge to explain and understand new knowledge. Rather than approaching any new data from scratch, you try to anchor it and contextualize it to what you already understand.

Many of us practice the technique without even knowing it, but it's something that we can certainly take better advantage of. The effectiveness of this method depends heavily on the content and the degree of your prior knowledge. It's best combined with other techniques and approaches.

A simple way to bootstrap new knowledge using old knowledge is to make analogies. If you're an expert cook trying to learn a complicated laboratory technique, you might draw parallels between the two, imagining the lab process as a "recipe."

Even creating a summary can be said to draw on this same approach to learning, provided you are crafting the summary in a spirit of extracting the essence of a concept to share with someone else, i.e. to teach them. Some people find it enormously helpful to imagine they are teaching themselves as they learn. This can be combined with questioning or creative note-taking.

A person learning a new musical piece on an instrument might notice themselves struggling on a particular section. They slow it down, take it apart and look at it more closely. They imagine themselves explaining to others *why* this piece is so difficult. By elaborating this way, they understand what needs to be learnt—a new fingering pattern, a different position of the hands, etc.

The person might then coach themselves mentally as they go: *that didn't seem to work so well... why do you think that is? Take a look at the position of your fourth finger. You already know that in the previous piece you learnt, the fourth finger can sometimes be a problem with this technique... OK, sit up straight and try again, breathe deeply and pull your fourth finger away on the third count, like* They trial and error a new approach, engaging and responding dynamically to their own learning, rather than mindlessly repeating the same pattern over and over without getting anywhere.

Another way to improve your self-explanations is to use concrete examples while trying to learn. Let's go back to the discussion of ethics we used in the previous chapter while learning how to effectively take notes. We can use the classic example of dividing a cake between three children to illustrate the principles we learned of. The deontologist would divide the cake based on some preconceived rule such as "everyone gets equal parts." However, the utilitarian would say that we should divide the cake to maximize the total happiness derived by the division. So if one kid is hungry while another is full, the former gets more than the latter.

This is just one example, but you can utilize several different ones to help self-explain different ideas to yourself. If you can, discuss your examples with others to gain feedback or constructive criticism. Alternatively, if you have access to a teacher, verify your examples with them to ensure that you've implemented the principles they're meant to convey accurately.

A recent study at the University of Waterloo found that the dual action of speaking and listening to yourself recite content helps you retain information much better than reading or writing in silence. This is because saying things out loud has a deeper impact on your long-term memory. You might initially feel slightly awkward talking to yourself, but that is a small drawback of an infinitely helpful technique. The following method of reading out loud will doubtless prove beneficial in your learning endeavors:

Feynman Technique

The Feynman technique, named for famous physicist Richard Feynman, is a specific application of self-explanation. It has four steps.

Step one: Choose your concept.

The Feynman technique is very widely applicable, so let's choose one we can use throughout this section: gravity. Suppose that we want to either understand the basics about gravity or explain it to someone else.

Step two: Write down an explanation of the concept in plain English.

Is this easy or difficult? This is the truly important step because it will show exactly what you do and do not understand about the concept of gravity. Explain it as simply, yet accurately, as you can and in a way that someone who knows nothing about the concept would also understand.

Can you do it or will you resort to saying, "Well, you know... it's gravity!" This step allows you to see your blind spots and where your explanation starts to fall apart. If you can't perform this step, clearly you don't know as much about it as you thought, and you would be terrible at explaining it to someone else. You might be able to explain what happens to objects that are subject to gravity and what happens when there is zero gravity. But

everything that happens in between might be something you assume you know but continually skip learning about.

Step three: Find your blind spots.

If you were unable to come up with a short description of gravity in the previous step, then it's clear you have large gaps in your knowledge. Research gravity and find a way to describe it in a simple way. You might come up with something like "The force that causes larger objects to attract smaller objects because of their weight and mass." Whatever you are unable to explain, this is a blind spot you must rectify.

Being able to analyze information and break it down in a simple way demonstrates knowledge and understanding. If you can't summarize it in one sentence, or at least in a brief and concise manner, you still have blind spots you need to learn about.

Step four: Use an analogy.

Finally, create an analogy for the concept. Making analogies between concepts requires an understanding of the main traits and characteristics of each. This step is to demonstrate whether or not you truly understand it on a deeper level and to make it easier to explain. You can look at it as the true test of your understanding and whether you still possess blind spots in your knowledge.

For example, gravity is like when you put your foot into a pool and the fallen leaves on the surface are attracted to it because it causes a barely seen impact. That impact is gravity.

This step also connects new information to old information and lets you piggyback off a working mental model to understand or explain in greater depth. The Feynman technique is a rapid way to discover what you know versus what you think you know, and it allows you to solidify your knowledge base.

Interleaved Practice

The final active learning method of this chapter represents a departure from what many might consider the established and logical way of learning a skill or a subject: devoting time to learning one subject in uninterrupted blocks, like eating all of your vegetables first before eating your dessert.

Blocking involves learning or practicing one skill at a time before progressing to another one. You don't move on from working on one skill until you've completed the routine—you finish Skill A before Skill B and finish Skill B before moving on to Skill C. Representing study time units as one letter, this practice would establish a pattern that looks like AAABBBCCC.

Interleaving disrupts that sequence. It mixes the practice of several related skills throughout the study session. So the pattern of interleaving would look like ABCABCABC.

For example, a beginning algebra student may be tasked with comprehending exponents, graphing, and radicals. Instead of taking each subject one at a time, they could start with exponents, break off and practice graphing, then work on the radicals of square roots, and then go back to studying exponents. When studying Shakespeare, one could divide portions of a study session by switching between the playwright's comedies, tragedies, and historical plays. Taking it to another level, you could study Shakespeare, then mathematics, and then African history all in the same study block.

Interleaved practice at first might seem a haphazard, somewhat randomized way of learning in comparison to others—but which method actually works best? Research indicates that interleaving is actually much more effective for motor learning (physical movement) and cognitive (math) tasks.

Its advantage over block learning is surprising: tests indicated than interleaving produces a 43% increase in learning and retention over block learning. You may have heard that multitasking is bad because it creates interruption and hinders the flow of learning. But when used deliberately, "interruptions" can also be exactly what makes interleaved practice so effective. Interleaving pushes a student out of the comfort zone of order and sequence. This disruption stands to make more of an impression on the student's mind than maintaining the study session's status quo. And it's also a form of retrieval practice: students regularly revisit recently acquired knowledge at a higher rate. The more often we can find information, call it back up, review it, and connect it with other subjects we already know, the more likely we are to understand and remember the information (Blaisman, 2017).

The blending of concepts or problems builds and reinforces stronger connections between them. Students generally perceive concepts as free-standing, self-contained bits of information with no apparent or obvious connections to other bits. Regularly reviewing material that's previously been covered facilitates discovery of these connections and encourages us to find unexpected bridges between different skills and ideas.

Like retrieval practice, interleaving brings our knowledge *out* of our banks of concepts and promotes active thinking about where they fit. In the same way that particles that are smaller have a

greater surface area, ideas that are encountered in smaller chunks seem to have a greater conceptual surface area, and are felt to connect more solidly to the surrounding flows of activity and information. Rather than task-switching being a disruption, it can, in this case, act to keep us on our toes and engaging more actively with what we're learning.

The benefits of interleaved practice are two-fold. First, it improves the brain's ability to discriminate between concepts. In blocking, once you know what the solution is, the hard part's over. With interleaving, each practice attempt varies from the last, so rote or automated responses don't work. Instead, your brain has to continually focus on finding different solutions. This process sharpens your ability to learn critical features of skills and concepts, which therefore helps you select the correct response and execute it.

Interleaving also strengthens memory associations. In blocking, you only need to hold one strategy in your short-term memory at a time. In interleaving, the strategy will always be different because the solution changes from one attempt to the next. Your brain is relentlessly engaged in calling forth different responses and bringing them into your short-term memory. Again, it's an active and more challenging approach—it reinforces your neural connections among different tasks and responses, which enhances and improves learning.

The practice of interleaving can be effective in text-based learning as well, but a little more advanced preparation might be needed. The most important tip to remember is that interleaving isn't the same as multitasking, which you should avoid. Don't play *too* loosely with the disciplines you're learning—interleaving between chemistry, English lit, and ceramics is probably more trouble than it's worth, not to mention messy.

Rather, within a single study session, move between multiple topics. Try to set a limit on how many different angles or subjects you'll handle in a given study block—three is enough and four might be good for intense sessions—but once you're in, feel free to let your instincts guide you from topic to topic. Setting a timer for each topic is fine, but in some cases, the enforcement of an artificial limit might not be ideal for comprehension purposes.

Even if the subjects you interleaf don't vary too wildly, you still have some wiggle room. For example, you can juggle readings in English literature, European architecture, and Greek philosophy without too much shock to the system. Subjects that spur the finding of connections are especially helpful—blending studies in art theory, art technique, and the history of pop cultural art of the '60s could very well produce meaning that can easily be shared across all three concepts.

All the strategies we've detailed in this chapter take information we receive and turn it into a moving part. We don't just store it in our minds and move on to the next idea. Instead, we question the information, compare it, and use it to illuminate other information. By immediately putting new ideas to use and pulling out learned concepts to connect with the new ones, you're turning education into action that deepens its meaning. When that happens, it's something you'll have a hard time forgetting.

Takeaways

Techniques that focus on *active* and conscious engagement with new material will always result in deeper understanding and better recall.

Many of the conventional study techniques we all use are actually quite poor at helping us learn, including summarizing, highlighting, using mnemonics, adding imagery to text, and re-reading text. Though these can be useful in limited contexts, they are not the most effective.

More effective techniques are more active and applied: practice testing, distributed practice (covered in a previous chapter), elaborative interrogation, self-explanation and interleaved practice.

In elaborative interrogation, we use questions to ensure a depth understanding of the material, asking "why" and "how" to reveal causal connections and relationships that go beyond the surface. This aids not only our understanding but our memory.

Self-explanation also forces us to delve more deeply into concepts, where we "teach ourselves" and perhaps identify gaps in understanding. By explaining ideas, sequences or concepts to yourself, you learn them "from the inside out."

Inspired by the physicist Richard Feynman, it is always worth checking your comprehension by seeing whether you can explain any idea in simple, straightforward language. If you can't, there are bound to be some conceptual gaps or misunderstandings.

Interleaved practice goes against conventional wisdom and encourages you to alternate between different topics or skills in a single study session. By blending topics, you develop a certain

cognitive agility and strengthen connections and relationships rather than learning isolated blocks in one go.

Active learning techniques work best when they're chosen for their appropriateness for the particular student, topic, and lesson at hand. Any of the above tactics are a good idea if they encourage depth rather than surface understanding, and allow you to make meaningful conceptual connections between ideas.

Chapter 4. Make Learning Secondary

"That is the way to learn the most, that when you are doing something with such enjoyment that you don't notice that the time passes."—Albert Einstein to his son, Hans Einstein

There is a lot of wisdom to unpack in that simple sentence Einstein once uttered to his son, and it ties directly into the focus of this chapter.

It's a straightforward premise. If you are lucky enough to be consumed with a goal or objective, and achieving that goal or objective happens to require the acquisition of skills or knowledge, then you won't even notice you're working to learn and remember. Your learning and expertise become second nature, all in pursuit of that goal.

I want to briefly repeat a story I've told elsewhere. I had a very motivating goal of talking to a girl in my Spanish class, Jessica. She tended to turn around and ask me for help because she was perhaps the one person who paid less attention than me in class, so I vowed to get better at Spanish so she would continue talking to me.

In this pursuit for her attention, I studied Spanish like a madman and even researched obscure references and vocabulary to impress her. I didn't know it at the time, but I had made

learning secondary, and the pursuit of my goal was my biggest priority. Every new word or phrase I learned was one I could use for another purpose.

I learned as a byproduct, and that is perhaps the easiest way to learn.

Here's another example that involves my older sibling. When he was growing up, the Internet was just starting to become popular. Of course, with the Internet came chat rooms, message boards, and all sorts of communication with people that weren't right next to you. It opened the world up for many people. I remember watching him sit at the family computer and struggle to type.

One day he downloaded some sort of chat program, which I now realized was AOL Instant Messenger—the infamous AIM that nearly every adolescent, teenager, and young adult used at the time. It couldn't have been one or two weeks later that I walked past him at the computer again and couldn't help but notice how noisy and busy the keyboard was. His typing speed had probably quadrupled in just that week since downloading AIM. He became obsessed with chatting online, and that obsession translated into competency quite quickly.

He had made learning how to type secondary in pursuit of his primary goal of talking to his friends online more quickly! All he wanted to do was type faster so he could tell jokes with proper timing and not get beat to the punch line by his friends, and he found a way to get that done through typing more quickly. His accuracy and so-called technique would probably have been better

if he attended typing classes, but he was an incredibly fast typist, with all credit going to AIM.

Here's a final example to illustrate that making learning secondary can lead you to learning and knowledge without you even realizing it.

This story is about one of my friends from college. When he was still living in the dorms, he was surrounded by people who happened to play the guitar. They had all learned at some point when they were teenagers and brought their guitars to college to serenade women. Occasionally, they lugged all of their guitars into the same room and jammed out to classic rock songs as a band.

Feeling left out, my friend asked if he could use one of their roommates' guitars when they weren't there. It wasn't a problem, so my friend began learning how to play guitar on his own, practicing the songs his dorm mates jammed to. It wasn't that he felt left out or desperate to fit in—he just saw music as a fun group activity and wanted to be able to participate.

The next time the group gathered to jam, he was able to join in on the fun, and when they went through various songs in their repertoire, he could learn on the fly and play quietly in the background before becoming more confident and playing more loudly. He started to bond with these guys and learned more and better guitar so the group could play more complex tunes and solos.

He is another shining example of why, if possible, you should make learning secondary. Think Daniel from *The Karate* who was forced to paint and clean and realized he was actually learning karate.

