

SAPERE AUDE

GUIDE TO EFFECTIVE LEARNING

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Author's note

This manual is the result of my **research project** carried out in Girona during the **11th grade high school in the 2024-2025 academic year by student Jordem Ferreira de Oliveira**, who did everything himself: from the research and structure to the writing and images.

The main intention has been to convert scientific information, which is often scattered and technical, into a clear and practical guide that can help anyone better understand how we learn and how we can study more effectively.

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INTRO

ABOUT THE MANUAL

Have you ever felt like you studied for hours, but after a few days, you can hardly remember anything? Or have you read about a topic several times, only to realize that when someone asks you about it, your mind goes blank? This experience is very common and often leads to frustration: it seems like your efforts aren't paying off as they should.

What many students don't know is that **it's not a problem of ability, but of method**. Our brains are not designed to learn in just any way; they have specific mechanisms for understanding, retaining, and using information. When we ignore these mechanisms, studying becomes a slow and ineffective process. On the other hand, when we know them and use them to our advantage, we can learn more clearly, with less effort, and with more lasting results.

This manual is intended to be a practical yet rigorous guide for anyone who wants **to learn better according to science**. It is not a set of magic formulas, but a tool for understanding how learning really works and for applying strategies that work on a daily basis: from taking notes in a different way to planning study time, remembering more, and feeling more confident when facing an exam or a professional challenge.

The goal is that, by the time you finish, you will not only know *what* to do to study better, but also understand *why* it works. This will allow you to make more informed decisions, adapt the techniques to your style, and, above all, discover that learning can be a clearer, more motivating, and even exciting experience.

WHY SHOULD WE LEARN HOW TO LEARN?

Throughout our lives, we all have to learn a great deal of information: for our studies, for work, or simply to grow as people. Often, however, we feel limited by a factor we tend to call *intelligence*. We consider it something fixed, almost like a label that determines **how much information we are capable of assimilating, with what quality, and how quickly**.

Many people believe that this ability is genetically determined: that we are born with a certain level of intelligence and that we just have to make do with what we have been given. But this idea is incomplete. It is true that each individual has natural predispositions, but intelligence is not a fixed limit: it is a **skill**.

If we analyze its *definition—the ability to learn, understand, and solve problems*—we see that intelligence is nothing more than a skill that can be developed. And, like any other skill (such as playing an instrument or practicing a sport), **it improves with proper practice**.

Therefore, we should not get stuck in the idea that "I am not smart enough," but rather ask ourselves: *am I training my way of learning well?* When we understand **how we think, how we process information, and how we truly learn**, we can apply strategies that work in tune with our brain. And this is precisely where the journey of "learning to learn" begins.

In addition to this main reason for learning better, there are other fundamental reasons that need to be clear in order to learn consciously:

1. Increased efficiency in studying

When we talk about efficiency, we are referring to the **relationship between the resources we invest and the results we obtain**. In the context of learning, this means achieving the maximum possible knowledge with the minimum amount of time and energy spent. It is not about doing things quickly for the sake of doing them, but about doing them in a way that really works and brings us lasting results.

We often think that studying more hours equals learning more, but that is not necessarily true. What really makes the difference is **how we use that time**. This is where the importance of improving our efficiency as learners lies.

When we learn efficiently, we need fewer hours of study to understand and retain the same information. This means we can devote the "extra" time to other essential aspects of our lives: getting better rest, enjoying a hobby, spending more time with family, or simply reducing stress and the feeling of constant fatigue.

Another great advantage of efficiency is that we don't have to go over the same information again and again. When we learn inefficiently, we often only memorize superficially for the exam, and after a few days most of it is erased from our memory. On the other hand, if we learn well, we consolidate our knowledge and need much less review to maintain it. This translates into fewer hours of accumulated work and a sense of real progress.

In addition, we have all had the experience of studying a subject we did not particularly like and feeling that, once the exam was over, all that effort had been useless because we could no longer remember anything. This situation is not only frustrating, but also demotivating. With good efficiency, even the least appealing subjects leave a mark on our memory: the time invested is not wasted, because the memory and understanding remain.

2. Stress reduction

One of the main factors that cause stress in studying is the feeling of **not having enough time** to complete all the tasks and, at the same time, study calmly. This constant pressure can negatively affect our psychological well-being and make studying a burdensome experience.

Another common cause of stress is the **frustration of not understanding a concept**. Often, we don't know why we don't understand it or what to do to overcome this block. In this situation, the most common reaction is to reread the same text over and over again, hoping

that, through sheer repetition, understanding will come. But this almost never works and only increases the feeling of helplessness.

When you understand **what causes the lack of understanding** and know specific strategies to overcome it, the situation changes completely. You are no longer stuck, but have a clear path forward. This significantly reduces stress, gives you more confidence, and can even make the study process more enjoyable and motivating.

3. Rediscovering the pleasure of studying

All human beings like **to learn**. It is a natural need: to feel that we understand what is happening around us, to discover new things, to remember interesting stories... But if that is the case, **why do we often dislike studying?**

The answer is simple: **studying and learning are not the same thing.**

- Studying is the attempt to understand and retain information.
- Learning is the result: integrating and remembering it clearly.

That's why you can spend 20 hours poring over notes and, despite your efforts, retain almost nothing. On the other hand, you can watch a movie or listen to a good story and remember the details for years.

Think about how you feel when you watch a series that hooks you: you follow the plot, understand the characters, and connect with what is happening. The entire hour you spend on it is fully utilized. On the other hand, when you study, you may only really get 15 or 20 minutes out of 60. The rest is consumed by doubts, repetitions, and frustration.

Now, what if **we could increase that proportion?** What if, by studying more efficiently, we could understand what we read better and more deeply? Instead of 15 minutes well spent, it could be 40 or 50. At this point, studying ceases to be synonymous with boredom and frustration and becomes an experience similar to watching a good movie: it hooks you, entertains you, and makes you want to continue.

In fact, we already experience this pleasure of learning in many everyday situations:

- When you learn a new recipe and it turns out well.
- When you discover an interesting fact in a conversation and then remember it.
- When you understand a joke or a pun that you didn't find funny before.
- When you solve a puzzle or a logic problem.

In all these cases, learning gives you a small **dose of pleasure and motivation**. The same can happen with your studies if you transform the way you learn. Not only will you

procrastinate less, but you will even look forward to studying more, because you will know that each session offers you a real return.

4. Increased confidence

When you notice that **you are** really **learning more with less effort**, your confidence also grows. You no longer depend on chance, thinking "I understand this topic" and "I don't understand that one," but rather you have a method that works consistently. This gives you security: you know what you are doing, why you are doing it, and what results you can expect.

In addition, having confidence in your learning style allows you to tackle any content with peace of mind, because you know you have the tools to adapt to any situation.

5. More developed critical thinking

When you learn better, you don't just memorize: **you analyze, compare, and contrast** the information you receive. This helps you form your own opinions and not just accept the first thing you are told. Instead of mechanically repeating facts, you begin to see connections, question things, and evaluate different points of view. In other words, efficient learning not only helps you accumulate knowledge, but also **think better**.

6. More autonomy and adaptability

Another key benefit is that you stop relying completely on the quality of a teacher, a book, or a specific explanation. Obviously, good teachers help, but when you know how to learn, you are able to **understand any subject on your own**.

This makes you more autonomous and flexible: whether it's a completely new topic or an unexpected problem, you know how to tackle it and adapt. In a changing world, this is one of the most valuable skills: the confidence that, no matter what happens, you have the ability to learn what you need.

OBJECTIVES

1. HELPING PEOPLE

We often accept our current abilities as if they were a fixed limit. We strive, we look for resources, we read advice... and yet we often feel that we are not making enough progress or that what we are doing is not effective enough. But that is not our fault: education has always focused primarily on **what we should** study—the content, the data, the concepts—but we have almost never been taught **how to study**.

And this is where the need for this manual arises. Its aim is to answer both basic and fundamental questions:

- How can I learn this information in a simpler and more lasting way?

- How can I organize myself to make better use of it?
- How can I be more independent and confident in my learning?

This manual is therefore intended to be **a practical and clear guide on "how" we really learn**, so that anyone can develop their skills, gain confidence, and learn how to learn.

2. AVAILABILITY OF INFORMATION

To achieve its main objective—helping people learn better—this manual has a complementary purpose: **to provide clear, organized, and reliable information**.

We are surrounded by a wealth of content on study techniques, but most of it is **fragmented and disorganized**. In some places we find tips on how to take notes, in others on how to review, in others on how to get the most out of classes... but there is almost never a comprehensive guide that integrates all of this into a **coherent system** with a logical order that facilitates understanding.

In addition, many of the techniques that circulate are based solely on mechanical repetition: reading a text five times, copying it several times, or repeating it aloud. These strategies may offer some results, but not because they are truly effective, but because the people who recommend them already have a **predisposition or natural ability to learn**. The problem is that this cannot be generalized: what works for one person does not necessarily work for everyone.

The manual, on the other hand, **is based on scientific evidence** and does not focus solely on "what to do with your hands" (reading, copying, underlining...), but on **how the brain actually learns**. The aim is to help find strategies that improve the quality of thinking and the way we process and integrate information.