Given the proper motivation, you can make it so learning and acquiring knowledge isn't a chore and is rather a rung on the ladder to your overall goal and sense of gratification. What's more important when you have a bigger goal is that you focus on efficiently making something work. You might not be worried about the specifics as much, but you will probably have the same end result.

From there, you have the choice to start deliberate practice, rehearsal, and fine-tuning everything, but simply having the right motivation will get you to a point of competency and even make you stand out. It's simply not as painful when you are chasing something greater versus learning for the sake or learning or being forced to. Again, we see the distinction between depth learning and superficial rote memorization.

Now, granted, you've picked up this book because your goal is (probably) to improve the way you learn, whatever your chosen topic. It's a little bit of a paradox, but to truly achieve this objective to its fullest, it's almost as though we need to pursue it i.e. aim for another goal entirely. Skill, expertise, and deep learning can all come as a byproduct of your larger overarching goal. But it's much harder to go the other way—to hope that plodding along at the superficial level is enough to earn you that

kind of deep understanding and passion that Einstein was talking about. So, what do we do with this knowledge?

Understand that a motivation other than learning and knowledge is your most powerful learning tool. You have to see the forest through the trees and understand the rewards and benefits of what your actions are leading toward. In essence, everything you learn or want to become better at is a tool on the way to your overarching goal or project. You have to have a WHY and not just a how.

Get more in touch with the reasons you're pursuing this or that goal, and remind yourself of its ultimate value to you in your life, beyond the immediate markers of success. Sure, you might want to pass this next nursing exam or win an award, but what are you doing any of it for? Didn't you start down the path in the first place because of your sincere love of helping others, and making a difference?

Of course, not every endeavor has to be deep and meaningful for you to power it up with some context. No matter what the goal is, there are ways to engage with your learning in such a way that you are "in the zone" rather than just going through the motions with a set of pre-determined exercises.

Don't have a goal or project yet? Make one that will make the acquisition of a desired skill necessary but not the primary focus. For instance, if you want to learn better geography, start playing board games that require such knowledge. If you want to get better at skiing, start entering small, local competitions that will

force you to improve. If you want to get better at typing, play a game that requires quick and accurate typing. If you want to learn a language more quickly, watch television shows that require greater vocabulary.

Make learning the journey, not the end point.

It's important to mention that it's not wise to *always* rely on motivation or inspiration. While the above considerations can frame your action and put your goals into context to inspire you, there's no getting around the fact that even with our most cherished goals, we sometimes need some discipline to continue slogging toward them. Inspiration, excitement and energy are great when you have them, but those require you to be in a positive state of mind, which isn't always possible.

It also puts you in a mindset where you have a prerequisite to learning and focusing. You need to feel inspired, you need to feel motivated, or you need to be in the right state of mind. This, we all know, definitely isn't always possible. But luckily, there are plenty of ways to cover a temporary shortage of motivation day to day, if we know that our broader aims are set in place.

I want to touch upon what I call the 10-minute rule. It works in two ways. First, if you don't feel like doing something, just do it for 10 minutes. Then you can stop. Of course, you'll rarely stop at the 10-minute mark because you'll have built up momentum and destroyed what was keeping you lazy: inertia.

Second, whenever you feel like stopping a task or quitting for the day, just give it 10 more minutes until you stop. You may not continue much past this, but giving yourself a specific deadline will make you want to finish as much as possible in that time, and it will make you just a tad more productive. Your motivation may be waning, but your discipline will keep you working.

The other big lesson of this chapter is that doing, using, and applying is, hands down, the most important part of learning. Recall the pyramid of learning where the most passive methods of learning yielded the least memory retention. When you apply your knowledge, you are at the participatory and active part of the pyramid. It's more work to be sure, and most of us like to slide down the path of least resistance.

Doing and getting your hands dirty allows you to find patterns and make connections that observation and study would never show you. I'd go so far as to say you will never master anything without some firsthand experience. Dan Coyle, talent researcher and scientist, suggested that the rule of two-thirds is most effective when learning or acquiring a new skill. You should spend one-third of the time reading and researching and the other two-thirds actually doing and practicing.

You can only learn so much about playing the guitar by watching videos and reading tutorials. Don't expect to be able to play like Jimi Hendrix the first time you pick the guitar up if you don't actively practice. If you're a complete neophyte, then you need to start with research and bone up on the ground rules and boundaries. Then you go and do.

Knowledge from research by itself is useless without the experience to back it up. When you combine those two, you gain intuition and judgment, which is usually the true goal.

The Six Facets of Understanding

So, rather than pursuing learning for its own sake, we pursue a goal, or some deeper understanding, and then our learning comes along for the ride. You reach that enviable state of mind where improving your skills and gaining knowledge almost happens automatically, without you even knowing it. This is more fun and, yes, way more effective than forcing yourself through a learning process that you don't care that much about.

Think about Einstein in the previous section. We know him today as a brilliant physicist and thinker, a human being who was able to step out of the intellectual confines of the scientific discipline he found himself working within; someone whose mind and contributions took the entire world into a new era of understanding.

Now, do you think Einstein sat down one day and decided to accelerate his learning, so he could memorize better, read faster or sharpen his study skills? Do you think he set out to be the most intelligent, learned person in the room? Nope. His motivation was far, far deeper than this. He genuinely wanted to He was inspired, and wanted to learn more, to see into the universe, to be able to explain its workings—theoretical physics was just a convenient tool!

So, to take your own learning to the next level, you need to connect to the deeper facets of understanding that can drive your behavior, rather than focusing on the techniques of learning itself. There are six of these, first proposed by Grant Wiggins and Jay

McTighe, to focus on instead of making learning your primary goal:

Explanation

Why does the sun appear to rise in the East? What's going on in the body when you catch measles? Why did the Second World War happen? When you tap into the "big idea" that ties all your observations together, you are accessing an You see the context, the connections in a bigger web, and this drives your learning. You see a person's psychology in relation to their family or culture, or an animal's behavior in relation to the ecosystem it belongs to.

This is the foundation of reasoning and theory—we take data and spin up a story from it, a story that explains and illuminates what we're talking about. So, you don't sit down and learn some dry facts, but see those facts as part of a bigger, more interesting whole that helps you understand the why and how of phenomena.

Interpretation

You look at art made during the Second World War and, knowing what you do about that historical period, you try to make sense of the images, try to see the feeling and meaning behind the symbols, playing around with different interpretations. You look at a piece written by Freud and consider his claims in light of what you know about his relationship with his mother. Or maybe you create a piece of music inspired by a novel—"interpreting" or translating ides from one medium into another.

Application

You might be trying to learn about some painfully boring legal history, or the details of some particular political legislation. It may seem uninteresting until you realize what this legislation is

used for. Some people make the focus of their learning the practical application of a skill or knowledge.

So, we learn about agriculture to produce better food and feed the nation. We learn how to write not because we care about the language itself, but because we want to be more effective communicators and express our message clearly (the message matters, not the medium!). It's about purpose, and function.

Perspective

History and anthropology can be boring to learn about. But it's never boring to imagine, for example, how the world looked to Stone Age people, or to imagine a group of people who had a completely different way of being in the world than yourself. What does your argument look like from "the other side"? How does your argument appear to people who completely disagree with you?

When we learn to gain perspective, we broaden our own view, and can give ourselves the gift of critical thinking. We see our own assumptions and biases more clearly, and use our learning to do something magical: access the inner worlds of other people.

Empathy

Related to this facet of understanding is empathy, or the ability to *feel* into another's experience, and not just grasp it intellectually. Think of Jane Goodall and all the amazing developments she made in understanding animal behavior because she approached her work with a gentle, compassionate curiosity for the animals she worked with. Her understanding was motivated by empathy.

We underestimate how often empathy inspires our learning and understanding. After all, empathy is simply understanding of our fellow human beings, not only via the humanities and the arts,

but in understanding anyone different from us, whether that's children, animals, people from the past, or those from an entirely different culture.

Self-knowledge

Finally, we can be driven to learn by the desire to understand *ourselves* better. Many social theorists, scientists and philosophers have begun with their own lives as a starting point, inadvertently uncovering something about the bigger world when they set out to understand the world inside themselves.

How many psychologists have learnt what they have because they wanted to understand their own brains, personalities or traumas? A historian might study a past event because of the effect it had on his great-grandparents; a scientist may unravel the mysteries of a genetic disorder their own child has; a lawyer might dig into a particular area of law precisely because it relates to personal mistakes she herself is trying to make sense of.

These six facets of understanding are non-hierarchical—none is better than the other. Learning is the but understanding is the Those who embark on learning without the deeper goal of understanding may find their work is shallow and unengaging; but those who are powered by a genuine desire to know more, may find that they get engrossed in their work in exactly the way that Einstein describes.

Problem-Based Learning

There is an urban legend about novice metalworkers. Their teachers tell them to carve a complex structure out of a solid block of metal with only hand tools at their disposal. After they complete this tedious and seemingly impossible problem, what do you suppose was accomplished by the student? They became true experts with hand tools.

What about famous Mr. Miyagi from *The Karate Kid* movie? Who can forget how he taught his student, Daniel-san, how to perform hard labor? And yet, after this goal was achieved, it turns out Daniel-san learned the basics of karate.

Through solving a problem or reaching for a goal, learning was made inevitable.

Problem-based learning (PBL) is where you start with a problem that needs to be solved, and you force learning through the process of solving that problem. You try to accomplish a goal that necessitates learning. Instead of setting out to learn X, the idea is to set a goal of solving problem Y, and in the process, learning X. Of course, this is pure learning transfer.

Usually, we learn information and skills in a linear manner. In school, a traditional approach is commonly used: material is given to us, we memorize it, and we are shown how that

information solves a problem. This might even be how you structure your learning when you're by yourself—because you don't know anything different.

PBL requires you to identify what you already know about the problem and what knowledge and resources you still need, to figure out how and where to obtain that new information, and finally how to piece together a solution to the problem. This is far different from the linear approach of most schooling. We can draw on my failed romantic escapades as an adolescent for illustration.

I wanted to impress *Jessica from Spanish* It's a noble and mighty motivation that has been the impetus for many changes in the life of a young (and old) male. We were in the same Spanish class, and I had the good fortune of sitting directly behind her. It turns out she wasn't too interested in Spanish, so she would constantly turn around and ask me for help.

I would first get caught in her eyes, but then my spirits would fall because I realized I had no idea how to answer her questions. *What if she started asking the other guys in the class? I didn't want that!*

With that in mind, I began to study and learn Spanish so she would have all the more reason to continue turning around and talking to me. It's amazing what you can do when you have the proper motivation for it, and I probably became fluent more quickly than anyone in the class that year. What's more, I would

look up obscure or complex phrases solely to impress her, just in case I had the opportunity.

I created a massive set of flashcards. They started with one word on the back of each card, but by the end of the school year, they had three to four sentences on the back of each, all in Spanish. I got an A+ in the class, one of the few in my high school career, but I never did get anywhere with Jessica.

This is a classic case of PBL—I wanted to solve the problem of X (Jessica), but I ended up learning Y (Spanish) in the process.

Of course, the key for us is to be deliberate about the problem you spend your time solving, so what you learn helps you accomplish what you want. It can be as simple as wanting to master a new scale on the guitar, and attempting to play a difficult song that incorporates that scale. You can see how focusing on solving a problem can be more helpful and educational than simply reading a textbook or hearing a lecture. There's certainly something to be said for firsthand experience.

PBL has been around in one form or another since John Dewey's pivotal 1916 book *Democracy and Education: An Introduction to the Philosophy of* One of the basic premises of Dewey's book was learning by doing.

Fast forward to the 1960s, when PBL had its modern start. Medical schools started using real patient cases and examples to train future doctors. Indeed, this is still how many medical

students learn to diagnose and treat patients. Rather than memorize an endless supply of facts and figures, medical students went through the diagnostic process and picked up information along the way. That's exercising a different muscle than reading and writing notes.

What questions should they ask of the patient? What information do they need from the patient? What tests should be run? What do the results of those tests mean? How do the results determine the course of treatment? By asking and answering all of these questions in the process of PBL, medical students ultimately learn how to treat patients.

Imagine that a medical student is presented with the following case: A sixty-six-year-old male patient comes in to the office complaining of recent shortness of breath. What are the next steps in this blank canvas?

In addition to medical, family, and social histories, the student would want to find out how long the symptoms have been occurring, at what time of day, what activities lead to shortness of breath, and whether anything makes it worse or better. The physical exam, then, becomes problem-focused: check blood pressure, listen to heart and lungs, check legs for edema, etc. Next the student would determine whether any lab tests or X-rays need to be done. And then based on those results, the student would come up with a plan for treatment. And that's just for starters.

If the instructor wanted the student to learn about how to deal with potential heart problems, they accomplished that. By applying their investigative skills to real-world cases, the learning was more realistic, more memorable, and more engaging for the medical students. Research has shown that when learning is problem-based for medical students, clinical reasoning and problem-solving skills improve, learning is more in-depth, and concepts are integrated for better overall understanding of the material.

PBL forces students to take ownership of the solution and approach, and they absorb a concept or set of information in an entirely different manner. Instead of simply solving for X, they must come up with the entire equation that leads to X. It involves a deep sense of exploration and analysis, both of which lead to a greater understanding than simple regurgitation.

PBL leads to greater self-motivation as well because rather than learning for learning's sake, there is a real-life issue at stake, with real-life consequences.

Living in the "real world," we typically aren't given case scenarios or assigned to group projects (at least not in the elementary-school sense of the phrase) to assist in our learning goals. Whether we know it or not, we can put ourselves in a position to enhance our learning by directing it to specific purposes. What follows are a few examples of how to find a problem that will necessitate further learning on your part.

Meal For instance, you want to solve a problem of dealing with delayed and frantic dinners. You choose this task because, besides

solving the problem of unnecessary stress and anxiety, you will learn how to become a better cook in every sense of the word. You want to solve X (stressful meals) but along the way also learn Y (how to cook better).