Finally, **availability also implies accessibility**. Much of the scientific research in this field is in English, which is a barrier for many people. That is why this manual has been translated into different languages—Catalan, Spanish, Portuguese, French, and English—so that anyone, regardless of their background, can benefit from this knowledge.

3. USEFULNESS OF THE CONTENT

Another fundamental objective of this manual is **to transform theory into practice**.

Information about learning is often found in scientific articles or general reflections on how we think. All of this is valuable, but it tends to remain **theoretical and abstract**. The problem is that when we only have theory, we don't know exactly **what to do with that information**, how to apply it to our study routine, or how it can really help us improve.

Therefore, this manual aims to **translate scientific knowledge into concrete and applicable strategies**. It is not just about talking about ideas in the abstract, but about showing **what we can do step by step**, within a **structured system** with a beginning, middle, and end.

In short, the aim is to ensure that science does not remain on paper, but becomes a **practical guide to learning better** and moving forward with greater confidence.

CONTENTS

This manual contains the following main content:

1. THEORY

Theory is not a set of abstract definitions, but rather the **starting point** for understanding how learning works. Here we explain the basics of **metacognition**, which is the ability to reflect on how we think, plan, and regulate our own learning. Understanding these mechanisms allows us **to know why some techniques work and others do not**, and how we can adapt them to our own way of learning.

This theoretical part also teaches us how **to build a clearer vision of the learning process**: how we organize information, what mistakes we tend to make, and how we can avoid them. It is not just about "knowing concepts," but about acquiring a critical awareness of our own study habits.

2. SYSTEM

Many people try techniques at random: today they underline, tomorrow they make summaries, then they try mind maps... The problem is that without order, learning becomes chaotic. The manual proposes a **structured system** that orders techniques progressively so that each step builds on the previous one.

So, instead of applying isolated methods, you will learn to **integrate them into a complete process**, from the first contact with the information to its long-term consolidation. This approach allows you to make better use of your time, reduce the feeling of disorder, and get the most out of your abilities.

3. ACTIVITIES

The activities are not just practice exercises, but **spaces for personal experimentation**. They invite you to apply the concepts immediately, so that you don't just stick to theory, but put them to the test in your daily life.

Many activities are open-ended reflections, helping you **discover your own way of learning** and compare it with new strategies. Therefore, the suggested corrections you will find are not single answers, but examples that guide you and allow you to evaluate different options. In this way, the manual becomes an **active conversation with yourself**, not just a text to memorize.

4. IMAGES

Images are an essential resource because learning does not depend solely on words. In this manual, you will find **diagrams that simplify complex ideas, graphs that show processes**, and **illustrations created specifically** to make explanations clearer.

This visual support not only helps you better understand concepts, but also facilitates **memory and retention**. Seeing an idea represented graphically is often much more powerful than just reading it. In addition, images act as **quick reminders** when you review the manual.

In addition to the main content, at the end of each main section there is a **summary** diagram that clarifies the main ideas covered.

HOW SHOULD WE USE THE MANUAL?

This manual is not designed to be read in one sitting like a novel. Its value lies in **assimilating and putting into practice** what you learn. Therefore, it is necessary to read it calmly, attentively, and with an open mind to experimentation.

1. Take your time

The manual contains a high density of ideas. If you try to read it all in one day, you will probably feel overwhelmed and will not be able to apply anything. The goal is for each concept to have time to **sink** in.

It is better to read a short section, reflect on it, and then apply it than to rush through it without retaining anything.

2. Take notes

While reading, it is highly recommended that **you take notes**. Writing down what you understand in your own words will help you consolidate the information and make it your own.

In addition, notes are a valuable resource when you want to review the manual later.

3. Do all the activities in order

The activities are not a supplement, but an essential part of the manual. They are designed to help you discover aspects that cannot be conveyed through theory alone.

- Some activities depend on previous ones, so it is necessary to follow them in the established order.
- Doing them will allow you to transform theory into **personal experience**.

Think of it this way: it's like trying a new food or feeling butterflies in your stomach for the first time. Even if someone explains it to you in words in a book, you won't fully understand it: **you have to experience it for yourself**.

4. Alternate between theory and practice

The best time to do an activity is **right after you've read the corresponding theory**. This will allow you to immediately consolidate what you've just learned and see how it works in practice.

Now, before you start reading the manual, we must always keep in mind activity 1:

ACTIVITY 1: APPLY THE INFORMATION IN THE MANUAL

The activities presented in the manual are essential key points for practice. However, there are many other important aspects that, although not formulated as specific activities, should also be put into practice in order to gain a deeper understanding of the content.

Therefore, the first activity in the manual—which we should carry out throughout our studies—consists of **finding ways to apply the information as soon as possible**.

This activity consists of two parts:

1. Make a list of all the ways in which we can apply the information in different contexts.
2. Actively putting them into practice.

Example of a list we could make while studying the topic "REVIEW":

- **"Flashcards:**
 - To learn vocabulary from German classes → I will use them when I encounter new words.
 - To memorize history dates → when we study the French Revolution, I will use them to remember each date.
- **Review with questions and exams from previous years:**
 - In math → before next week's Functions exam, I will practice with questions from previous years."

In addition to this question, all other activities in the manual are found together at the end of the manual. After all the activity statements, we find the "Suggested Answers."

THEORY

WHY AND HOW DO WE LEARN INFORMATION?

Have you ever wondered why there are things you remember for a lifetime and others you forget a few minutes after reading them? Why can you easily retain details of things that interest you—such as the name of a soccer player or a scene from a TV series—but a definition or formula you studied for hours seems to be erased from your mind?

Imagine you are a soccer fan and, one day, you unexpectedly bump into Messi or Cristiano Ronaldo on the street. You only see them for a few seconds, but you will probably never forget them. On the other hand, how many faces of strangers have you seen in the last few days that you no longer remember? The difference does not lie in the amount of time you are exposed to the information, but in **how your brain processes it**. In this case, two factors are key: **relevance** and **attention**.

1. RELEVANCE: when information affects us in some way

The brain does not process all information equally. It gives priority to what is important to us. But what makes something relevant?

Mainly two aspects:

- **Prior knowledge:** everything you already know, have experienced, are interested in, and remember. This knowledge determines who you are, your tastes, and your actions.
- **The way you reflect on information:** how you think about it and relate to it.

Let's go back to the example. If you didn't like soccer and didn't know who Messi or Cristiano were, that moment would probably be of no importance to you. They would be just two more people in the crowd. But if soccer is part of your life—if you already have prior knowledge and an emotional connection to the subject—then seeing that soccer player on the street will be considered relevant. And your brain, without apparent effort, will remember it.

This happens all the time. If a stranger has a characteristic that stands out or reminds you of someone or something you know (a similar voice, a way of walking, very striking hair...), that information connects with your experiences and **is therefore more likely to be perceived as relevant** and remembered. But if you don't recognize a connection between information you already know and the new information you've picked up with your senses, you won't remember it.

In short, information is **relevant** when **it connects you meaningfully to what you already know or care about**. In other words, the way we relate information to what we already know must make sense to us; it must have **meaning**.

And how can we differentiate **meaningful connections** from **superficial ones**?

Let's look at the example of "*photosynthesis*":

When we learn a new word or concept such as *photosynthesis*, our brain tries to connect it with what we already know. But **not all connections are useful or meaningful**. For a connection to be truly meaningful, it must fulfill at least one of these three functions:

1. help us **remember better**,
2. help us **understand** the concept **better**,
3. allow us **to apply it** in another context.

Let's look at two types of connections:

SURFACE CONNECTION (not meaningful)

A person can try to remember the word *photosynthesis* by thinking:

"It has 11 letters, like other words I know," or:

"It is written with the Latin alphabet (a, b, c, d...) like all the words I know."

This type of association **is superficial** because it does not provide any understanding of what photosynthesis really is, nor does it help to **apply it** in any context or **to remember it**. The brain has no reason to retain this information or to return to it when it needs to understand a related concept.

MEANINGFUL CONNECTION

Now imagine that you discover that the word *photosynthesis* comes from the Greek:

- "*photo*" means **light**,
- "*synthesis*" means **production or formation of a new substance**.

With this connection, you can understand that *photosynthesis* literally means **"production from light."**

This is a **meaningful connection** because:

- It helps you **remember** the word through its etymological origin,
- It allows you **to better understand** the process (plants produce a new substance—glucose—from sunlight).
- It allows you **to apply** this knowledge when you encounter other concepts such as *chemosynthesis* (production from chemical reactions, not light).

Why is it important to understand this?

This example shows that **the brain retains information better when it is connected to relevant prior knowledge** and when those connections make **functional sense**.

The more **meaningful connections** a piece of information has with our **prior knowledge**, **the more relevant** it will be to us.

Other examples of possible meaningful connections:

1. "Proposal"

- **Prefix:** *pro-* → toward the future, forward
- **Root:** *-pos-* → to put
Literal meaning: "to put something toward the future"
This helps us understand that a *proposal* is **an idea or action planned for the future**, that is, a *goal or suggestion that one wishes to carry out*.

2. "Moribund"

- **Root:** *mor-* → death
- **Suffix:** *-bund* → Latin suffix indicating inclination or state (as in *vagabond*)
Literal meaning: "one who is on the path to death"
This connection allows you to understand very visually that someone **who is moribund** is **someone who is not dead, but who is heading toward death**. It helps you remember the word even if you haven't heard it much.

3. "Transport"

- **Prefix:** *trans-* → across, from one place to another
- **Root:** *-port-* → to carry, to bring
Literal meaning: "to take from one place to another"
If you didn't know the word *transportar*, but you know *llevar* and *transatlántico*, you can deduce that it means **to move something from one place to another**, and that allows you to understand related words such as *transporte*, *transbordar*, etc.

2. ATTENTION: the gateway to learning

Relevance and attention are closely linked. Without a minimum **of initial attention**, there is simply no learning. Imagine walking down the street without looking at anyone: you might not even recognize Messi if you passed him. But if you pay a little attention and your brain detects a familiar face, then you activate the next step: analyzing, connecting with previous records, and, if everything fits, storing this information.

Once this initial attention occurs, if something **is not relevant to us**, the brain stops paying attention and the memory quickly fades. In other words, what we see remains in our **short-term memory**, which we use to remember details for a short time. For example, when someone gives you directions and you remember them just long enough to get there.

However, if this information is interesting to you and connects with something you know, it can leave your **short-term memory** and move into **your long-term memory**, which lasts much longer. For example, this is what would happen if you recognized Messi: you would remember him for the rest of your life.

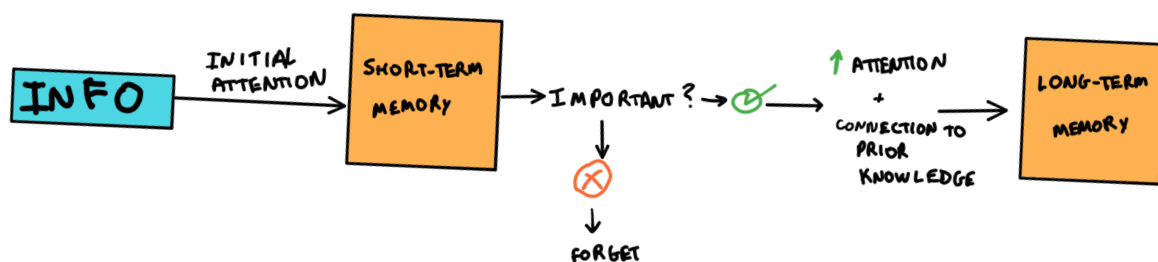


Figure 1: Diagram explaining the process information goes through before being consolidated into long-term memory.

However, we can do more than just automatically remember things that are familiar to us at first glance, as happens when we passively recognize a person. We can do the opposite: **voluntarily decide to focus on something, think about it, look for connections with what we already know**, and thus **make it relevant in a conscious way**. We can actively seek ways to remember any type of information actively, without relying on luck.

This is one of the central objectives of this manual: **to learn how to make study information relevant**, systematically and effectively, in order to facilitate real learning.

Now what?

Now that you know what makes information truly learnable, you may be wondering: how can I make what I study more relevant? How can I activate my attention more efficiently? And what methods really work to consolidate what I learn?

These are the questions we will explore from now on. The path to learning is not just about studying more, but **studying better, in a smarter and more meaningful way**. And this manual will accompany you step by step so that you can achieve this.

SUMMARY

1. Key factors in learning

- **Relevance** → Personal importance of information.
- **Attention** → Necessary gateway for information to be processed and remembered.

2. Relevance: the brain prioritizes what **is important or connects with what we already know**.

Causes:

1. Prior knowledge

- Everything we already know, have experienced, or are interested in: this is the basis for establishing new connections.

2. The way we think about it

- Reflecting on it and establishing relationships with previous information: if we cannot find a relationship → we do not remember it.

Types of connections:

- **Superficial connection:** Relationships that do not contribute to understanding, application, or facilitate recall.
- **Meaningful connection:** Relationships that help us remember better, facilitate a better understanding of the concept, and allow us to apply it in other contexts.

More meaningful connections → more relevant information → easier to retain.

3. Attention: The ability to focus the senses on specific information.

- **Function:** Without initial attention, there is no learning.

Process:

1. **Initial attention** → We detect the information.
2. **If it is not relevant** → It remains in **short-term memory** (details for a short time).
3. **If it is relevant** → It moves to **long-term memory** (permanent memory).

Voluntary attention

- It does not depend solely on automatic interest.
- We can **decide to focus, think, and look for connections** to make it relevant.
- It allows us to make any information meaningful.

MASTERY

Perhaps this has happened to you before: you think you have understood some information, that you remember it well, that you have a clear understanding of it. But then someone asks you a question, asks you to explain it in your own words... and your mind goes blank. It all sounds familiar, but you don't know where to start.

This phenomenon is very common. Knowing "a little" can give the illusion that it's enough. But the truth is that **there's a big difference between having memorized an idea... and truly understanding it.**

Now imagine two people who have read exactly the same science text.

The first can repeat a few sentences. They give brief answers, often copied from memory. When you ask them to relate it to another topic, they pause. When you ask them to explain it to someone else, they say, "Ugh... I understand it, but I wouldn't know how to say it."

The second person, on the other hand, uses their own words. They know how to find examples, make comparisons, and anticipate questions. They can even spot errors in an incorrect explanation. **They have mastered the information.**

What has happened here? It is not just a question of time or effort. It is a question of *depth of learning*.

And this is where the concept of **mastery** comes in.

We talk about **mastery** when we have a high degree of understanding and ability to *use* information. It's not just about memorizing facts or repeating definitions, but knowing how to apply, explain, analyze, relate, and create from that knowledge.

For example, when a teacher knows how to explain a topic in different ways depending on who they are teaching, answer unexpected questions, and help others understand it, it is not just because they know it by heart, but because **they have a high level of mastery**. They have mastery.

IMPORTANCE OF TEACHING SKILLS

When we study, we often think that the most important thing is to remember the information. But our goal should not be just to remember, but to be able to use it: to solve a problem, make decisions, understand another point of view, or have another perspective on the world. Mastery allows us to do that: to put knowledge into action, into real life.

Imagine that you understand how a cell works, but you don't know how to apply that knowledge to understand a disease. Or that you remember a mathematical formula, but you don't know when or how to use it. In these cases, the information is of little use to you. On the other hand, when you achieve mastery, you are able to use what you have learned in a **flexible, practical, and profound** way.

And that **is** precisely what we are looking for when we talk **about learning to learn**. It is not just about knowing how to study better, but about reaching that point of deep mastery more quickly and with greater confidence, with consistency. Mastery is the ultimate goal of any well-executed learning process. We want to identify the steps, tools, and most common

mistakes so that we can build that solid understanding in **less time** and more **efficiently**. Therefore, understanding what mastery is, what differentiates it from simple memorization, and why it is key is one of the first things we need to do to begin truly learning.

LEVELS OF MASTERY

When we learn something new, memorization is not enough. There are different ways of "knowing" something. Remembering a fact is not the same as understanding it, nor is understanding an explanation the same as knowing how to apply it. These differences show us **the levels of depth with which we can master knowledge**. Below, we examine each of these levels.

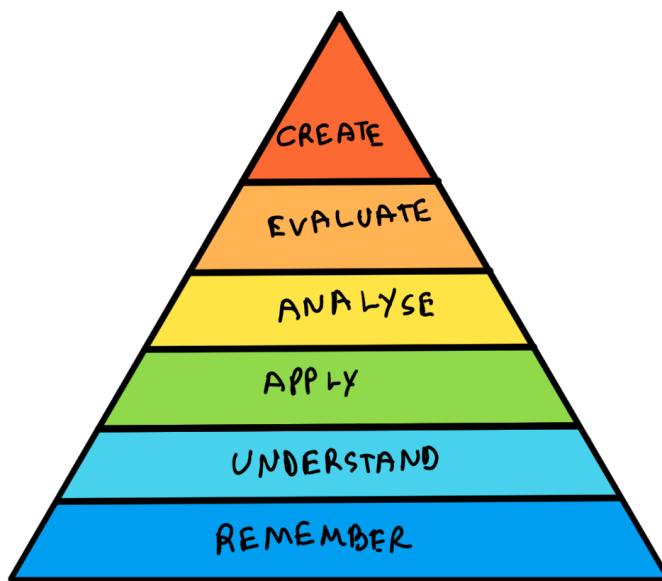


Figure 2: Illustrative image representing the different types of mastery in the form of a triangle according to their level of complexity.

1. Remember

Expanded definition:

This is the ability to retain and reproduce accurate information as it was learned. At this level, there is no need to understand the meaning of what is being memorized. It is simply retained through repetition or association, but without finding any internal meaning. This is the most superficial level of learning.

Example:

Remembering a sequence of random numbers without any pattern or meaning. Or memorizing the lyrics of a song in a language you don't understand, just because you like the melody and repeating it is enjoyable.

2. Understanding

Expanded definition:

This level implies that you are now able to make sense of the information. It is when you not only repeat it, but can explain it in your own words and identify its meaning. However, this understanding is limited: you do not make connections with other knowledge or relate it to other ideas. You understand each element in isolation.