So, what steps would you take to become more proficient in the kitchen? One way would be to implement a meal-planning system to allow you to try new recipes and techniques. First, determine what do you already know about the problem? Your family needs to eat. Recipes would be nice, perhaps starting out easy and then becoming more involved. You need the ingredients to make those recipes, a schedule of what meal to serve when, and a strategy for how you will tackle the more advanced techniques.

What do you still need to know? You need actual recipes and ingredient lists. You need some sort of organized plan for when you'll serve each dinner, probably a calendar. You may want to identify specific skills you want to acquire.

Where will you obtain new information to help solve this problem? Maybe you start by asking members of your family to share their three favorite meals with you. Then you hop on Pinterest to find some recipes. From there, you make a grocery list, maybe on a notepad, or your computer in a Word doc, or a grocery app you find. Next you need to put your meals onto a calendar. Again, you may do this on your computer, or you might find a meal-planning printable or app. And maybe you want to explore online grocery ordering with delivery or pickup to further save time (and probably impulse spending). You'll need to figure

out how you will learn new cooking approaches: reading, YouTube videos, going to a class, etc.

By making a strategic plan to enhance your cooking skills, you have solved your mealtime chaos by using PBL! You identified what you already knew (you need ideas about what new skills you wanted to learn, meal ideas, recipes, a grocery list), figured out what you still needed to know (the techniques themselves, specific recipes, ingredient lists, a meal calendar), and where you found that information (family, Pinterest, apps, books, online, computer, etc.).

Not only have you created a plan for your family's upcoming meals, you have devised a strategy to use moving forward week after week, month after month, all the while learning new techniques and improving your cooking skills. By developing a meal-planning strategy, you are saving time and money, and you may see a decrease in chaos and an increase in family satisfaction with meals. Call it killing two birds with one stone. Problem-based learning provides a helpful framework for a thoughtful, organized way to approach a problem, challenge, or dilemma in order to learn a new skill or new information. You can think of PBL as a series of steps as demonstrated in the examples above.

Define your problem.
Determine what you already know.
List potential solutions and choose the one most likely to succeed.
Break the steps into action items (a timeline often helps).

Identify what you still need to know and how you will get that information.

There are some distinct advantages to PBL. Not only will you have better retention of what you have learned, you will generally gain a deeper understanding of the problem and solutions than if you had taken a less focused approach. While it can seem like a problem-based approach has too many steps and will take too long, generally PBL tends to save you time in the long run since you aren't randomly trying less-well-thought-out solution after solution. Planning and formulating a systematic plan ultimately saves you time, and often money, too! That is the benefit of directly solving a problem—you get to the heart of what matters.

PBL can be applied to most any aspect of your life. You may have to get creative in how to design a problem or goal around something you want to learn, but this is the type of learning technique that will skyrocket your progress.

Gamification

Another way to make learning relevant and motivating to you is the concept of Gamification is when you apply the principles that make games addictive to nongaming contexts. For instance, gamification in an office setting might be allowing people to "level up" if they work a certain number of hours or complete a certain number of milestones. This would serve to motivate people on two fronts: for the arbitrary level-up and to hit the actual work milestone.

Often, people have difficulty becoming motivated purely out of duty or obligation. That's where gamification is best used—if you can make someone focus on leveling up, you can motivate them to hit their work milestones as a byproduct of wanting to progress a level. For instance, let's say that for each sale someone makes, they gain a point. If they accrue enough points, their title is upgraded from sales salmon, to sales tuna, to sales shark, to sales whale, to sales fisher. The idea behind gamification is to make people care about these levels and, in the process, make them care about their sales numbers.

You see this all the time with points, badges of honor, loyalty programs, and prizes for those who move up in the ranks. In reality, it's not about the points or badges at all—it's about motivating people to perform the underlying action that gets them the points or badges. It's about having some external marker of your progress, that almost becomes addictive in itself. The feeling

of moving along a set course and gradually improving can be very motivating, and keep people challenging their own limits.

Gamification creates an extremely fertile ground for learning because it makes people forget about the unpleasant work they are partaking in. Instead, they focus on gaining points and gaining in general.

You can create the effect that you are actually being rewarded when you learn, as opposed to feeling annoyance and becoming burned out.

Let's take a famous example that has driven literally millions of dollars in revenue: the McDonald's Monopoly game. The McDonald's Monopoly game is a gamification strategy where customers receive stickers every time they purchase something at McDonald's. The stickers could be used in two ways. First, they could be used to complete a Monopoly board, and the more complete it was, the better chance you had for winning a prize. Second, certain stickers by themselves bestowed rewards and gifts like free hamburgers and drinks.

For many, it became an obsession to try to complete the Monopoly boards or get free prizes—all of which could be accomplished by simply spending more money at McDonald's. The outcome McDonald's desired was clearly to increase their revenue, and by making people focus on progressing in the Monopoly game, they distracted people from the fact that they were spending much more money on McDonald's than they would have otherwise. People could see and taste their progress

in the game—visually through how complete their Monopoly boards appeared and through taste because they would literally get free food relatively frequently.

The free food was a short-term and immediate reward that kept people returning on a day-to-day basis, while the completion of the Monopoly board was a long-term reward that kept people coming back on a yearly basis—it gave purpose to the entire venture. Having both rewards was critical, because together they addressed short-term boredom and long-term lack of positive reinforcement.

Because of the gamification strategy, people ignored the fact that they were essentially spending a lot at McDonald's for very little tangible reward—the reward was advancing in the game itself. In 2010, McDonald's increased its sales by 5.6% in the United States solely by using this strategy. It's similar to how games at a carnival can be so profitable. People will pay a sum to throw beanbags and knock down a pyramid of cans for a prize worth less than a dollar. But it's not about the value of the prize; it's about accomplishing the goal of knocking down the pyramid. It's not about the pain of learning—it's about the game and your own progress. Everything else becomes secondary, but even though it's not your primary concern, it will still occupy a fair amount of your mental bandwidth. That sweet feeling of advancement to the next level is a huge psychological reward. We anticipate it, then we feel it, and then we immediately seek more of it by striving to level up once more. It's addicting.

How can you gamify your learning and create short-term and long-term incentives? It's not necessarily giving yourself levels and badges, because that doesn't quite work in the same way when it's self-generated. This can vary from person to person, and it might be most effective to involve others. One of the best examples is something I've personally experienced in the form of a workout tracker.

Many CrossFit gyms use a mobile application called SugarWOD to record statistics and level of performance for each workout. Just the act of entering this information at the end of the workout is motivating. Further, it's a social platform that allows users to view and give feedback on the workouts of friends. There are even standardized levels of performance so you can compare your workouts with other people and see how you measure up. Finally, tracking upward progress is incredibly gratifying and motivating. Perhaps social pressure is good motivation to learn.

Naturally, there are times when gamification is less appropriate—even the most enthusiastic and competitive person will soon grow bored of points and badges and levels if they see they don't relate to anything real. Gamification is an amazing tool for encouraging yourself to enjoy what ordinarily would be a slog—but it can never replace the need to decide on a genuinely worthwhile goal. On the other hand, if you can combine a worthwhile goal with occasional gamification? You get the best of both worlds.

In an ideal world, learning by itself would be the reward that motivates us all. Isn't it a wonderful feeling to be enriched and knowledgeable in the ways of the world? Isn't it a shame that

there have been so many books written in human history, and even if you devoted all of your free time to reading, you wouldn't put a dent into that number?

Well, then there wouldn't be the need for books like this one. Learning is most effective when you don't have to think about the act of learning.

Takeaways

One surefire way to enhance your learning is to act in such a way that it doesn't feel like you're learning at all. When you make learning secondary, i.e. you make your gains in skill and understanding a side effect of some other task you can't help but get carried away with, you learn more quickly and more easily.

We're more likely to reach our specific goals when we are driven by a deeper and more comprehensive desire to understand what we're learning. There are six facets of understanding, and they all go beyond the superficial.

We can be motivated by **explanation** (why does XYZ happen?), **interpretation** (how can this data be changed from form X into form Y?), **application** (what can I actually *do* with this knowledge?), **perspective** (what other way can I look at this?), **empathy** (how is that other person looking at it?) and **self-knowledge** (who am I?).

If we can tap into our most powerful motivation to understand the material in front of us relative to it, we are more able to find energy, enthusiasm and comprehension for our studies.

Problem-based learning is a way of focusing on the real-world application of knowledge. This engages us in the practical world of problem and solution, cause and effect. We become engrossed because we want to keep acquiring mastery and skill.

Gamification is a way to make learning fun and almost accidental. Gamification uses gaming principles in a non-gaming context. Games work best when the rules are clear, there is an obvious and linear progress from step to step, and rewards are immediate and proportional. Gamification is great for supplementing exhausted motivation, and making everyday study more fun and enjoyable. It can't, however, completely replace a deeper motivation or purpose.

Chapter 5: Teaching to Learn

You might wonder why a book on learning would include a chapter on teaching. Rather than teaching and learning being opposites, they are really two aspects of the same single process —in understanding both, we gain a fuller appreciation than if we had examined the subject from just one side or the other.
There is unexpected value in observing how others synthesize information.
First, you will see how someone else learns and absorbs information. Sometimes you can visibly see someone's face light up when they *get* and this is no small feat in the process of learning.
Second, you will see how the act of teaching improves the learning of the teacher. In observing how people synthesize information, you can improve upon how *you* do it. Understanding both sides of the coin is a helpful exercise. This, of course, is the process of teaching others to help you yourself learn. This chapter is about how learning to effectively teach others is a great method of learning in itself—and a good skill to have in general.

The Learning Pyramid

The infamous learning pyramid—also called "the cone of experience"—sheds light on why being able to teach is vital. In fact, much of what we talk about dances around the spectrum of more passive learning as less useful and more active learning as more impactful. This is what the learning pyramid encompasses. Some may take it as gospel, but the numbers are best if they are seen as rough guidelines. However, they still showcase the different results our learning activities, as learners retain:
90% of what they learn when they teach someone else or use their skills immediately

75% of what they learn when they practice what they learned

50% of what they learn when engaged in a group discussion

30% of what they learn when they see a demonstration

20% of what they learn from audio-visual

10% of what they've learned from reading

5% of what they've learned from a lecture

These numbers aren't exact or necessarily even proven. As with most modern theories or modules of education, the learning pyramid faces its share of dissenters. However, it *does* show a general trend that's true: the more involved you are, the better you learn. The more active and deliberate, the better.

Without a doubt, teaching is one of the most involved, participatory, and *non-passive* types of interactions with new information we can have. Like self-explanation and the Feynman technique, teaching someone not only roots information in your mind; it forces you to see what you truly can explain and what you can't. Teaching yourself is good; teaching others is even better.

Teaching exposes the gaps in your knowledge. Having to instruct and explain doesn't let you hide behind generalizations: "Yeah, I know all about how that works. I'll skip it for now." That won't fly if you're explaining a process to someone else—you have to know how every step works and how each step relates to each other. You'll also be forced to answer questions about the information you're teaching, and iron out the exact relationships between ideas.

Having to explain what's going on is essentially a test of your knowledge, and you either know it or you don't. If you can't explain to someone how to replicate something you are teaching, then you actually don't know it yourself. For whatever reason, it's easier to believe you understand something better than you do right up until you're forced to prove it!

Let's take photography as an example. According to the learning pyramid, reading and lecturing combined take up 15% of your retained knowledge, which makes sense: there's only so much you can learn about photography from a textbook or a lectern. Audio-visual aids and seeing demonstrations—what certain angles look

like, how to use computers to filter a print—are more helpful in learning to take and process certain pictures. A group discussion about photography would unlock some memorable ideas, and of course, spending the time to practice taking and developing pictures makes solid impressions on your experience.

Now let's examine the bottom (or top, depending on your view) part of the pyramid related to teaching others. You're reinforcing the basic knowledge in others and explaining the principles, types, and general guidelines of photography. Theoretically, you're overseeing all the upper (or lower) segments of the pyramid for students and using your knowledge of the photography process as a guidepost for all of them. And this doesn't even include the pre-instruction time when you're preparing for your own class.

All those teaching activities are active agents that call upon what you already know—and remember when we said you get more from pulling something *out* of your brain than putting stuff *into* it? That's exactly what's happening with that 90% tier of the pyramid. You're actively extracting from your previously learned knowledge, sending it out, and reshaping it for others to understand and learn. In turn, that reinforces what you know and deepens your experience in the process.

It's common that you even surprise yourself and find additional insights by explaining and reasoning out loud in a way that simplifies and condenses. Putting vague concepts into concrete words and images can often have a clarifying effect on *your* understanding, not to mention your students'. Teaching forces you to create bite-sized chunks and teach replication—a task you may find far different than explaining theories or concepts.

The Protégé Effect

"Teaching to learn" isn't a radical or even particularly novel concept. In the field of education, it's already regarded as one of the best ways to learn. But there's another element to why teaching can be so helpful to the teacher.

Recent studies have given rise to something researchers call the "protégé effect." This process demonstrates that people who teach others work harder to understand, recall, and apply material more accurately and effectively. There's something about the work required to extend your knowledge and understanding to another mind that makes you more creative, empathetic and broader minded. Tutors in general therefore score more highly on tests than their non-tutoring counterparts. Why do you think this might be?

To increase the usefulness of this effect, scientists have developed virtual pupils for students to tutor. These virtual students are known as "teachable agents" (TAs). Researchers at Stanford University, which is sort of a hotbed for this kind of technology, explain TAs as follows:

"Students teach their agent by creating a concept map that serves as the agent's 'brain.' An artificial intelligence engine enables the agent to interactively answer questions posed to it by traversing the links and nodes in its map. As the agent reasons, it also animates the path it is following, thereby providing feedback, as well as a visible model of thinking for the students. Students can then use the feedback to revise their agent's knowledge (and consequently, their own)."

Students working with a teachable agent are therefore on the opposite side of where they usually are in the typical teaching paradigm—instead of being the student, they're the teacher. The TAs serve as student models, and like all active students, they can ask questions and even give wrong answers. Trials have shown that students using TAs significantly outperform their peers who have only been studying for themselves, without TAs to serve as feedback.