For example:

Understanding the definition of a new word, knowing what it means, and being able to explain it, rather than memorizing it word for word. But you still don't relate it to other similar words or think about when you might use it.

3. Apply

This level involves going one step further. Not only do you understand the information, but you are also able to use it in different situations. Applying means knowing how to identify when and how you can use what you know to solve problems or interpret situations. You need to have a sufficiently solid understanding to adapt your knowledge to real or practical contexts.

For example:

Reading a problem statement and knowing exactly what information you have learned should be applied to solve it, even if the context is somewhat different from what you studied.

4. Analyze

Here you begin to look at the information from an outside perspective. Not only do you know what it means and how to use it, but you break it down, study it thoroughly, and compare it with other data. Analyzing involves making connections between different ideas, identifying patterns, differences, and similarities. This level requires more critical and flexible thinking.

For example:

Compare a concept with others you know, observe how it relates, what it has in common, and what makes it different. This allows you to understand it in a much deeper and more accurate way than if you saw it in isolation.

5. Evaluate

Evaluating means assessing using your own criteria. It is when you have such a solid grasp of the subject that you can judge whether an answer is correct, whether a theory is coherent, or whether one solution is better than another. It is not just a matter of giving your opinion, but of using your knowledge to make an informed assessment.

For example:

This is what a teacher or expert does: they listen to someone else's explanation and can identify whether they really understand the subject, whether there are any errors, or whether the answer is well reasoned. To do this, it is necessary to have a deep understanding of the content and the criteria to evaluate it.

6. Create:

This is the highest level. Creating means making a new contribution, generating your own ideas based on what you already know. It requires combining knowledge in an original way, having mental flexibility, and a very deep understanding of various aspects of a topic. It is an active and creative process that is only possible when you have a lot of experience and mastery.

For example:

Inventing a new theory, proposing an unprecedented solution to a problem, or discovering an innovative way to explain a concept. This is often what those who research a topic in depth do, such as those who pursue a doctorate or develop new models within a field.

LEVEL	DEFINITION	EXAMPLES
Recall	Memorizing information mechanically and without real understanding. There is no connection to meaning.	Memorizing a sequence of random numbers or the lyrics of a song in an unfamiliar language.
Understanding	Giving meaning to the information being memorized. You begin to grasp what it means, but in isolation and without connecting it to other ideas.	Understanding what each word in a song means and grasping the meaning of the phrase.
Apply	Use the information in new contexts or to solve problems. It is necessary to understand and remember well what has been learned.	Read a statement and know which formula or concept to apply to solve a problem.
Analyze	Compare, contrast, and relate ideas.	Compare two theories and see how they are similar and how they differ.

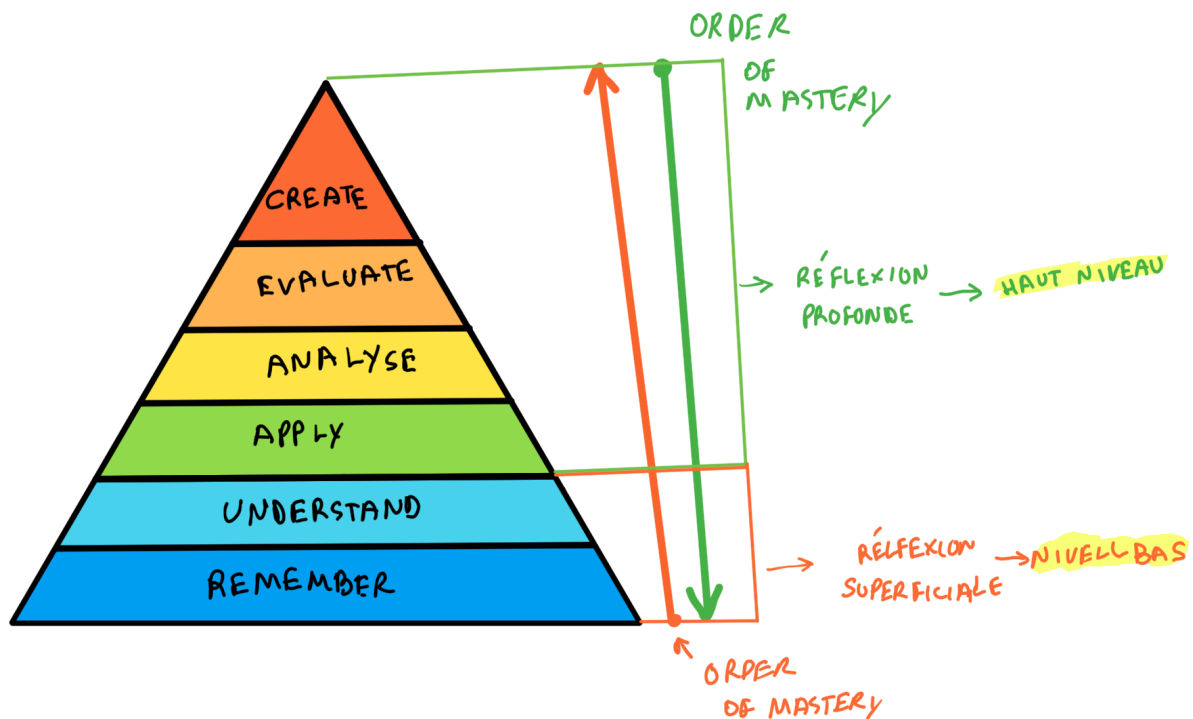
Evaluate	Judge the quality, consistency, or validity of information.	Decide whether a classmate's answer is correct or whether an argument is sound.
Create	Generate new ideas, theories, or solutions based on existing information.	Create a new theory or model based on prior knowledge.

HIGHER-ORDER THINKING

Imagine that someone explains two ideas to you that you don't yet fully understand. Instead of memorizing them or waiting to understand them one by one, you decide to compare them. You ask yourself how they are similar, how they differ, and whether both can be true at the same time. Even if you are missing pieces, this effort to analyze triggers a much deeper understanding. And often, after comparing them, you realize that not only do you understand them better, but you also remember them more easily.

This may seem counterintuitive. We are used to thinking that in order to analyze or evaluate information, we must first understand and memorize it. But science shows us that the reverse approach not only works, but can be even more efficient. If we start by thinking **deeply—comparing, applying, evaluating**—it forces us to understand the concepts better and, as a result, remember them more easily.

This approach is based on what is called ***higher-order thinking*** or ***deep thinking***. It consists of focusing on activities such as **comparing, applying, analyzing, or evaluating** information even before fully mastering it. Instead of starting with the basic stages (remembering, understanding, which are called ***surface thinking***) and climbing steps as if we always had to follow a fixed ladder, this type of thinking allows us to work from the top down: manipulating information, asking ourselves questions, looking for patterns, or applying concepts in new contexts. (*Deep thinking*) helps us understand and remember (*surface thinking*). As a result, we understand the content better and remember it more easily. For example, it is as if, instead of reading recipes, we tried to cook a new dish and, in the process, learned the ingredients, techniques, and proportions naturally.



EN: Figure 3: Comparative diagram between types of thinking and types of mastery. Superficial thinking (remembering and understanding) and deep thinking (applying, analyzing, evaluating, and creating) are organized according to their level of mastery.

Higher-level thinking drives us to seek meaning. It forces us to see information as a tool for solving real questions, not as a list of definitions to memorize. It helps us move beyond superficiality and encourages us to apply information, contrast it with other ideas, and evaluate whether it makes sense or not. The best part is that you don't have to wait until you're an expert to start thinking this way. In fact, starting to **evaluate, analyze, and apply** information is one of the best ways to become one. What's more, this not only helps us learn better, but also develops our **critical thinking** skills, making us more discerning, more independent, and better able to form our own opinions.

The most interesting thing is that we often already think with this depth instinctively. When something catches our attention, we look more closely, we get hooked, we look for contradictions, or we ask questions. But understanding this **process** allows us to do it **consciously** and **systematically**. In other words, we can decide to apply this type of thinking whenever we want to learn in depth.

And... how do we do this in practice? How can we activate this way of thinking voluntarily? This is where a key element of learning comes in: **curiosity**.

ANSWER TO THE ACTIVITY 2

SUMMARY

Teaching

- It is not just about memorizing, but about understanding and mastering knowledge: knowing how to apply it, explain it, relate it, analyze it, and create from it.
- Importance: it allows us to transfer information to real life (solving problems, making decisions, understanding points of view). It is the goal of learning.
- Levels of mastery:
 - **Remember** → repeat without understanding.
 - **Understanding** → assigning meaning in isolation.
 - **Apply** → use in new contexts.
 - **Analyze** → compare, relate, think critically.
 - **Evaluate** → assess using your own criteria.
 - **Create** → generate new ideas or solutions.

Deep thinking

- This consists of starting directly with complex activities (**comparing, applying, analyzing, evaluating**), even if we do not fully master the information. When we do this, we automatically master lower levels (understanding and remembering) as well.
 - This forces us to understand better and makes it easier for us to remember, unlike superficial thinking (remembering and understanding without connections).
 - **Example:** Trying to cook without a recipe → in the process we learn ingredients and techniques.
 - **Importance:** It transforms information into a real tool, develops critical thinking, and autonomy. It can be consciously activated through curiosity and questions.
-

INQUIRY BASED LEARNING

Have you ever been studying a topic, watching a documentary, or listening to someone speak, and a question popped into your head that you couldn't ignore? Perhaps you were watching a movie set in the Middle Ages and wondered how the laws of that time worked. Or maybe, while studying a science concept, you realized that there was a part you didn't fully understand... and you started searching for answers on Google, YouTube, or even asking someone for help.

At that moment, without realizing it, you were learning in a way that science considers particularly powerful: from your own questions. You weren't following a script or forcing yourself to memorize. You wanted to understand. And this is where inquiry-based *learning* comes in, or in other words, **learning from curiosity**.

This method consists of turning questions into the engine of learning. Instead of passively receiving a list of information, you are the one who guides the process based on your doubts and interests. It's not just about "being curious," but about **asking real questions, seeking meaningful answers, and connecting them to what you already know**. It's a more active, deeper, and, above all, much more **relevant** way of learning, since the information you find is **meaningful**.

Why is learning from questions so powerful?

When you are the one looking for an answer, your brain is activated in a completely different way. Instead of considering information as something external that has been "imposed" on you, you experience it as something **you are missing and want to complete**. It's as if you find a gap in a puzzle and look for exactly the piece that fits into that space. This small difference **automatically increases your interest**, because there is a genuine need to understand. You no longer study "because you have to," but because there is an open question you want to solve. And this motivation completely changes the way you learn.

This curiosity not only keeps you more connected to the content, but also has a direct effect on one of the most decisive factors in learning: **attention**. As we have seen earlier in this manual, to truly learn, it is not enough to pay attention for a few seconds or skim through the material. **Deep and sustained attention** is necessary, lasting longer and focusing on the relevant details.

This is where asking questions plays a key role. When you are interested in something and ask yourself "why does this happen?" or "how does it work?", **your attention naturally focuses** on everything that can provide you with an answer. There is no need to force it. Your brain scans the information with a clear intention, looking for clues, comparing, filtering... And thanks to this, you notice details that, in another context, **you would not even have noticed**.

Instead of trying to memorize every detail "just in case it comes up on the test," you identify what **you need to understand in order to resolve your question**. And when you finally find the answer, that information **is not just any piece of data**: it is exactly **what you were looking for**, and therefore **becomes much more meaningful and memorable**.

This is the key: instead of trying to make all the information seem relevant to you through sheer willpower, **relevance activates itself when the answer makes sense to a question you have**. But this leads us to a new question:

How can we formulate questions that really help us learn better?

DIFFERENT TYPES OF QUESTIONS ACCORDING TO THE LEVEL OF MASTERY

As we have seen, asking questions is a very effective way to activate attention and make information meaningful to you. But it is important to keep the following in mind: **not all questions lead to the same type of learning**. There are questions that only allow you to superficially remember a definition, and others that force you to think, relate, analyze, or even create something new. The deeper the question, the deeper the learning it generates.

Therefore, we can classify questions according to **the level of thinking they activate**, from the most basic to the most advanced. These categories are not arbitrary: they reflect what happens in our brains when we process information. Below, we will look at some specific examples for each level, with the aim of using this resource consciously.

LOW-LEVEL QUESTIONS

These questions are useful to start with, especially when we are faced with a new and unfamiliar topic. They help us understand what a word, definition, or rule means. But **we shouldn't stop there**: if we only ask these types of questions, we will learn superficially and have difficulty applying what we know.

Remember

These questions are only meant to help us retain information.

- *"How can I memorize this definition?"*
- *"What are the steps of the scientific method?"*
- *"What are the parts of a cell called?"*

These are useful for reviewing or getting started on a topic, but **they do not involve understanding or applying** the information.

Comprehension

These questions help you understand the literal meaning of a concept.

- *"What exactly does this term mean?"*
- *"How does this process work?"*
- *"Why does this happen?"*

These types of questions activate thinking a little more, but they are limited, as we think in isolation, finding the meaning of a single concept.

Higher-level questions (those that generate true learning)

These questions take you a step further. **You are not only seeking to understand, but also to use, analyze, evaluate, or even create based on the information.** These questions are the key tools for using higher-level thinking, the concept we discussed in the previous section.

Apply

These questions seek to see how you can use what you have learned.

- *"How can I apply this formula to a real problem?"*
- *"In what situation would this study strategy be useful to me?"*
- *"How can what I've learned help me write a good text?"*

(This is basically what we do in activity number 1: make a list of ways in which we can apply the information we are learning in the manual. Instead of seeing theory as just a set of facts to memorize, we actively use it to discover how it can influence our lives and how it can be useful in practical ways. This way, we think more deeply about the content.)

Analyze

Here you divide the information into parts and look for relationships, comparisons, or differences.

- *"How does this theory differ from that one?"*
- *"What are the parts of this process and how do they interrelate?"*
- *"How does this connect to what I learned in the other topic?"*
- *"Is this information consistent with what I know?"*

Asking these types of questions forces you to look at the information from different angles and discover structures that are not visible at first glance.

Evaluate

These questions make you judge the quality, usefulness, or logic of an idea.

- *"Is this example sufficient to understand the concept?"*
- *"Is this explanation complete, or is something missing?"*
- *Would there be a better way to explain this?*

Create

These are the most powerful questions. They ask you to **generate something new** from what you have learned, using your creativity.

- *What new theories could I develop from this topic?*
- *Based on my knowledge, how can I solve these problems in new ways?*
- *With this information, could I invent a system to solve problems in another field?*

In short, the more elaborate a question is, **the deeper and more lasting the understanding you will gain from the answer.** Therefore, if you want to truly learn, it is not enough to ask yourself "what does this mean?" You must start asking yourself questions that **make you think, apply, compare, discuss, or imagine.** These are the questions that transform information into real knowledge.

But... how do you do this in practice? How can we use these questions when studying at home? And in class?

Now you're ready to understand how to apply all this **to your own way of studying**.

APPLICATION WHEN STUDYING

1. YOU STUDY ON YOUR OWN

A common situation is to study a new topic and try to memorize it by reading it several times. But if you don't have a real interest in it, you'll find it very difficult to remember the details. And even if you try hard to concentrate, the information often seems disconnected and meaningless.

There is a much more effective alternative: **let your own questions guide you**. Instead of trying to understand everything right away, ask yourself questions as the explanations progress. When a sentence catches your attention or you don't understand it, **stop and ask yourself why it seems strange, what exactly you don't understand, or how it relates to other things you already know**.

Example: Imagine you are learning a language and you read a sentence with a structure you have never seen before. If you simply accept it as an "exception," you will probably forget it. But if you ask yourself, *"Why is it said this way here and not as I expected?"*, you look for an explanation and find it, **that rule or structure will become much clearer and integrated into your way of thinking about the language**. And you will remember it, because **you yourself have created the need to understand it**.

In addition, asking yourself questions allows you to reorganize the order in which you study. It is not necessary to follow the structure of the book or video exactly: you can start with whatever interests you most. When you study what **catches your attention first**, you are much more likely to end up getting to the other points, because your questions will naturally lead you there. And then, those details will no longer be random: **they will be the answers to questions you had asked yourself**, and therefore they will make sense and be relevant.

DO A PROJECT

Imagine you want to learn a new skill, such as programming, writing better, or even understanding photography better. The most common path offered to us is a book, a course, or a manual. The problem is that often the linear order and the information presented do not connect with what you really need or want. You end up learning information that is not relevant to you at that moment, and that makes it difficult to remember or makes it seem boring.

This is where creating **your own project** comes in. The idea is very simple: instead of following a path that someone else has designed for you, you decide for yourself **what you want to create** and set out to do it. And as you progress, you discover what information you need to solve the challenges that arise.

For example, imagine you have a dream of creating a simple computer game. You don't need to be an expert in programming to get started. Your starting point is your curiosity: "I

want to make a character move across the screen." This question already leads you to investigate: *What is the simplest programming language to do this? What is the basic command to move a character?* When you find the answer, you're not only learning programming, but you're doing it with a **clear and personal goal** in mind.

This process repeats itself over and over again. Each step of your project generates new natural questions:

- *How can I add points when the player achieves a goal?*
- *Why is the code giving an error and how can I fix it?*
- *What tools can help me make it easier?*

Each answer you find is like a piece of a puzzle that fits into your project. And here something very powerful happens: what you learn has **more meaning and greater power to remain engraved in your memory**. It is not isolated information from a book, but a concrete solution to a problem that you yourself had to solve.

In addition, carrying out a project can provide you with **personal motivation**. When it's your project, your own idea, it's much easier to stay consistent. You're not working because someone has imposed it on you, but because you want to see the end result. This generates a special energy, almost as if each step were a small victory. In this way, it motivates you to learn the content more quickly, as the information is more relevant and presented in a more dynamic way. Similarly, creating a project involves deep, high order thinking, constantly reflecting on how you can apply information and create with it, rather than just understanding it, let alone memorizing it.

Thus, we could say that learning based on research and project creation works as a kind of "personal adventure." It is not a marked and predictable path, but a journey full of discoveries that you yourself are building. And the most interesting thing is that this method adapts to almost any field: from programming, writing a book, learning history by creating a podcast, to understanding science by conducting small experiments.