Stanford scientists studied the effects of TAs on eighth-grade biology students. Some students were asked to learn biological concepts so they could teach their TAs. The rest were asked to develop an online concept map to demonstrate how their understanding of the concepts was organized. Results showed the students who worked with TAs spent more time engaged with the concept and displayed more motivation to learn. Simply put, the students put forth greater effort to learn for "teaching" their TAs than they did for themselves. They felt responsibility and accountability beyond themselves, and this made them put in the extra work regarding their expertise—the protégés are depending on you!

The scientists at Stanford attributed three factors to the power of the protégé effect:

The ego-protective buffer. This is a sort of psychological shield that allows students to examine failure without the negative feelings it typically produces. This can be a powerful metacognitive force since students are more apt to reflect upon their learning without the emotional sting of disappointment. It's almost like a crash course in cultivating a growth mindset and embracing failure productively.

Incrementalistic view of intelligence. When the learning process is directed externally to support another's learning, students spend more time examining their own understanding. This helps students see how reviewing and revising their insight can impact their own learning.

Sense of responsibility. Teaching another person—or, in this example, the virtual TAs—motivates students to take more command over their own learning process. When they realize that what they say will be absorbed by another thinking unit, they're more meticulous about getting the information right to begin with. Learning is always going to be more effective when we adopt an attitude of conscious and active control over the process, which is something teachers are naturally encouraged to do.

Not all of us who aren't teachers or tutors have the opportunity to share our knowledge directly with willing students. However, thanks again to the miracle of technology, you can find plenty of online sites with message boards or forums, all filled with questions you can answer (or at least *find* the answers for).

A nice site to start with—despite its somewhat unruly nature—is Quora.com, where users just literally ask questions of the hive-mind of the Internet. Many questions are very general, and some serve as bait for trolls or fanatics. But they're easily funneled out, and you're left with a lot of genuine inquiries asking for serious answers. It's a good, almost comically quick way to share information with others—more importantly, it allows you to reap the rewards of the protégé effect and learn better.

Give Good Feedback

When we learn with the intention to teach, we break the material down into simple and understandable chunks for ourselves. We're also coerced to examine the topic from a more critical, thorough standpoint to improve our comprehension. We must be able to pick actions, behaviors, and thoughts apart and steer people to the correct paths. We need to keep in mind the broader aim and goal, even as we tackle the smaller details and tasks on the way there.

Delivering feedback is a key aspect in this regard, and it serves to regulate and direct the learning process. It prepares you for potential roadblocks and helps you learn in a different way. It also encourages you to work at giving honest, productive, and helpful feedback. But not all feedback is created equal—poorly considered feedback can be as useless as criticism or attack, resulting only in anxiety or negative feelings. There are a few points in the act of beneficial feedback that are important to follow:

Be specific. University of Auckland professors Helen Timperley and John Hattie stress the importance of giving learners very specific information about what they're getting right or wrong. Generalities like "Great job!" don't contain much valuable information about what the learner did right, and a vague statement like "not quite there yet" doesn't give any insight into how the student can do better next time.

Researchers, therefore, suggest taking a few extra minutes of time to give learners information about what *exactly* they did well and where they need to improve. Name the steps that made the biggest impression on you: "I liked how direct and ordered your calculations were," "You had a real command of the facts in this story," or "You seemed to get a little anxious when you talked about the numbers, but that can be fixed." It can also be of great help to tell the learner what they're doing differently than before.

Sooner is better. Feedback is always more effective when it's given as immediately as possible rather than days, weeks, or months later. One study that compared delayed versus immediate feedback showed a very significant performance increase among those who received instant assessments. Another project from the University of Minnesota showed that students who received lots of prompt feedback were better able to understand the material they'd just read.

Delayed feedback creates a psychological distance between the end of an activity and the learning moment, and that time lapse can only weaken the impact of the feedback. Better to negotiate with your schedule and deliver feedback quickly to ensure that your suggestions and opinions will be at their most conveyable and understood.

Tie it to a goal. Timperley and Hattie note that effective feedback is most often oriented around a specific achievement that students are working toward. Your feedback should be clearly understood in terms of how it will help students progress toward their final objective. "This essay should be an integral part of your final project," "Your layering is getting you closer to a cosmetology license," and so forth. It's encouraging to have reminders of what you are ultimately working toward.

Be careful. Your feedback has to be given in a manner that encourages rather than discourages. Some people are far more sensitive to negative feedback than others, and there's never a point in having others feel denigrated or ashamed. Offer feedback in a way that doesn't make people fear hearing from you.

In other words, sometimes you'll have to sugarcoat your response. It's not easy to walk the line between honest and helpful. In moments of giving feedback, try to imagine how you'd want to hear it if you were in a state of only moderate confidence.

You'll need to practice a little sensitivity and tact, but also have enough imagination to consider where your student really is, and what would be best for them to hear. Their personality, age, subject and level of mastery all go into helping you decide how to frame your feedback.

Positive feedback stimulates the brain's reward centers, leaving the recipient open to taking a new direction. Negative feedback, on the other hand, indicates that adjustment must be made and implies that the initial effort wasn't satisfactory, which turns on defensive instincts.

This doesn't mean you have to avoid negative or corrective feedback entirely. Just make sure it's presented respectfully and follow it up with suggested solutions and outcomes. "I'm aware you're having troubles with this part of the lesson, but I'm very confident you have the resources to break through your resistance" or "Mistakes are all part of this process, and everybody's made them—and we've all come out the other end just fine."

Feedback is an excellent opportunity to model for your student the optimal attitude to failure or challenge. When you communicate that learning is enjoyable and that making mistakes

or being "in a learning curve" is expected and even desirable, then you encourage the best from your student—and learn to do the same for yourself.

Finish with a plan. At the end of your feedback session, make sure there's a blueprint of actionable steps to move forward with. Without them, there's not much of a purpose to your feedback. A plan to set your guidelines in motion creates a positive, even optimistic resolution that both parties can look forward to. For example, "Now that you've gotten through this, let's go slower on the next proposal and measure each part of it against our criteria."

Getting Feedback from Others

Finally, what about us? The prospect of hearing feedback can be a source of stress, which is why it can be difficult to ask for it. However, the more we take the initiative and ask for feedback, the less stressful it gets. Even more deeply, if we ask for honest, unsparing, or even negative feedback— "C'mon, give it to me straight"—studies show that we stand a higher chance of personal satisfaction and an ability to adapt more quickly to new roles and responsibilities.

Before asking for feedback, ask yourself what kind you're looking for. Are you seeking appreciation, evaluation of a project, or a willing mentor or coach? Don't hesitate to ask direct questions about your role—in fact, being specific and making requests like "What do I do to improve in this area?" or "How could I have handled this differently" cuts past the clouds of uncertainty and gets right to something real and useful.

Don't be afraid to ask for feedback too soon. In fact, just as a teacher shouldn't wait to give feedback until days after it's useful, neither should we delay in getting it. Ask as close to real-time as you can get it.

Finally, widen your pool of responders. The more friends, colleagues, or online connections you request feedback from, the higher the chance that you'll be able to form a truly objective response from a multitude of perspectives. Make them feel comfortable about being direct and constructively critical. If there's one thing everyone can agree on, it's wanting to have their opinions heard!

We often think of teachers in elevated terms—which is fair, since education is a noble profession—but the best teachers would tell you they learn almost as much from their students as the students learn from them. Teaching means working with a multitude of personalities, analyzing problems, and understanding through empathy. The discoveries you make through that process can be as profound as anything you'll learn as a student. Even if you don't plan on becoming an educator, the benefits of *thinking* like one are just as accessible to you.

Deeper information Processing

The more we engage and interact with data, the better we understand it—and the better we remember it. Deep information processing is about making sure we have more than just a superficial connection to the new information we want to master, and can effectively move into understanding.

Consider the following example: someone gives you a list of random items, and asks you to read it and try to remember as many of the items as you can. Now, imagine the same list is offered again, but this time each item forms a part of a story, with a beginning and end, and with each item playing a particular role. In which situation do you think you'll be able to remember more? Obviously, the second one, where you are told a story about the items.

A study by Giulia Galli in the journal *Frontiers of Psychiatry* explains why: when it comes to memory and data retrieval, the brain favors "semantic operations" over "shallow operations"—which simply means that we recall information better and understand it more when it has meaning attached to it. Neuroscientists have researched the ways that new data is "encoded" into the brain. When you try to store random, neutral data on its structure and features alone (for example, trying to memorize a random string of letters), the memory isn't encoded as deeply as when you process it in a more meaningful way (for

example, learning not just strings of letters, but letters that form words that actually mean something to you).

By looking at images of the brain during different kinds of learning, neuroscientists have discovered that there are in fact different levels of understanding—and the deeper ones are more effective. This means that when you learn well, you are actually enlisting a completely different cognitive system and even different regions of the brain. Have you ever been studying and felt like information was simply going "in one ear and out the other"? Well, this might have been precisely what was happening—shallow encoding was failing to cement learning in your brain, i.e. without a deeper understanding of the data's meaning, the data didn't "stick."

So, learning (and especially memory) is not so much about how you retrieve and recall data, but how you encode and store it in your brain when you encounter it in the first place. Generally, new knowledge that is connected to information you already possess "sticks" more; so does knowledge that connects to other knowledge, i.e. in a narrative or sequential fashion.

The more parts of your brain that engage with the new data, the more thoroughly that new data is encoded. For example, when you pay attention to a scene with all five senses, and also engage with your emotional response to it, you are far more likely to remember it. Similarly, when you can understand the *practical application* of the new data, and its it's naturally easier to access in your brain later than random data you don't really understand that well.

To master deep information processing, you need to understand and use metacognition. In essence, this entire book is an exercise in metacognition, which is very simply the act of thinking about your own thinking. Looking closer, metacognition is more accurately described as cognitive self-regulation. It's our ability to not only be aware of how we're thinking, but to understand and control our methods of thinking according to our own purposes.

If you can look at data with an understanding of how and why you process it as you do, then you have some scope to change and shape that process—you become an active participant in your own learning. You feel more confidently in charge of your learning, you have a better idea of where you're going and why, and can evaluate your progress and adjust along the way. Really, you become your own teacher.

Let's look closer. Metacognition is actually two processes in one. First, you try to observe and understand what your brain is doing, and second, you try to control, regulate and shape what your brain is doing. As you can see, you cannot do the second without doing the first—to make changes, we need a thorough understanding of what we're changing. *Self-regulation always starts with self-knowledge.*

Part 1: Learn about learning. What influences your learning experience? What strategies are there for learning, and which are best for specific situations? How do you uniquely learn? What are your strengths and weaknesses?

Part 2: Regulate your learning. What are your broader goals? How can you achieve them? What plans can you make, given what you know about yourself? What strategies are you using and how well are they working? Can you make adjustments to do better?

In deep learning, we cycle continuously between part one and part two. As we learn how we think, we devise ways to regulate that thinking, and as we observe the effects of that regulation, our learning and thinking expands and changes, and we start again with something fresh to observe and regulate.

Metacognition is like zooming in and out, toggling between two modes: thinking and observation of that thinking. First we think, then we zoom out and observe ourselves thinking, try to understand the process, and interpret what we see. We zoom in again, and repeat. It's as though we have not one mind but two —a mind to work in the world of data, and another mind to watch and regulate the first mind, and observe not the data, but the way the data is being processed.

It sounds complicated, but you probably engage in metacognition more often than you even realize. A few examples will make the concept clearer. Let's say you are tackling some complicated coursework that is at the very limit of your understanding. You stop every once in a while to notice something interesting: that whenever you encounter a diagram in the textbook, you're drawn to it and study it closely, whereas you get bored with the solid paragraphs of text all around it.

You notice your own noticing—metacognition. You wonder if you would have an easier time if more of the material was in a diagram form. So you seek out these diagrams or make your own (cognition) and then check in with how well you're retaining and understanding the material (metacognition). With these two processes, you are not only better grasping the material in front of you, but are becoming masterful and managing your own thought processes, which is the ultimate in transferable skills!

Whilst metacognition is about asking questions of yourself (i.e. how you think), we can also ask questions of the content itself. The famous physicist Heisenberg claimed that "what we see is not nature itself, but nature exposed to our method of questioning." Heisenberg understood that questions are at the root of all deep understanding and learning.

It's a change in perspective, to see learning as a quest for better *questions* and not better But this perspective shift empowers you to learn on a deeper level. It reminds you that we advance more in knowledge when we directly engage with the unknown, rather than prematurely work from assumptions and banked knowledge. The quality of our questions determines the quality of our answers—which is more or less what learning is all about.

Yes, I know your teachers told you that "there's no such thing as a bad question." While it's true that being ignorant and asking for clarification is never something to be ashamed of, some questions really are better than others. Let's say you're a naturalist out walking one day and encounter a mysterious flower.

You could just ask a knowledgeable friend what the plant is, and that would be fine, since they would give you an answer and then you would have new knowledge.

But it's a completely different process when you begin with What can you see in front of you? How does this plant resemble the ones you do know about? What are its features? What do you know about this area, and the place the plant is growing, and what does this tell you about the kind of plant it is? What about the season, and the plants growing around it? Even if your friend told you what the plant was, you could have further asked, how do they know? *How* do they distinguish this plant from another very similar one?

Having answers is a fixed, static state of affairs. If the game changes, however, our answers might not work anymore. And if we don't really understand why we have those answers or what they mean, our grasp on that knowledge is very tenuous. We are actually in a far better position when we know little but are equipped with the tools to understand, enquire and analyze. It is easier then to find new answers, if necessary.

What makes a good question?

A good question is like a tool—it helps you do things and take action. It broadens your reach and your understanding. A good question opens ideas up for you so you can see inside them. A good question lets thinking flow, move, expand and, hopefully, arrive at an illuminating answer. A bad question only stifles

thinking, shuts your mind down or sends you down an irrelevant path.