In short, when you learn this way, knowledge ceases to be a list of meaningless facts and becomes **real tools to make your imagination possible**. It is a living learning experience, connected to your motivation and curiosity. And that is what makes it so powerful.

2. YOU STUDY IN CLASS

You can also apply this method while following an explanation in class, especially if you don't find the subject very interesting. We often think that paying attention means keeping quiet and listening without missing a single detail, but **true active attention goes much further than that**. A powerful way to stay connected is **to constantly ask yourself questions while listening**.

Imagine that you become that "overly inquisitive" person who looks for inconsistencies, contradictions, or unclear points. It's as if you want to prove the teacher wrong. You don't have to say it out loud, but you can **think as if you want to test the teacher's speech**:

- *Does what they're saying make sense?*
- *How does it relate to what they said before?*
- *What example could I come up with to check if I have understood correctly?*
- *Is there a better way to explain it?*

This way of following a class is known as **active listening**, because you are constantly reflecting on the information you receive, trying to make sense of it, connecting it, and evaluating it. It is **very different** from the usual way of class, where **we just copy what is explained or try to understand the concepts individually to study them later**. Instead, when you listen actively, **you are already processing the information as you receive it**, as if you were testing it in real time.

Even if you don't master the subject, using **higher-level thinking**, such as analyzing and evaluating your teacher, keeps you in a **state of sustained attention**. Every word the teacher says takes on a purpose: **you are scanning the information to see if it fits with what you already know**. And, inevitably, questions arise. Some you can resolve later by asking the teacher or your classmates directly.

And if you don't have direct access to someone to resolve them...

The role of artificial intelligence

Asking questions does not always mean having someone nearby who can answer them. Today, **you can use tools such as artificial intelligence to follow an almost infinite thread of questions and answers**. And that allows you to learn a subject in depth, guided solely by your curiosity.

For example: you ask an AI a question such as *"What does this concept mean?"* Based on the answer, a question arises: *"How does it relate to this other one?"* or *"Are there any practical examples?"* or *"What if this were false, what would happen?"* If you follow this process, you can build a solid, personalized understanding, **tailored to your real questions**.

Ultimately, this is why we learn best about topics that interest us: our brain becomes a **question-asking machine**. And these questions activate attention, generate connections, provide meaning, and facilitate memory. But even when you **have no initial interest** and don't like the topic, you can **force this process voluntarily**: if you set out to ask quality questions, even if artificially, you will be setting the same mechanism in motion.

And that is what makes a study session an **active and meaningful process**. As physicist Richard Feynman said in his book *The Meaning of It All: Thoughts of a Citizen-Scientist* (1998):

"We absolutely must leave room for doubt or there is no progress and there is no learning. There is no learning without having to pose a question."

Feynman applied a chain of questions to truly understand a topic, such as *"Why is this so?"* or *"How does this work?"*, until he reached the limits of knowledge, that is, until he achieved the **highest possible level of understanding** on a topic.

Thus, we know that we can **master** a subject more quickly if we think more deeply (higher-level thinking), through curiosity, by asking ourselves quality questions on an ongoing basis.

ANSWER TO THE ACTIVITY 3

SUMMARY

INQUIRY BASED LEARNING

- **Definition:** learning from curiosity and your own questions.
- **Function:** turning questions into the driving force of learning.
- **Characteristics:**
 - Active, deep, and relevant process.
 - Information becomes meaningful when it answers a personal question.
 - Improves sustained attention and motivation.
 - Connects prior knowledge with new knowledge → increases the relevance of information
- Key: encourages **high order thinking** → **increases mastery of a subject**

Importance of questions:

- Difference between memorizing and wanting to understand.
- Personal interest generates natural attention and deeper understanding.
- A found answer has more value and is better remembered.
- Learning = looking for pieces that fit into your own puzzle.

Types of questions according to the level of mastery:

- Low level (superficial learning):
 - Remembering: ways to remember *"How can I remember this?"*
 - Understanding: grasping the literal meaning. E.g.: *"What does this mean?"*
- Higher level (true learning, high order thinking):
 - Apply: use knowledge in real-life situations. *"How can I apply this?"*
 - Analyze: compare, break down, find relationships. *"How are they connected?"*
"What is the difference or similarity?"
 - Evaluate: judge quality, consistency, and usefulness. *"Is this well explained?"*
"How would I do it?"
 - Create: generate new ideas, solutions, and systems. *"What can I create from this?"*
- Principle: the more elaborate the question, the deeper the understanding.

Application in study:

- You study on your own:
 - Ask yourself questions continuously while reading.
 - Reorganize your study based on your own questions.
 - Example: learn a language by asking yourself why a particular structure is used.
- **Carry out a project:**
 - Learning arises from specific needs.
 - Each challenge generates meaningful questions and answers.
 - Example: develop a simple video game → research programming step by step.
 - Advantages: personal motivation, deep learning, creative thinking.
- **Studying in class:**
 - **Active listening:** Constantly ask yourself questions while listening.

- **Look for inconsistencies**, examples, and connections.
- It maintains sustained **attention** and encourages **critical thinking**.

The role of artificial intelligence

- It allows personalized question and answer chains to be followed.
- It helps build understanding tailored to questions.

Conclusion

- Deep questions activate high order thinking and accelerate mastery.
-

SCHEMA THEORY

Imagine that someone asks you to explain a series you have seen and love. If you had only memorized the names of the characters and a few isolated details, you would have a hard time conveying what it is really about. But since you have followed it from beginning to end, you have a complete picture in your head: you know how the characters relate to each other, what conflicts recur, how the story evolves, and you can even predict how a character would react to a new situation.

This happens because, in your mind, you don't have a list of disconnected facts ("the main character is called X, the female lead is called Y"), but rather an **organized network of information** that gives meaning to the whole. You can jump from one scene to another, make connections, see patterns, and reconstruct the thread of the story at any time.

This is precisely what we do with any knowledge: when we truly learn, we don't accumulate information as if it were a drawer full of loose papers, but rather we build structures that connect the pieces and allow us to use them flexibly. These structures are what we call **mental schemas**.

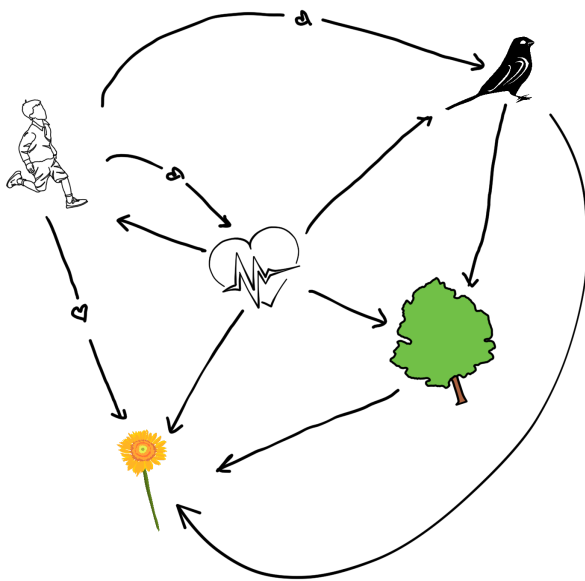


Figure 4: Illustrative image representing the interconnectivity of different ideas in the form of a network, as occurs in our minds.

What is a mental schema?

A **mental schema** is an **internal structure of knowledge** that allows us to understand, remember, and use information.

Everything we know is represented mentally in an organized way, in different knowledge structures (such as concepts, experiences, or life experiences), which are connected to each other and form small schemas. These small schemas, in turn, are grouped into larger structures and help us better understand complex ideas and events.

In other words, a mental schema is a **set of organized meaningful connections**. That is, relevant pieces of information that are related to each other in a way that makes sense together and, when grouped together, allow us to build a broader understanding of a topic.

For example, think of **a city you know well**. Perhaps you know how to get from your house to school. And also how to get from school to the library. These are two **concrete connections**: small sections of a route that you have learned. But on their own, they don't say much about what the city is really like.

What makes you know your neighborhood well is not just knowing how to get from one place to another, but the set of these **small relationships**, which allows us to have **a complete network of connections between many different points**, enabling you, for example, to choose the shortest route between two places, know where to go if you want to avoid a traffic light, or discover alternative routes. In other words, to have a **structured and functional view** of how space is organized.

This is exactly what happens with knowledge: **each "meaningful connection" between two ideas** is like a journey between two places. But when these small journeys between places you know **are organized and expanded**, they create your mental version of the map of your city, which you use to move freely around it. The same thing happens with knowledge: when connections are organized and expanded, they form a more complex scheme (the mental map of the city) that allows you **to orient yourself within the subject**, see how it works, and use the information more flexibly (such as finding shorter paths between two places).

Therefore, when we talk about **prior knowledge**, we are referring to this: **everything we know about a subject**, but not as a disordered list of ideas, but as a **network of interconnected information** that helps us make sense of new ideas.

The more structured and functional this framework is, **the easier it is to learn, understand, and apply new information**. In other words, the more developed and organized it is, **the more mastery we have**.

Thus, there is a direct relationship between **the degree of connection and structure of a set of ideas** and **the level of mastery** we have over that content (as we saw in the classification of levels of mastery).