In a classroom, a teacher carefully uses just the right questions at the right time to spur on the students' learning process. Questions guide their understanding, challenging them and focusing their awareness onto the things they have yet to understand. They get to grasp the problem from the inside out, see why it all comes together the way it does. When you are learning on your own, it's your job to play this teaching role with yourself, using questions to facilitate and shape your own learning process.

Do you remember being in school and having the teacher ask a weird question, only to have the class sit there and try to guess what the teacher was thinking, worried they'd say something stupid? These questions were bad ones, because they turned awareness away from understanding the content, and onto things that didn't matter, for example the shame of being "wrong."

When you question yourself as you learn, you need to make sure you're not just going through the motions in the same way as these teachers did. Your questions, being tools, need to perform a function, or else they're just getting in the way—or worse, actively impeding your understanding.

Remember, your question is not there simply to give you the "right answer," but to inspire your learning and understanding. It should guide rather than force. It is a tool that allows metacognition—so if you feel like your thinking is shrinking rather

than expanding, it's not the right question. You don't want to waste too much time on the formation or the answering of the question itself—rather, you are looking at what the question points to. If it's not pointing to anything greater than itself, it's not a great question.

Forget about some finish line that you're rushing toward; forget about judgment and being right or wrong; forget about reducing things down to a handful of simple concepts. Put all of that aside and just look at what's in front of you with the curiosity of a scientist. One question might inspire another—follow it with interest and see what else that question opens up for you.

As you question yourself, you are engaging in a kind of personal Socratic dialogue, unfolding your own learning with internally created prompts. Rephrase ideas, turn them over in your head, and allow yourself to wonder. Take nothing for granted. Keep asking why, and don't be afraid to look at your own questions as the subject of inquiry. Imagine, at first, that you are just getting to know the problem, like you'd get to know a person, and are simply at play rather than the serious work of arriving at an answer as quickly as possible.

Deeper Inquiry

Ask yourself questions before, during and after your learning process. Create a scaffold of questions around yourself so the knowledge can be built up on a solid foundation.

Questions to ask before you start learning

Naturally, the exact questions you ask will come down to your unique situation, and it's probably best not to rely too heavily on pre-formed questions in any case—the magic comes from devising your own queries. But to get you started, consider some of the following.

These are "what?" questions, asking about the big picture behind this particular lesson. What is the focus and emphasis, and what is its nature? Sometimes, you go a long way by simply identifying the kind of thing you're trying to learn. Is it more of a skill/technique or a piece of static knowledge? If it's an idea, what kind of idea is it?

In anything new we learn, we have to formulate what we see in terms of what we already know—this is unavoidable. What connections can you draw between the new thing with your pre-existing knowledge? Observing is never neutral—when we observe, we are already interpreting, because we choose what to focus on and what to downplay. So, ask yourself, what is most important

in the material, from your perspective? You may need to break things down and tackle smaller units in sequence. If so, which unit would make most sense to start with?

Let's imagine you are trying to learn about a new historical event; it takes place in a period of time you're familiar with, but in a country you don't know much about. You can deliberately ask yourself, "What don't I quite understand yet?" or, "What's the main gist of this event, and how can I find out about it?"

By asking questions before you start learning, it's as though you are setting up a little fence around the material you intend to learn. Asking good questions has a way of helping you set goals and lay out a plan going forward. For example, you could identify what you don't know and then set a course for a way to figure it out. Could you follow what others have done? Why or why not?

Questions before learning are about orienting yourself—what do you know and what don't you know? What are your resources (references, teachers, other students?) and what are your unique strengths and weaknesses? Finally, questions before learning serve to contextualize and add meaning. This is the big WHY behind all learning. What's the point of the information you're trying to absorb? What does it really mean to you as a person, and how does it fit into your world?

Asking these questions also cues and prompts you, and helps you interpret what comes your way against your own desired outcomes. Think about what you'll do with the knowledge once you have it. You might also like to consider if your particular

approach is really all that beneficial. Ask yourself directly—am I approaching this the right way? How else could I do it?

Become curious about how your own mindset and attitude is interacting with the material. Use your skills of metacognition to notice how you are learning, and become curious about how you could do better. For example, what is the effect of believing that your accounting work is boring and irrelevant? Might a different attitude actually make things flow much more easily and quickly?

Questions to ask while you're learning

Your learning is never passive. Once you've drawn yourself a road map and seen the rough terrain you're about to explore, then you set off, but you keep your eyes peeled and stay open-minded. Here, the name of the game is As you learn, regularly take a step back and take note of what is going on.

What's working and what isn't?
Where are you having difficulty and which ideas are flowing well?
What is capturing your attention and interest? What is unexpected?

Keep your ears pricked and look at the material—if you're having difficulty, try to determine whether something is confusing, complex or just new. Sometimes, we encounter something we don't yet understand and panic, thinking that if we don't understand it now, we never will. Sometimes, we see something at a glance and it looks very difficult and confusing, but it's truly

just complex, and we are only able to see small parts of it. This doesn't mean we can't understand it eventually!

Regularly asking, "Is this new, complex or confusing?" is an invaluable habit, because it alerts you what to do next. If something genuinely is confusing, ask yourself why, and what you're doing to encourage the confusion. It's like being on a hike through strange terrain. Simply look up and pause occasionally and ask, "Where am I and how did I get here? Am I closer to my destination? Where's the path?"

As you learn, remember that you are asking questions not just of the material, but of yourself—i.e. you're practicing metacognition. When you ask some variation of the question, "What is my mind doing right now?" you give yourself the opportunity to try doing something different with it. Ask yourself what questions you could ask!

Look where your attention is going, and notice the effects of your actions. It's not just about intellectual and cognitive concepts, though—ask about your motivations, emotions and energy levels, too. Maybe you notice that as the lesson goes on, you are feeling more and more confident. Why is that? What about the lesson is encouraging this feeling and how can you get more of it?

Or maybe you notice that you're feeling down that day and it's coloring your mindset as you try to work through some math problems. Knowing this, what's the best course of action? Take a break, maybe? You could pause, come back when you feel better

and carry on asking questions—do things feel easier now? More manageable? Take note and remember that for next time.

As you go along, your learning deepens and your questions continue, helping you stitch together a bigger web of understanding. Ask questions whose answers will help you connect what you're learning to what is already known. Constantly ask, "how does this fit into the bigger picture?" As you read some literature, keep wondering how the political environment at the time likely influenced the plot. See if you can notice any patterns in this current novel that connect with ones you've read before. What have others said so far about the way these separate elements fit together? If you don't know, how can you find out?

An amazing question to routinely ask as you learn is, "If I were my own teacher right now, what would I suggest next?" You might be surprised just how good you are at facilitating your own discovery process if only you give yourself the opportunity to actually pause and ask the right questions!

Questions to ask after learning

It would be a shame to just end your learning session abruptly, forgetting half of what you've covered and missing the opportunity to integrate and absorb all the new material you've encountered. The questions you ask after learning are incredibly important. In a broad sense, how do you think you did?

Try not to be too judgmental about your progress—it's far more useful to look objectively and with an open mind to see both what worked for you, and what didn't. Look at how you felt before the study session and how you feel now, and see what's different. Are there still some things you don't quite understand? Taking a broad view, what part of the lesson was the most important?

Rather than trying to simply regurgitate what you've learnt, place it in context with your bigger, personal goals. What can you actually *do* with what you've learnt, and how does it change your goals? For example, you may notice that the way the lesson is presented doesn't fit all that well with your unique interests, and that next time you might want to change the focus so you more closely follow what's most important to you.

Try to capture the essence of where you've been, and "bank" that knowledge. Place it against everything you already know, and take the time to become familiar with it. At the same time, begin to ask yourself what comes next—now that you've completed this piece of knowledge of skill, what can you follow up with?

Learning progresses step by step. It can be enormously empowering to complete one step in the process and move on to the next, knowing you are slowly but surely building up a scaffold for more complete knowledge. How can you "level up" and challenge yourself next? At the end of a study session, ask yourself, what can I do tomorrow, based on what I've learnt today?

Checking in with your progress is not just a practical matter, though. You definitely want to see whether your approach is actually working, test your retention, and assess whether your style of learning is as effective as possible. But also remember to ask how you feel, and exactly how your learning has affected you, as a person, given who you are.

Do yourself a favor and notice whether you feel excited, bored, anxious, confused, pleased, and so on after learning. Notice any changes not only in the way you feel, but how you think and behave. Is what you're learning generally making you a better person, or the kind of person you want to be? Granted, changes will be very small day by day, but are you broadly going in the right direction? Do you like the path you're on and the subtle ways you are altering your ways of thinking?

One of the best questions you can ask as you embark on any learning goal is, "How will I think of this process after one year, or 5, or 10? Will it generally be a good thing and why?" Doing this may seem intense, but the truth is that connecting to your deeper purpose and longer-term goals can keep you focused and determined on a path that may be challenging and require endless patience. Knowing where you're going, you can constantly check up on your path and adjust as necessary, ensuring you are always in control of your own development.

Now, when you see all the possible questions you can ask of yourself, before, during and after any learning session, you might wonder how on earth you find time for it all. However, good questions don't need to take a lot of time or effort, and the

more you practice paying conscious attention to what you're doing, the easier it will become. Don't be afraid of stopping regularly to see where you are and how the process is going—you might discover that you are actually more efficient and faster in your learning this way.

The PQ4R Method

Let's finish this chapter with a look at a common method designed to help people improve their basic reading comprehension skills, enhance their memory and perform better in exams. Though the technique was originally used by those managing dyslexia or other learning challenges, the approach is actually just as useful for all types of people who want a more structured, more efficient way to approach their reading when learning. It can improve your overall comprehension and let you develop a more sophisticated, richer understanding of what you read and absorb.

The title stands for **preview, question, read, reflect, recite, and**

Let's take a closer look at each step. First, **preview** is much like the first step in other approaches we've explored, in that it's about skimming and scanning important headings, subheadings and possibly images, illustrations or other data such as tables.

You don't dive in immediately, but get your bearings by looking at the overall structure of the piece in front of you, and trying to grasp the overall theme. If you read a story that primarily concerns the research of a particular scientists, for instance, you might be able to skim through and see their aims, the methods, and the conclusions they came to, in a very general way.

Look at not only what the main topic is, but the language that's used, the author of the piece and their context and motivation for writing what they did; notice even, if you can, the things that deliberately *aren't* mentioned and why. The so-called THIEVES method can help you ask some crucial questions:

T is for Reading the title, what's the main topic and theme, how does it connect to previous and subsequent chapters or pieces, and to your study in general, and does it say anything about the position of the author? For example, you can guess that the author who's written, "The hidden colonialism of GMO investment in India" will likely have a critical opinion about the economic, political and financial consequences in the field, rather than dwell on topics of conservation or the scientific details of plant genetics.

H is for Read the opening paragraph and ask yourself a few questions—questions you can prime yourself with and answer as you read on.

I is for Read any opening sections, or italicized summaries or intro paragraphs, and pause to see what you know already and what possible gaps you have in your understanding. To return to our example, maybe you know a little about the enormous changes happening to the agricultural industry in other countries, but not India specifically.

E is every first sentence in a paragraph: Look at each paragraph and see if you can begin to pick out the general argument or

logical structure of the whole piece. You might notice the piece begins with some background and history, then moves on to an anecdote about a particular village in India, then talks about some new legislature and a current controversy, finally ending with some evidence to support the author's position, i.e. that the developments are generally a bad idea.

V is for visuals and vocabulary: Now take a look at pictures, photos, diagrams, tables, infographics, maps, charts and so on. Read their captions and look closely at why the author has chosen these, and what they imply about the bigger picture. By now, you've probably also noticed a particular kind of vocabulary and style of writing. Is this formal or informal? Full of jargon? Written in first person? Passive voice? Consider the effect the language has on your understanding of the piece in general. Find any bold or italic sections, or any definitions or pull quotes, and try to see why they have been emphasized.

E stands for end of chapter questions: Before you carefully read through the full piece, focus on any questions associated with it, either in an exercise or test. If you keep these questions in mind, you can prompt yourself to focus your reading more directly on certain questions. If you have an essay, for example, that asks you to write 1000 words on the pros and cons of the legislature outlined in the piece, you can start reading it by looking out specifically for advantages and disadvantages, either highlighting or making notes as you go.

Finally, S is for summary: If there's a summary or final conclusion, read through this to round out a complete

understanding of the topic as a whole. Check in with yourself to see what you understand in total, given all the previous steps.

Now, this may seem like an awfully long and convoluted process for the very first step of previewing, but the truth is that the THIEVES method or other methods like it can be done in a matter of minutes. When you are in the habit of approaching new information with a pre-determined plan, you may discover you actually move through material more quickly.

The next step in the PQ4R method is to ask Look again at the headings and subheadings you found, and deliberately turn them into questions. For example, a title of "Three Main Types of Photosynthesis" might naturally have you asking, "What are the three types of photosynthesis?", "How do the three types of photosynthesis differ from one another?", or "What is the most common kind of photosynthesis?" If you can, consider questions using who, what, when, where, why or how, and try as many questions as possible.

You can also ask general questions inspired by your preview. What do you predict are the main themes and what are you expecting to learn from reading it through? What do you hope to better understand after absorbing this knowledge completely?

Next, we move on to actually **reading** the piece. If you do the previous steps thoroughly, you may find that your reading is much more focused, and that you understand more, more quickly. Practice *active* reading, by responding to what you read. Write

questions in the margin or highlight/underline important sentences.

Too many people think they're reading when what they're actually doing is passively running their eyes over some written words, so that the information goes in one ear and comes straight out the other. When you prepare your reading technique ahead of time, though, your reading is going to be more intelligent, more focused, and more responsive. If you stumble on a sentence that you don't understand or find a word you've never seen before, stop and unravel it, and make sure you dig deeper into its meaning. You may well need to read the text a few times over, to grasp what is being said.