Therefore, to know if a person **truly** has **mastery** over a subject, **it is not enough for them to know many things or be able to repeat them**. They need to **have a clearly formed knowledge structure and be able to move freely within it**, in the same way that we can relate characters from a book or series we know very well with little effort, a history teacher can easily connect complex historical events, or when we can move freely around the city where we live.

REQUIREMENTS FOR MASTERY

As we have seen, a mental framework is not a simple accumulation of information, but a network of **meaningful connections**. However, for this network to reflect **true mastery**, it must meet three fundamental requirements:

- **Number** of connections
- **Quality** of these connections
- **Clarity** in structure

These three elements are **necessary conditions**: if one is missing, **we cannot speak of true mastery**. We may have a lot of information, but if it is not well connected, it is useless. We may have deep connections, but if there are only two or three, they are insufficient to understand a subject. Or we may have many relevant connections, but if they are disordered and diffuse, knowledge remains scattered.

Only **when there is quantity, quality, and clarity at the same time** can we speak of a well-developed framework and, therefore, of **deep and functional knowledge**.

1. Quantity: having a sufficient volume of connections

To master a subject, it is necessary to have built **sufficient connections**. It is not enough to know four basic ideas: it is necessary to have related many elements of the subject and to have a rich and **diverse** understanding.

Imagine a person who wants to learn to play the guitar. If they only know three chords, they will be able to play some very simple songs. But if they know twenty, and also know some scales and rhythmic patterns, they will have many more possibilities for combining, creating, and adapting music.

In this case, each chord is like a small piece of knowledge. The more pieces you have, the more options you have to understand and act within the subject. *Quantity* is not everything, but it is essential: you cannot achieve mastery if your knowledge is very limited or superficial.

Quantity does not only refer to accumulating data, but also to having **many relationships between concepts** that make up an extensive network. It is not everything, but it is essential: you cannot achieve mastery if your knowledge is very limited or superficial.

2. Quality: having deep and relevant connections

Not all connections have the same value. In a truly useful framework, connections must be **meaningful**, that is, **relevant, explanatory, and transferable**. These relationships help us to **better understand, reason, and apply knowledge in other contexts**.

To say that "the French Revolution preceded the Russian Revolution" is a chronological connection. But relating them by their causes, by the ideologies involved, or by the social impact they had constitutes a much richer connection.

This demonstrates a **deeper understanding** of the subject.

Quality connections are not mere associations; they are relationships that **explain, structure, and give meaning**.

3. Clarity: having an orderly and accessible structure

The first two requirements—quantity and quality—are what define whether information is relevant, as we saw in the first part of the manual: information is relevant when it creates a meaningful connection with our prior knowledge. But simply gathering a lot of information that we remember and know how to use individually **is not enough** to achieve mastery.

And this is where **clarity** comes into play: a good mental framework is not only extensive (with a lot of quantity) and deep (with quality connections), but also **clear and well organized**. This means that knowledge is **grouped together in a meaningful way, hierarchized**, and can be **easily retrieved and applied**.

Example: You may know many streets in your neighborhood and know each one very well, but if they are jumbled up in your head, you will have trouble finding your way around. On the other hand, if you have them well organized mentally, you can decide which route is best, find alternative routes, and move around smoothly. This is what it means to have a good **mental map**: a clear and functional framework.

Without clarity, knowledge remains **vague or confusing**. We find it difficult to retrieve, explain, or apply it correctly.

The three **requirements—quantity, quality, and clarity**—are not independent options, but **conditions that must be met simultaneously**. If only one or two of them are met, the knowledge is not solid enough to speak of **true mastery**.

MISSING REQUIREMENT	CONSEQUENCE
Lack of quantity	Knowledge is too limited and incomplete.
Lack of quality	Superficial connections, memorization without understanding.
Lack of clarity	Difficulty accessing, applying, or explaining knowledge.

MOST COMMON SCHEMATA

Mental schemas are not all the same. We use many types to organize different kinds of experiences or knowledge. Here are some of the most common ones:

TYPES OF SCHEMATA	WHAT IT ORGANIZES	EXAMPLE
Person schema	Knowledge about other people or social roles.	How you think a teacher, police officer, or friend should act.
Schema of oneself	The knowledge you have about yourself.	"I am responsible," "I am good at math."
Task outline	How to do something step by step.	Outline for studying for an exam: read, underline,

		summarize.
Event outline	How a common situation works.	Going to the doctor: entering, waiting, consultation, prescription.
Conceptual outline	How knowledge about a topic is organized. (<u>Main type of outline we work with when learning</u>)	What do you know about "photosynthesis," "democracy," or "energy"?

THE CONCEPTUAL FRAMEWORK

When we learn theoretical knowledge, the type of schema we construct and use most frequently is the conceptual schema. It is the mental structure that helps us organize the meaning of a topic, with its main ideas, examples, relationships, and applications. It is as if we were constructing a mental map that allows us to move freely and with understanding within the topic.

Within a conceptual schema, we can have other more concrete or specific schemas. For example, within the schema of "mathematics," we can have a small schema about "fractions," or within "biology," a schema about "reproduction." These small schemas are grouped, connected, and organized within a larger system.

How is a mental schema activated?

So far, we have seen **what a schema is**, why it is so important, and what types we usually use. But we have not yet talked about **what activates a schema**, that is, how we know what **knowledge** to use when faced with a new situation or information.

To understand this, we will focus on two key factors: **context** and **perspective**. These are what signal our brain to activate the most appropriate schema.

Schemas are not static, nor are they always used in the same way. What really matters is **what activates them**, and this is where two key factors come into play:

1. Context

This is the external situation you experience or observe. The context activates the schema that seems most relevant.

For example:

- If you enter a library, the "silence" and "study" schema is activated.
- If you read a scientific article, you activate schemas about science and analysis.

2. Perspective

This is how you mentally approach the situation. The same context can activate different schemas depending on your role or intention.

Example:

In a debate on climate change:

- If you are a student, the "learn facts" schema is activated.
- If you are an activist, the "protest and action" schema is activated.
- If you are a teacher, the "how to make students think" schema is activated.

This explains why two people can understand the same text in different ways: each activates a different schema, i.e., **prior knowledge**, depending on their experience, prior knowledge, and objectives.

Let's summarize:

Imagine that your mind is like a **large living library**. Each **mental schema** is like a **thematic bookshelf** within that library: there you classify everything you know about a topic, situation, task, or person. That bookshelf not only contains books—information—but also **connects** them **to each other**, so that it makes sense and is easy to consult.

When you learn something new, your brain acts like a **very organized librarian**. The first thing it does is check to see if you already have a shelf related to that information:

- If it finds a suitable one, **it classifies the new book** so that you can easily access it when you need it.
- If it doesn't find one that fits, it can:
 - **Create a new bookshelf** (form a new outline),
 - Or, if it doesn't know where to put that information, **set it aside** (forget it or don't integrate it).

When you later encounter a similar situation or need to recall an idea, you return to that shelf and open the right book, whether to remember something, make a decision, or understand a new experience. And the better organized the library is, the easier it will be to find what you need and use it effectively.

That's why we say that a **good mental framework** should not only have **many books (quantity)**, but these books should also be **well written and well connected (quality)**, and **organized in a meaningful way (clarity)**. Without these three things, the bookshelf will be filled with books that we don't know how to find, don't understand, or don't even remember are there.

In short, our **prior knowledge** is represented internally by **information schemas**. The **quantity**, **quality**, and **organization** of the connections that link different pieces of information determine our level of **mastery** of a subject and our ability to learn **new information**.

ANSWER TO THE ACTIVITY 4

SUMMARY

SCHEMA THEORY

- Learning is not about accumulating random data, but rather building **organized networks of knowledge**.
- Mental schemas allow us to understand, remember, and use information flexibly. → Having mastery

Mental schema

- **Definition:** internal knowledge structure that organizes **all the information** we know in a meaningful way.
- **Characteristics:**
 - Set of connections between ideas, experiences, or concepts.
 - The connections form networks that facilitate the understanding and application of knowledge.
 - The more structured the schema, the easier it is to learn and apply new ideas.

Prior knowledge

- Network of interconnected information = a mental framework
- Helps make sense of new ideas.
- The degree of connection and organization determines the level of mastery.

REQUIREMENTS FOR MASTERY

1. Number of connections

- Have sufficient relationships between concepts.
- Not just accumulating data, but many connections that form an extensive network.
- Without quantity: limited and incomplete knowledge.

2. Quality of connections

- Meaningful, explanatory, and transferable relationships.
- They provide deep understanding and application in other contexts.
- Without quality: superficial memorization.

3. Clarity in structure

- Knowledge that is organized, hierarchical, and easy to retrieve.

- Allows for fluid and functional application.
- Without clarity: diffuse knowledge that is difficult to apply.

Conclusion: only with **quantity+ quality+ clarity** at the same time does **true mastery** exist.

THE CONCEPTUAL FRAMEWORK

- Organizes the meaning of a topic: main ideas, relationships, examples, and applications.
- It can include sub-schemes (e.g., within 'biology', a scheme on 'reproduction').