Next, try to **reflect** on what you read. This means that you pull everything together and make broader sense of it. How does everything fit together in the topic, in the subject in general, and in your own personal world? How does this new piece of data fit into what you already know? Look at the questions you had in the beginning and see how you fared with the answers.

Are you surprised by anything? Maybe you have formed your own opinion as you went, and realized that you missed something in the beginning, but understand it better now. Reading is never passive—always ask yourself how you can

This can occur at different levels. Maybe you ask what the information means specifically for your exam or assignment coming up. Or maybe you can ask what the new information teaches you about this topic, theme or subject in general. On the

other hand, you might want to know how this information serves *you* personally, and how it can help your unique life. Does it mean anything for your individual goals, does it solve any of your problems or improve your communication? Data is just data, after all, until you decide how you're going to both interpret and apply it. The idea is to find *meaning* behind what you read, and place it in a bigger context.

Next, we move on to **review** (or perhaps So, you've skimmed, then asked questions, then read through everything. You're now a bit more familiar, but need to make the information more concrete. Write things down or drill the important points with a conversation or flashcards. You may even talk out loud to yourself. Summarize things in your own words, or draw up a table, chart or mind map that captures the main ideas. Here, you don't just want to make a summary, but gather up your genuine understanding of the meaning behind the ideas, and how they all interconnect to one another.

Finally, end the process with a which is similar to the first step of How did you do? Have you answered any questions or learnt anything new? How well do you understand things and how much of it could you retain for future use, such as in an exam? Does anything need to be further reinforced, or have you thoroughly grasped the material that was once unknown to you?

To recap, the steps of the PQ4R method are to **preview, question, read, reflect, recite, and review.**

If you're like most people, you might look at this and think what a huge amount of work it is! Actually, if you follow the structure, you may find the opposite is true: that you can spend far less time on your studies and be far more effective if you approach the whole process with focus and an organized plan. Make a note for yourself somewhere for each step of the PQ4R and you'll quickly get used to the process, especially since one step leads smoothly on to the next.

By the time you are in the later sections, you may have a deeper understanding of the information, which might not have been acquired if you had simply sat down to randomly read through the text with no plan, no goal, and no system. This approach is admittedly best for those occasions when you feel overwhelmed or have difficulty orienting yourself in a challenging new topic. Combined with the many other methods we've explored in the book so far, it's a simple but very powerful way of taking change of your learning, no matter how complex it is.

Takeaways

Tackling the learning question from the teacher's point of view enriches your own understanding, and gives you a firmer grasp on the things you yourself want to learn better. In the Learning Pyramid, activities that are most active, hands-on and teaching-focused end up being the most effective.
The protégé effect explains how tutors who teach others invariably perform better than students who don't also teach. This is because they learn in more organized increments, can detach their ego more thoroughly from failure and experimentation, and take on more responsibility for active learning.

Good feedback is an essential part of the learning process, and learning to give and take good feedback is part of gaining mastery in any subject.

Good feedback is specific, given as quickly as possible, and tied to a concrete goal. When giving feedback, use tact and awareness, understanding that people learn better when they feel supported and praised. Tailor your feedback to your student's personality, learning style and degree of mastery.

Deep information processing is about engaging with data beyond the superficial, so we can see into its meaning and significance.

Metacognition essentially consists of two modes: thinking, and thinking about thinking (or regulation of that thinking). Learning is best when it switches between these two modes.

We can encourage metacognition through the use of self-questioning, asking questions before, during and after learning to shape, guide and enrich our comprehension.

The PQ4R method is a way to bring metacognition to your reading, and consists of the following steps: **preview, question, read, reflect, recite, and** When we methodically follow each of these steps with a text or piece of information, we engage beyond the shallow levels and process information deeply by regularly asking questions of ourselves, the material, and the way we are interacting with it.

Chapter 6. Mistakes in Learning

Learning is a fluid activity. It's taking concepts that were unknown or nebulous to us in the past, finding a way to funnel them into our understanding, and incorporating them into our lives as need be. There are plenty of learning techniques, as we've seen, but no actual rules.

As such, there are some traps and inefficiencies that can come up when we're trying to learn. They can be reduced with some disciplined approaches and organization. In this chapter, we'll examine some of these pitfalls and what to do to correct them. Simply put, most of us are making mistakes in our attempts to learn and we don't even know it. You may have caught some errors now by virtue of learning the techniques presented thus far in this book, but that's just the beginning.

Lazy Reading

How do you take in the information you need and really read to effectively increase your knowledge?
Enter: the *four levels of reading*, and it was developed by philosopher Mortimer Adler in his suitably titled publication *How to Read a Book*. Adler explains that reading is not a single, universally consistent act. He breaks up the act of reading into four individual levels that differ in purpose, effort, and the amount of time they take. Furthermore, different tiers apply to different kinds of reading—some books can be appropriate for all levels, while others just support one or two. Especially in the higher two levels, faithfully following these tiers of reading will greatly advance your expertise on the subject.
Adler's four levels of reading, from simplest to most complex, are:
Elementary

Inspectional

Analytical

Syntopical

Elementary. You're already past this level. This is, essentially, learning to read. It's the kind of reading that's taught in elementary school. You're learning what the letters are, how words

are pronounced, and what they objectively mean. It's knowing that the sentence "The cat is on the bed" means there's a cat on the bed, and that it *doesn't* say there's a dog on the couch. Blows the mind, right?

The elementary stage also applies to an adult who's learning a new language and has to be trained to understand new alphabets, vocabulary, and pronunciation. It also describes a student reading a technical textbook for the first time who has to learn new syntax or specific jargon. Anytime you come upon a new language, dialect, or lexicon, you're doing elementary reading.
Inspectional. The next level up for readers is understanding the essence of a certain book—but not digesting the whole of it. It's called the inspectional stage, and it's sometimes disparaged or discounted by avid readers. But in developing expertise, it's a very valuable process.
Inspectional reading actually has two mini-stages of its own:
Systematic skimming. This is casually examining certain elements of a book apart from the body of the text: skimming the table of contents and the index, or reading the preface or the blurb on the back inside jacket. If you're assessing an e-book, it could mean reading the online description and customer reviews as well. Systematic skimming gives you enough information to know what the book is and how you would classify it: "it's a novel about World War II," or "it's a book that explains how to cook French cuisine." That's it.

Superficial reading. This stage is actually reading the book but in a very casual way. You start at the beginning and take in the material without consuming it or thinking too much about it. You

don't make notes in the margins. You don't look up unfamiliar phrases or concepts—if there's a passage you don't understand, you just proceed to the next part. In superficial reading, you're getting a sense of the tone, rhythm, and general direction of the book, rather than absorbing every single element of the narrative.

Inspectional reading is something like a recon mission or a survey. You're just getting a sense of what the book is about and the reading experience. You might pick up on a couple of very broad, general ideas in the book, but you won't go very deeply into them. You'll just find out what you might be in for, and then you'll decide whether you're interested enough to go more in-depth.

For example, let's say you're looking at a book on classical music. In your systematic skimming, you'd see the title and subtitle. You'd read the back flap, which says it's "an in-depth but gently irreverent study of classical composers." You'd read the table of contents—there are chapters entitled "Wagner in Drag," "Mozart's Cat Imitations," and "Beethoven's Love of Rats." At this point, you've probably ascertained that this is *not* a terribly serious work and not one that's likely to add to your expertise, although it may be entertaining.

Why should a budding expert go through this stage and not just skip to the next level? Even though it's not a deep dive, it gives you a lot of answers. You'll get a sense of the writer's approach: is it serious, comical, or satirical? Does it rely on real-life accounts or imaginary situations? Is it heavy on statistics? Does it quote a lot of outside sources? Are there pictures?

Having a good sense of the answers to those questions will help you frame the content and define your expectations, which—if you've decided to proceed with the book—will make the next level of reading more productive.

Analytical. The third level of reading is the deepest level for consuming a single book or volume of work—it's full digestion of, *and interaction* the material at hand. The challenge of analytical reading is simply: "If time were not an object, how thoroughly would you read this book?"

Analytical reading can be described as taking the book out of the author's hands and making it your own. You don't just read the text; you highlight or underline key points, and you make commentary or ask questions. In a way, you can use the marginalia to simulate an ongoing conversation with the writer. The goal of analytical reading is to understand the material well enough so you can explain it to someone else without a lot of effort. You're able to describe the subject very concisely. You're able to list its parts in order and say how they connect with each other. You're able to understand and specify the issues the writer's concerned with and what problems they're trying to resolve.

For example, if you're reading Stephen Hawking's *A Brief History of* you'd highlight key phrases in the first part about the history of physics: the Big Bang theory, black holes, and time travel, for example. You might asterisk the names of Copernicus and Galileo with a note to research them more fully. You might question Hawking's explanation of the expanding universe with writing in the margins.

Analytical reading is hard work. But it's the level at which the thrill of gaining new understanding is most profound and rewarding. This kind of interaction with reading makes learning proactive—instead of just listening to what some person's telling you, it's more like you're extracting the information yourself. When you're doing that, you're engaging more of your mind, and that

means it's far more likely you're going to *remember* what you've learned. That's a much easier path toward expertise.

Syntopical. In the final level of reading, you work with multiple books or pieces of material covering the same subject. One could describe syntopical reading as "compare/contrast," but it's actually a lot deeper than that. (And syntopical reading is not to be confused with the similarly spelled *synoptical* reading, which is pretty much its exact opposite.)

At this stage, you're trying to understand the entire breadth of the subject you're studying, not just a single volume about it. Sound familiar? You analyze the differences in the ideas, syntax, and arguments presented in the books and compare them. You're able to identify and fill any gaps in knowledge you might have. You're conversing with multiple partners, forming and arranging the most pressing questions you need to answer. You're identifying all the issues and aspects of the subjects that the books cover and looking up phraseology and vocabulary that you don't understand. Syntopical reading is a relatively major commitment, almost like a semester-long college course you're teaching yourself. Think of it as an active effort, something one doesn't normally associate with the relaxing act of reading a novel.

It's like a TV show or movie in which someone's trying to unravel a multilayered criminal enterprise. Somewhere in the movie, they show a giant bulletin board in the station with drawings, Post-its, and pictures of people, with pieces of yarn showing how they're all interconnected. When new information is discovered from different sources, it all gets added to that board. That's what syntopical reading is like: it's a concerted effort to find the answers and increase your expertise, and you don't even have to deal with the mob. You can concentrate on more lawful subjects like Occam's razor, absurdist theater, or the stock market.

These four levels serve as connected steps that gradually make a subject approachable, more relevant, and finally, fully familiar to you.

In the elementary stage—well, you're learning to read. You kind of need that for everything.

In the inspectional phase, you're getting an overview of the framework and structure and gauging your interest. You're priming yourself in case you decide to commit to the analytical phase by estimating what's in store for you at a deeper level.

In the analytical phase, you're committing to an extensive effort to understand as much of the subject as you can from as many viewpoints as possible. You're absorbing and questioning the book, and creating further curiosity about the topic it addresses, driving yourself to learn more.

In the syntopical phase, you've "graduated," in a sense, from a single or limited perspective of the subject to a holistic study of all its elements. This is where you're layering the levels of your expertise at multiple points—something you can't even comprehend in typically casual or recreational reading.

Fixed Versus Growth: What's the Right Mindset?

Throughout this book, we've been hinting at an ideal perspective and attitude when it comes to learning. The approach we take to our own goals, how we think of failure, how we understand our own skills and the process of learning itself—all these things have a heavy impact on how well we perform.

Dr. Carol Dweck of Stanford University has studied attitudes toward learning for decades, as covered in her book *Mindset: The New Psychology of* Dweck determined that most people adhere to one of two mindsets: fixed or growth.

People with the fixed mindset believe that talent and intelligence are inborn genetic traits. You either have talent or you don't. You were either born with intelligence or you weren't. There's nothing you can do that will change that fact, because it's just your fate. You can imagine how this might affect your efforts and attitudes toward learning new things. Why bother working hard if it won't change anything, right? And if you do fail, you can shrug your shoulders and claim that it was always going to be that way.

Those with the growth mindset, on the other hand, believe that talent, intelligence, and capability can be developed as one grows. Through work, effort, and struggle, a person can *become* talented or intelligent. To the growth mindset, failure isn't fatal; it's just another step on the learning curve. If there is effort, there will be *some* change and improvement. With this mindset, working hard is possible and worthwhile because of the belief that it can and does lead somewhere. That even if you don't know something now, you *can* know it in time and with effort.

Dweck found that people with the fixed mindset tended to focus their endeavors on tasks with high chances of success, which came from the desire to "look smart." They steered away from jobs where any kind of struggle was involved. They avoided obstacles, ignored criticism, and felt threatened by others' successes. They also tended to not try new things or experiment because they felt failure was imminent. There's a lot of ego in this mindset, since achievement is wrapped up with self-worth and even identity.

People with the growth mindset, Dweck asserted, were more open and embraced challenges. They believed that tenacity and effort could change the outcome of their learning. They persisted through barriers, listened to critical feedback from others, and used other people's successes as inspiration and learning opportunities. Most importantly, failure and adversity have a different effect on those with growth mindsets—they don't see challenge as embarrassing or something to be avoided at all costs. Making a mistake isn't a disaster—it's just the price you sometimes pay for getting better.

You don't always have a say in what happens in life. But how you interpret challenges, setbacks, and criticism is your choice. You can interpret them through a fixed mindset and say you don't have the talent or ability to succeed, or you can use the growth mindset to use those obstacles as openings to stretch yourself, ramp up your strategic efforts, and expand your skills. You might be able to guess which is more conducive to accelerated learning and exposure to anything new—which one do you think is a mistake in learning?

Dweck's most revelatory research explored how these mindsets are created. Not surprisingly, it likely starts early in our lives. There's

no intention here to skew to Sigmund Freud's perspective that everything we are is a result of our childhood experiences, but there are undoubtedly more connections than meet the eye.

In one seminal study, Dweck and her colleagues offered four-year-olds a choice: they could either redo an easy jigsaw puzzle or try a harder one.

Children who showed fixed mentalities stayed on the safe side and chose the simpler puzzles that would affirm the abilities they already had, whereas the kids with growth mentalities considered the mere *option* strange: why would someone want to do the same puzzle over and over and not learn anything new?

The fixed-mindset children were focused on results that would guarantee success and give them the appearance of being smart. The growth-minded kids wanted to stretch their abilities. For them, the definition of success was *becoming* smarter. Ultimately, the growth-minded kids did what they wanted to do because they weren't necessarily concerned about possibilities or failure.

Dweck's study got even more interesting. She brought adults into the brainwave lab at Columbia University to study how their brains behaved as they answered questions and received feedback.

The fixed-mindset kids were only interested in feedback that reflected their present abilities. They turned a deaf ear to information that might have helped them learn and improve their performance. Strikingly, they showed no interest in hearing the right answer to a question they had gotten wrong—they had already labeled their answer as a failure and had no further use for it.

People with a growth mindset, though, paid keen attention to information that would help them gain knowledge and develop new skills. For them, there was no shame in getting the answer wrong, and the explanation of the right answer was welcomed as

a great help in their development. The growth-mindset kids' priorities were learning—not the binary ego trap of success or failure. What manifests in childhood can stay with us for an entire lifetime if not addressed.

Fortunately, no matter how deeply a fixed mindset is ingrained in a person, it doesn't have to be a permanent condition as they might believe. Mindsets are malleable and can be taught. It turns out old dogs *can* learn new tricks (yes, even those old dogs who don't think they can!). And it's something worth doing, since it can make the final difference between two people who possess the same talent, intelligence and opportunities.

Dweck and her colleagues developed a technique they called "growth mindset intervention." The word "intervention" might make it sound like a mid-scale invasion, but the beauty of the idea is how minor the adjustments really are. Small changes in communication—even in the most innocuous comments—can have long-lasting implications for a person's mindset.

One key area of focus in this technique is the nature of praise. Complimenting someone's process ("I really appreciate how you struggled with that problem") rather than their innate trait or talent ("You're so clever") is an easy but powerful way to promote the growth mindset.

Praising talent only reinforces the notion that success or failure rests on an inborn, unchangeable, static, and stagnant trait. Praising the process applauds the effort and work—the *action* that's taken to get to the next step. You want to reinforce the idea that talent is less important, whereas effort is everything. You can predict how process praise might work in the classroom: "I know that chemistry lab had a couple of issues, but you worked right through them" or "I'm impressed with how thoroughly you worked on this term paper." But it's easy and

effective to transmute that mindset in our everyday existence in the home and workplace: heighten the value of the process, maintain open channels of communication and constructive criticism, and build upon what we learn in the process for future projects.

This is something you can do for others and also yourself in how you evaluate your actions and behavior in the face of learning.

The Myth of Tailoring Learning Styles

The notion of different learning styles has been a topic of conversation and endorsement in educational circles (not to mention publishers who sell teaching guides). Following close behind is the idea that teachers should tailor their efforts to appeal to students more oriented toward a particular learning style over another. The theory says some students learn better when the material is presented visually, while others prefer verbally, logically, or some other manner. Of course, the same people who endorse these approaches just happen to be selling products that cater to each type of student. How convenient! But does science exist that supports tailoring learning styles? In other words, are some people's brains just wired differently, so that information ceases to become information if it isn't presented in the right style? Well, the learning styles in discussion are well known, and in an anecdotal way, they even make logical sense:

Visual (spatial): Prefers learning through images, pictures, colors, and maps.

Aural (auditory-musical): Leans toward learning through hearing sound and music.

Verbal (linguistic): Chooses to use words, in both speech and writing—books, lectures, etc.

Physical (kinesthetic): Prefers using the body, hands, and sense of touch. Typically enjoys sports and exercises.

Logical (mathematical): Favors logic, reasoning, and systems, particularly finding patterns and connections between unrelated elements.

Social (interpersonal): Likes to learn in group settings with open communication and exchange with others.

Solitary (interpersonal): Tends to be more private and independent as well as self-reflective and personal.

It's not a stretch to say that some students consciously *like* some ways of learning over others. I certainly enjoy some activities more than others and, in doing so, may create a self-fulfilling prophecy for myself based on enjoyment. There are even some biological factors that appear to support the theory, as there are different brain structures for each of these types of functions that the learning style corresponds to:
Visual: The occipital lobes at the back of the brain manage the visual sense. Both the occipital and parietal lobes manage spatial orientation.

Aural: The temporal lobes handle aural content. The right temporal lobe is especially important for music.

Verbal: This is the domain of the temporal and frontal lobes, especially two specialized regions called Broca's and Wernickeï's

areas.

Physical: The cerebellum and the motor cortex (at the back of the frontal lobe) handle much of our physical movement.

Logical: The parietal lobes, especially the left side, drive our logical thinking.

Social: The frontal and temporal lobes handle much of our social activities. The limbic system also influences both the social and solitary styles. The limbic system has a lot to do with emotions, moods and aggression.

Solitary: The frontal and parietal lobes, and the limbic system, are also active with this style.

But?

There's no scientific evidence to suggest that the brain works in such fragmented ways. The only data produced to support the theory is presented by poorly run studies or misinterpretation of certain conclusions. The myth—or "neuromyth"—of learning styles is starting to meet more resistance, but there's still an adherence to the idea. In fact, there's plenty of evidence to suggest that all learning styles are equally effective when you account for attention and preference.

Paul Howard-Jones, a researcher at Bristol University, said that tailoring learning styles and other neuromyths are "misconception(s) generated by a misunderstanding, a misreading, or a misquoting of facts scientifically established by brain

research to make a case for use of brain research in education or other contexts."

There's a risk in assuming that there's only one style that we should adhere to. We'd be doing a disservice to our range of ability and missing out on other potentially effective methods and mediums. Such an opinion tends to become a self-fulfilling prophecy that you'll only pay attention to one method and reject the others. That can only work to your detriment, especially if you're consciously avoiding certain ways of thinking in the mistaken belief that it's not worth developing them.

How do we handle this in our daily lives? There are certain approaches we gravitate toward based on our talents and preferences, but that doesn't mean others won't work. The best method is to mix mediums and strive to include multiple styles of learning. Your brain is a remarkably flexible and adaptable organ, and thrives on challenge, change and variety—so give it some!

The multiplicity of available media in our current landscape makes this an easier task to pull off than even just a few years ago. If you wanted to learn more about baseball, you could read an ample number of books, listen to audiobooks or even musical pieces about the sport, watch a movie about baseball (or the documentary series by Ken Burns), refer to applicable YouTube videos, and immerse yourself in the experience at an actual game, whether as a watcher or, if you can manage it, a player.

If you seek to learn in only one style, your options will be limited. Your options may even be terrible, whereas materials in other styles might be far superior. There is also the benefit of mixing and matching different types of media to gain full perspective of whatever you are trying to learn. Remember the

value of interleaving, and why it's so important to encode new material using as many of the senses as possible?

This same approach can be used in any subject that's got enough audio, visual, and textual content to use in learning. Frankly, there aren't many that don't. History, mathematics, foreign languages, music, and even practical arts like woodworking or computer skills all have various forms of media with valuable information. Incorporate this media into your study plans as much as you like, and don't feel the need to chain yourself to a categorization that has no scientific basis, no matter how logical it may appear to be.

Mind Styles Vs. Learning Styles

If learning styles are not really scientifically supported, is there a better alternative? Anthony Gregorc believed so, and in 1977 proposed his own model to explain and describe the different ways people learn. He identified two learning modes which he set out on a continuum, creating a field or matrix onto which fell an individual's learning preferences, i.e. "mind styles."
To see where any person fell on the two axes, they could complete a 40-question test. The two axes are simple polarities:

Abstract vs. concrete (perceptual quality)
Sequential vs. random (ordering ability)

To be concrete in your perception means to take in the world through your five senses, in the here and now. This thinking is literal, practical and direct. The abstract quality of perception, on the other hand, is more to do with intuition, and looking beyond what is obvious and right in front of you. Any model-making, imagination, or "seeing beyond" is more abstract than it is concrete. This is more nuanced and subtle in communication.

To have a sequential ordering ability means your mind organizes data in a sequence or linear fashion, i.e. one thing after another. This is a preference for step-by-step logic, a narrow focus, and a plan followed from start to finish. Random ordering, however, favors information in meaningful chunks, in no particular order.

It's more spontaneous and impulsive. You may skip steps, start at the end and work backwards, or jump around rather than follow a plan.

Every person, Gregorc claimed, falls somewhere on either spectrum. Even those individuals that are relatively balanced between two styles will have a slight preference for one way over another. If one is on the X axis and the other on the Y, we create four distinct types in each quadrant:

Concrete sequential type

The preference is for the here and the now, engaged with in an orderly, step-by-step process. This style is practical and hands-on. Such a style learns best when information is detailed and ordered, and when chaos is low. Too much abstraction can feel useless—rather, the idea is to apply concepts and make them real. Such a person might also benefit from deferring to a mentor who can demonstrate with clear instructions, as in more traditional learning techniques.

What works: facts, order, logic, structure, predictability
What doesn't work: rambling group work, unclear instructions, using imagination, trying to answer questions "with no right or wrong answer"

Concrete random type

This style also likes to work with the senses in the concrete here and now, but with more spontaneity and intuition. While the previous type is like a skilled mechanic or engineer, this type is more like an artist. They enjoy trial and error, and will experiment often just to see what happens, rather than take someone else's word for it. In contrast to concrete sequential types, they don't defer to authority much, preferring instead their own investigations and experience.

What works: risk, independent problem solving, competition, self-directing

What doesn't work: formal routines, rules for the sake of rules, restrictions and limits, compiling reports, going over what's already done

Abstract sequential type

Abstract types are in their head, not in the concrete here and now. They thrive with creating and interpreting verbal and nonverbal symbols, and like to engage with these in logical, linear ways. They are the scientist types, who make models and theories and learn by encountering theoretical knowledge in an ordered, analytical way. They may respect authority, but only if they perceive that it comes with genuine expertise.

What works: working alone, being in stimulating environments, to have their own analysis heard and understood

What doesn't work: pointless repetition, rule-following, overly emotional approaches, superficiality, boredom

Abstract random type

This type also favors the inner, intuitive and abstract world, but prefers to encounter it in a looser, less formal way. Rather than fixed outline and planned direction, learning is more flexible and spontaneous. Rather than this leading to chaos, however, it allows this type to gradually synthesize a whole that make sense to them —they just arrive at that order through a less linear path. Unlike the abstract sequential "scientist" type, this style belongs more to theorists in the arts and humanities, philosophers, thinkers and visionaries.

What works: group harmony, a personalized environment, broader guidelines and enough time

What doesn't work: competition, authoritarianism, restrictions, judgment, force and arbitrary focus on details

As you can see, the above types are not so much cognitive modes, but rather more like thinking personalities (and indeed you may notice some elements of the MBTI personality theory in there). So, you may not need to alter the form the information you want to learn takes to better appeal to your cognitive learning style, but you can adjust your learning environment to better suit your own style of thinking.

Taking Lazy Notes

Learning "mistakes" can rear their head in the form of faulty beliefs about your styles and preferences, bad reading habits and a general mindset that undermines your growth rather than encourages it. But there are also more practical, obvious mistakes you may be making in your learning without even realizing it. Frequently, when a teacher delivers content, usually through a lecture, he or she gives students a handout that contains prewritten notes on the topic. This often takes the form of note pages that can be generated automatically from a PowerPoint presentation. The teacher may mean this to be a nice and convenient favor—but it's very bad for learning.

Learning happens when it's active and at least partially self-driven. When you're taking notes and organizing information yourself, you're synthesizing it and making it personal. You're not digesting —poorly, usually—someone else's structure of teaching; instead you're engaging your own brain activity.

The information you get is presented in a linear fashion, but to make it meaningful, you might have to take a less predictable route. By writing notes in your own words—somewhat similarly to retrieval practice—you must think about the ideas in your text and coursework and how you can explain them in a coherent way. The simple act of taking active and fresh notes can be transformative.

Learning proper note-taking will help you retain, analyze, and finally remember and learn what you've read. You don't use what worked for someone else and try to force it down; instead, you

create your own material and organize it in a manner that makes sense to you.

There are commonly said to be four main stages of effective and great notes:
Note-taking
Note editing
Note analysis
Note reflection

Most of us may not get past the second step—if we get there at all. We might spend a little time highlighting in a book, scratch a few notes and never look at them again until it's exam time. But the latter three steps are where the magic happens, because it's when you dive a level deeper than simple information retention. It's here that you engage. You organize your own thoughts, analyze the connections, and reflect on how everything fits into the bigger picture... i.e., you learn.

The most famous method of note-taking is called the *Cornell* and it actually encompasses much of the aforementioned four stages of great notes. Here's how it works.

On your handwritten sheet for note-taking (writing by hand is key), split it down the middle and into two columns. Label the right column "Notes" and the left column "Cues." Leave a couple inches empty at the bottom of the page and label that section "Summary." You can arrange to have a few prepared pages like this so you're always ready to go, or even commit to outlining an entire notebook in this manner.

You now have three distinct sections, but you will only be taking notes in the Notes section. This is where you take normal notes on the bigger concepts with supporting detail as concisely as possible. Write everything you need to make a thorough assessment of what you're learning. Make sure to skip some space between points so you can fill in more detail and clarification at a later point. Draw charts and diagrams, make lists where appropriate, and give your best effort to capturing what matters. You don't need to think about organization or highlighting while you are taking the initial notes. Just write what you hear or read and give as complete of a picture as possible.

After you're done taking notes, move on to the left Cues side. This is where, for each section or concept, you filter and analyze the Notes side and write the important parts on the Cues side. Where the Notes side is more of a jumbled mess, the Cues side is a relatively organized account of the topic at hand—basically, the same information is on each side. Write the main supporting facts and anything that matters, but in a more organized way. There is the added benefit of having to go through your notes immediately, synthesizing everything and drawing out what's important and what's not.

Finally, after you're done with the Notes and Cues sides, move to the Summary section at the bottom. This is where you attempt to summarize everything you've just taken notes on into a few top-level ideas and statements, with only the important supporting facts or exceptions to the rules. The goal is to say as much in as few words as possible because, when you review your notes, you want to understand quickly and not have to deconstruct and

analyze all over again. You should be able to skim the Summary and Cues section and move on.

There are similarities between the Cornell method and the four stages of note-taking, but in each case, you have created your own study guide. Better yet, you also have the entire process you used to create it documented on the same page, from original notes to synthesis and summarization. You have a record of information that allows you to go as deep as you want or refer to whatever you want. The most important part is that you've created something that has personal significance to you because you've phrased everything in a way in which you derive meaning. You are making the information fit your mental scheme, not the other way around. What you're left with is something that genuinely has a chance of enhancing your learning, rather than just wasting paper and ink.

Overall, taking notes is not a lazy, passive activity. That's the real secret of great notes. Many people seem to think that once a note is put down on paper, that's the end of it, and they almost unconsciously give themselves permission to never think of that point carefully again. Nothing could be further from the truth. Good notes are intended to serve as something you can refer to, instantly understand, and find helpful, as opposed to having to decipher them. This won't work if you have to first try to understand someone else's sense of structure and organization, and it certainly won't work if you're never inspired to keep up a kind of dialogue with the notes you make.
Peter Brown, author of the book *Make It* simplifies this point on notes: he maintains that when no effort is put into the learning

process, it doesn't last very long. What exactly does this mean?

In one study Brown cited, students were allowed to copy notes word for word on some material but were asked to rephrase *other* material in their own words. When these students were tested later, they did a far better job of recalling the material they had paraphrased themselves.

It may be convenient—for the students, if not the professor—to provide written notes for lectures. But the lack of effort this arrangement inherently has will handicap the student. In fact, the less effort and involvement a student is able to use, the worse the learning will be. It's as though every bit of material that has not been genuinely and personally engaged with is invisible, and soon forgotten.

Plan your note-taking style in advance and bring everything you need to the lecture. Different colored pens, highlighters, Post-it notes, multiple binders—whatever implements you've designed that help *you* learn. Try to keep your notes as concise as possible, with abbreviations, legends, or acronyms, and write down only the information that matters (though you get to decide what that is). Remember that simple is often best—you don't need to go all out with fancy stationery if it doesn't really add anything to your process.

How can we make these note-taking principles relevant to the rest of our lives? In other words, how can we make sure we are paraphrasing everything we want to learn for ourselves, even outside of the classroom? How can we ensure we expend effort and make learning as active as possible in the real world?

This is where the problem-solving we developed in school environments becomes real. But it's also representative of the truism that learning doesn't stop when we're out of school—actually, our state of learning won't die until *we* do.

We can't say enough about the benefits of personal documentation, whether it's for everyday functionality, work issues, interpersonal relationships, or just self-expression. Taking notes on anything we go through or experience on a daily basis and creating an organized system to make these notes accessible later helps us retain knowledge we'll need in future practical applications.

Whether taken by hand (which we still enthusiastically endorse) or by digital applications (which we'd be foolish to declaim), structuring the events of your life—raising a family, starting a business, pursuing a hobby—into a narrative, through your own words and notes, is an almost fail-safe way to derive continued meaning and personal value from your life.

Of course, it's not the writing and documenting *per se* that is adding the value, but our relationship to it, and the way we use these tools to inspire something more valuable in us: conscious control of our own learning. When we use writing, note-taking, analysis and self-questioning, we get closer to what we're learning, no matter what exact form this intimacy takes.

Learning is defined by trial and error. Making a mistake in learning is almost never a fatal derailment from our path through education. Like all of the solutions we present in this book, these mistakes are solved by practice and adjustments in our mental approach. If you address mistakes the same way we suggest you do with the topics you study—actively, not passively—then these errors will serve as opportunities for future learning, and will eventually be fewer and further between.

Takeaways

Just as we take on better habits to learn more effectively, we can work to dismantle bad habits that undermine our learning.
One bad habit is "lazy reading," or reading where we don't actively engage with the material. Learning *how* to read is as important as learning *what* to read.
Our attitudes and perspectives can play an enormous role in how well we learn, and how resilient we are to challenges and adversities. A fixed mindset is one in which we think knowledge and skill are inborn and can't be learnt, whereas a growth mindset sees development as possible, and achieved through effort and focus.
It can be a mistake to assume you have a "learning style" when little scientific evidence exists to support this idea. While we all have preferences, the brain is designed to take in data in a variety of formats, using all our senses, and our learning improves when we draw on as many of these as possible.
It's better to adapt your learning process in terms of "mind styles." Everyone falls on two axes: Abstract vs. concrete (perceptual quality) and Sequential vs. random (ordering ability). These produce four types, with different preferences for encountering new information.
Like lazy reading, lazy note-taking is passive instead of active, and fails to produce lasting learning. Use Cornell notes, with a column each for notes, cues and summary, so that you can engage more closely with the material.

A good note-taking strategy comprises not just note-taking, but note editing, note analysis and note reflection, so that the notes become living reflections of your process rather than something that's inert and quickly forgotten.
All learning is trial and error, and what works for one person in one context might not for another person in another context. It's

all about consciously observing, adjusting and appraising your own process as you go, and empowering yourself to make incremental improvements.

Summary Guide

Chapter 1. Fertile Conditions to Learning

Accelerating learning means working with the pre-existing, inbuilt mechanisms we all already possess. When we work with rather than against the brain, we can get the most from our learning experiences, and enjoy learning more.

An unavoidable fact is that the human attention span is limited. We need to respect the limits of our attention and plan learning accordingly—i.e. by digesting new information is smaller, more manageable chunks.

A good length of time for any learning period is more than 30 minutes, less than 50. Too short and you won't be able to get into any depth, and too long and your cognitive powers will begin to fatigue.

To use your time wisely, plan ahead and designate times in your schedule for specific learning blocks.

Use concept learning to guide you: as you learn, prioritize understanding and comprehension over rote memorization, i.e. concepts before facts. When you have a deep rather than surface appreciation of information, you anchor new ideas in context and make it easier to remember and apply them.

Deliberately engage in productive failure. Know that failure can actually be a valuable source of information, if embraced correctly.

Challenge yourself without frustrating yourself, and make sure that when you work (and fail) you give yourself the chance to look closely at *why* things happened as they did. Ask yourself why you failed and think about how you could have done better.

Cultivate a growth mindset, where you set ego aside and assume that learning is uncomfortable sometimes. Failure is a part of learning, so embrace it when it happens. Use your failure to inspire you to make new plans for going forward, and shape your next steps.

"Expect frustration, but don't succumb to it." With the right mindset, "failure" is something that brings you closer to success, not further from it.

Chapter 2. Memory Retention

Learning relies on memory, and memory is in turn an interplay between two processes: storing and retrieving information. There are three main steps: encoding, storing and retrieval.

How well we **encode** material (i.e. cement it into our minds) depends on the degree and intensity of attention we pay it, as

well as the senses through which we encounter it, and our associated emotions.

When we **store** memories, we do so either as transient sensory memory, short-term memory or more long-term memory.

Retrieval is when we return to stored memories and pull them out again, either with a cue or helpful sequence, or without one. We can retrieve information in a few ways: recall it directly (no cues, this is obviously preferable), recognition (remembering something after a cue or prompt, and relearning, which is the least effective and lasting method.)

Forgetting is a normal state of affairs, and occurs on a "forgetting curve." Every time we rehearse, however, we refresh this memory, and the subsequent forgetting trails off at a less steep curve. The goal is to rehearse until the curve eventually flattens, and the rate of decay slows enough for you to say, "I've permanently learnt this."

The study cycle is a process to follow to maximize your learning process given the way memory works. The steps are: preview, attend, review, study and assess, and then begin the cycle again. In a study session, it's best to flow through each step consciously —establishing context, paying attention, actively reading and engaging, drilling the material and then taking time to assess how well the process went afterwards.

Retrieval practice is the art of practicing what most cements memories—retrieving them. It is an active process and instills memory firmly.

Spaced repetition is most effective for practicing retrieval and countering forgetting. Deliberate practice, too, can help you control what you're practicing, and how this can enhance your learning and knowledge over time.

Chapter 3. Active Learning Techniques

Techniques that focus on *active* and conscious engagement with new material will always result in deeper understanding and better recall.

Many of the conventional study techniques we all use are actually quite poor at helping us learn, including summarizing, highlighting, using mnemonics, adding imagery to text, and re-reading text. Though these can be useful in limited contexts, they are not the most effective.

More effective techniques are more active and applied: practice testing, distributed practice (covered in a previous chapter), elaborative interrogation, self-explanation and interleaved practice.

In elaborative interrogation, we use questions to ensure a depth understanding of the material, asking "why" and "how" to reveal causal connections and relationships that go beyond the surface. This aids not only our understanding but our memory.

Self-explanation also forces us to delve more deeply into concepts, where we "teach ourselves" and perhaps identify gaps in understanding. By explaining ideas, sequences or concepts to yourself, you learn them "from the inside out."

Inspired by the physicist Richard Feynman, it is always worth checking your comprehension by seeing whether you can explain any idea in simple, straightforward language. If you can't, there are bound to be some conceptual gaps or misunderstandings.

Interleaved practice goes against conventional wisdom and encourages you to alternate between different topics or skills in a single study session. By blending topics, you develop a certain cognitive agility and strengthen connections and relationships rather than learning isolated blocks in one go.

Active learning techniques work best when they're chosen for their appropriateness for the particular student, topic, and lesson at hand. Any of the above tactics are a good idea if they encourage depth rather than surface understanding, and allow you to make meaningful conceptual connections between ideas.

Chapter 4. Make Learning Secondary

One surefire way to enhance your learning is to act in such a way that it doesn't feel like you're learning at all. When you make learning secondary, i.e. you make your gains in skill and

understanding a side effect of some other task you can't help but get carried away with, you learn more quickly and more easily.

We're more likely to reach our specific goals when we are driven by a deeper and more comprehensive desire to understand what we're learning. There are six facets of understanding, and they all go beyond the superficial.

We can be motivated by **explanation** (why does XYZ happen?), **interpretation** (how can this data be changed from form X into form Y?), **application** (what can I actually *do* with this knowledge?), **perspective** (what other way can I look at this?), **empathy** (how is that other person looking at it?) and **self-knowledge** (who am I?).

If we can tap into our most powerful motivation to understand the material in front of us relative to it, we are more able to find energy, enthusiasm and comprehension for our studies.

Problem-based learning is a way of focusing on the real-world application of knowledge. This engages us in the practical world of problem and solution, cause and effect. We become engrossed because we want to keep acquiring mastery and skill.

Gamification is a way to make learning fun and almost accidental. Gamification uses gaming principles in a non-gaming context. Games work best when the rules are clear, there is an obvious and linear progress from step to step, and rewards are immediate and proportional. Gamification is great for

supplementing exhausted motivation, and making everyday study more fun and enjoyable. It can't, however, completely replace a deeper motivation or purpose.

Chapter 5: Teaching to Learn

Tackling the learning question from the teacher's point of view enriches your own understanding, and gives you a firmer grasp on the things you yourself want to learn better. In the Learning Pyramid, activities that are most active, hands-on and teaching-focused end up being the most effective.
The protégé effect explains how tutors who teach others invariably perform better than students who don't also teach. This is because they learn in more organized increments, can detach their ego more thoroughly from failure and experimentation, and take on more responsibility for active learning.
Good feedback is an essential part of the learning process, and learning to give and take good feedback is part of gaining mastery in any subject.

Good feedback is specific, given as quickly as possible, and tied to a concrete goal. When giving feedback, use tact and awareness, understanding that people learn better when they feel supported and praised. Tailor your feedback to your student's personality, learning style and degree of mastery.
Deep information processing is about engaging with data beyond the superficial, so we can see into its meaning and significance. Metacognition essentially consists of two modes: thinking, and thinking about thinking (or regulation of that thinking). Learning is best when it switches between these two modes.

We can encourage metacognition through the use of self-questioning, asking questions before, during and after learning to shape, guide and enrich our comprehension.
The PQ4R method is a way to bring metacognition to your reading, and consists of the following steps: **preview, question, read, reflect, recite, and** When we methodically follow each of these steps with a text or piece of information, we engage beyond the shallow levels and process information deeply by regularly asking questions of ourselves, the material, and the way we are interacting with it.

Chapter 6. Mistakes in Learning

Just as we take on better habits to learn more effectively, we can work to dismantle bad habits that undermine our learning.
One bad habit is "lazy reading," or reading where we don't actively engage with the material. Learning *how* to read is as important as learning *what* to read.

Our attitudes and perspectives can play an enormous role in how well we learn, and how resilient we are to challenges and adversities. A fixed mindset is one in which we think knowledge and skill are inborn and can't be learnt, whereas a growth mindset sees development as possible, and achieved through effort and focus.
It can be a mistake to assume you have a "learning style" when little scientific evidence exists to support this idea. While we all have preferences, the brain is designed to take in data in a variety of formats, using all our senses, and our learning improves when we draw on as many of these as possible.

It's better to adapt your learning process in terms of "mind styles." Everyone falls on two axes: Abstract vs. concrete (perceptual quality) and Sequential vs. random (ordering ability). These produce four types, with different preferences for encountering new information.

Like lazy reading, lazy note-taking is passive instead of active, and fails to produce lasting learning. Use Cornell notes, with a column each for notes, cues and summary, so that you can engage more closely with the material.

A good note-taking strategy comprises not just note-taking, but note editing, note analysis and note reflection, so that the notes become living reflections of your process rather than something that's inert and quickly forgotten.

All learning is trial and error, and what works for one person in one context might not for another person in another context. It's all about consciously observing, adjusting and appraising your own process as you go, and empowering yourself to make incremental improvements.

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