ACTIVATING A FRAMEWORK

- Key factors:
 1. Context: the external situation activates the most appropriate schema.
 2. Perspective: the role or intention of the person activates different schemas in the same context.
 - This explains why two people can understand the same stimulus in different ways.
-

NOTE-TAKING

HOW DO WE TAKE NOTES? AND... WHY DOESN'T IT WORK VERY WELL?

Why do you take notes? It may seem like a silly question. "To study later," you might say. And maybe also because it's what's expected in class. We've always done it. But... have you ever really questioned it? Why do you take notes this way, with long sentences, words copied exactly as the teacher says them, one idea after another, as if you were writing a little book? Do you really learn better this way? Or is it just what you've always seen done?

In general, we take notes as if they were a literal transcription of reality. We copy definitions, diagrams from the blackboard, examples that appear in the presentation... but we rarely ask ourselves **what we are really doing with this effort**.

We are a bit like scribes in ancient Egypt: we don't try to understand it thoroughly, but rather store information to read later.

But here's the key question:

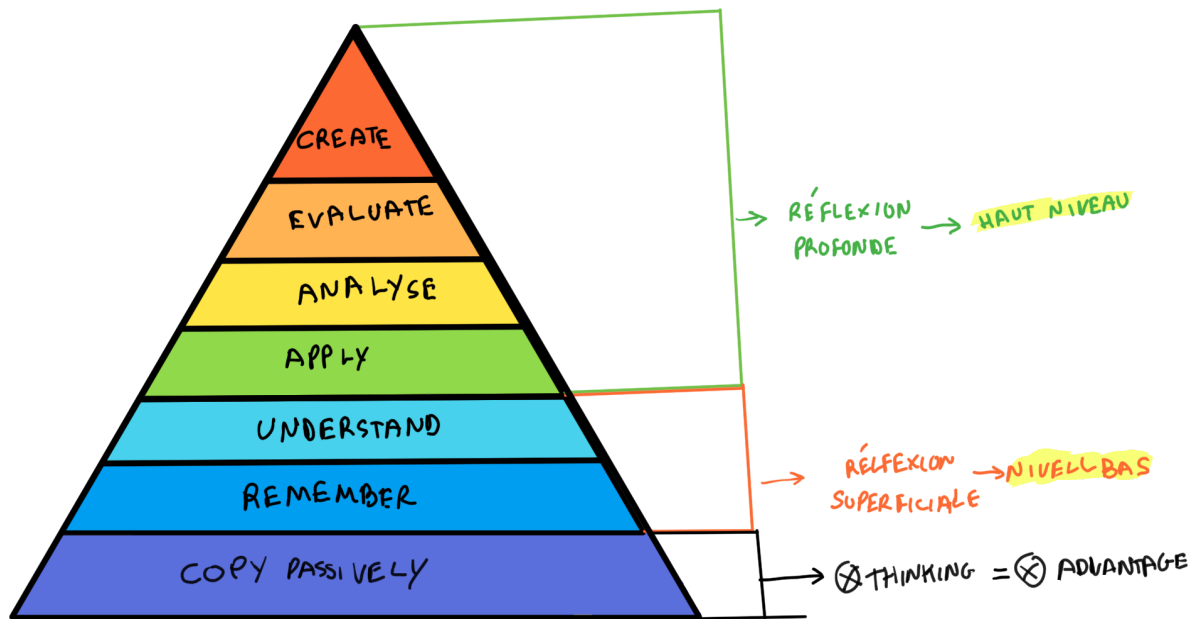
Is the sole function of note-taking to store information, or should it also help us learn better?

Most students use notes only as a data warehouse: a place to "store" what they have heard or read so they can study it later. But this fails to take advantage of one of the most important functions of learning: **thinking about information as we receive it**.

It's **not** just a **matter of memory**, but of how we interact with what we hear.

Many students copy notes so quickly and automatically that they don't even have time to understand what they are writing. Note-taking ceases to be a mental process and becomes a **mechanical task**: information passes through us as if we were a transcription machine. **The less time we spend writing something down, the less we have thought about it.** And the less we have thought about a piece of information, the less likely we are to actually learn it.

This type of note-taking is so passive that it could be considered **inferior even to superficial thinking**. When we just copy, **we neither remember nor understand** (lower levels of thinking), we simply transcribe. We don't ask ourselves how we will remember it later. We don't look for meaning. We make no effort to connect it to anything we already know.



EN: Figure 5: Image comparing the type of thinking when taking mechanical notes with superficial and deep thinking.

It's a bit like when we read a text quickly, skimming over it. We look at the words, our eyes scan the lines, but we don't stop to understand what they mean. In contrast, when someone **reads actively**, they pause, reflect, and interpret. Two people may read exactly the same thing, but only one will truly understand it. **The same is true of note-taking.**

However, there is also a slightly more **active** way of **taking notes**, and it is an important step toward more effective learning.

For example:

- Write down an idea in your own words.
- Summarize what you have just understood.
- Give an example that comes to mind to understand it better.

These strategies involve a **very important change**: **they make you stop for a few seconds and reflect on what you are hearing**. They force us to **process the information**, to look for ways to make it more understandable to us. And that, even if it is still a superficial thought, already represents **a much deeper learning** than simply copying. We begin to filter, to organize, to take a first step toward understanding.

But... is that enough to learn deeply?

Not entirely. These types of notes, although much more useful than passive copying, **still do not help us to think deeply**. We still do not ask ourselves how we can apply the information, or how it contrasts with what we already know, or what questions it raises for us. **We are beginning to understand**, but we are not yet **learning in depth**.

Why do traditional notes prevent us from thinking deeply?

Even when we try to take notes actively—writing in our own words, summarizing, or giving examples—we encounter a significant limitation: the **format**.

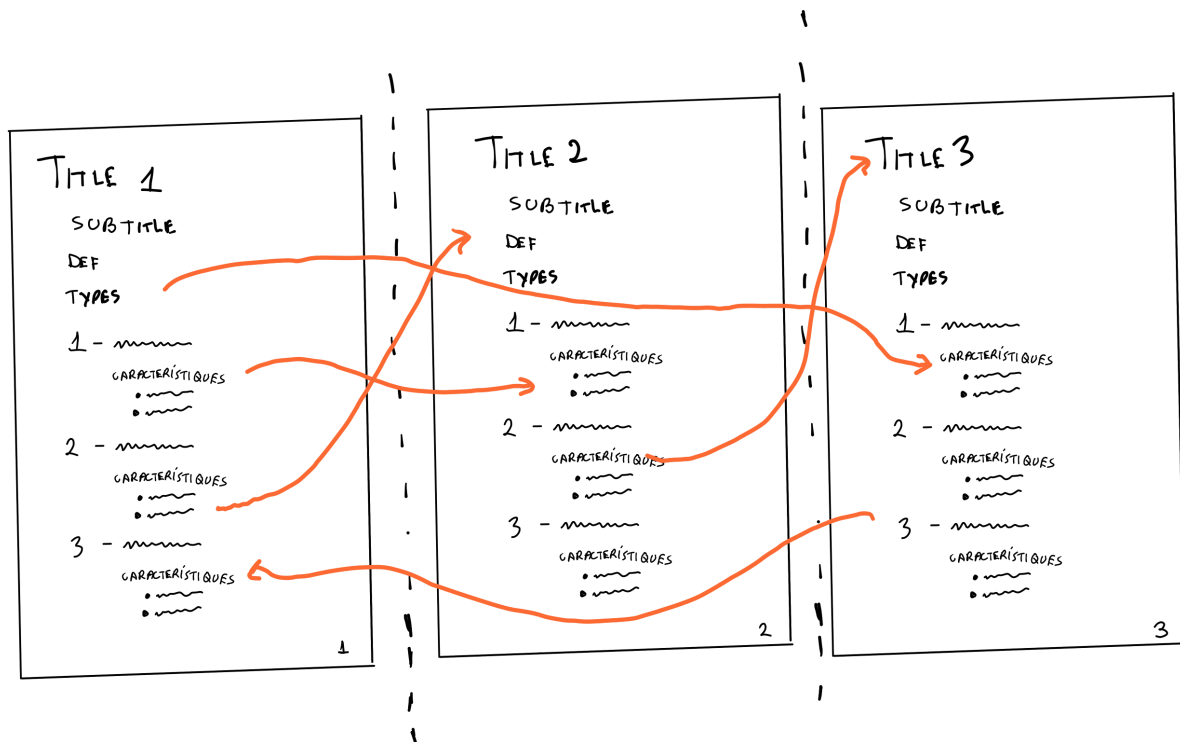
Traditional notes, in lines and sentences, **are not designed for deep thinking**. They do not allow us to contemplate information holistically or clearly represent the connections between ideas that are separated in time or space within the text.

Imagine you are taking notes in a class and suddenly realize that an idea you are writing down now is related to something the professor said ten minutes ago. You might jot down a small comment in the margin or in parentheses, but you notice that the connection is lost. And that doesn't happen just once. The more you try to think deeply and **connect concepts**, the more frustrated you become: **you don't know where to put them, how to organize them, or how to show that they are connected**.

It's as if you had to build a complex puzzle... but you could only place the pieces next to each other, in a straight line.

What options do we have, then?

1. **Write very long texts to explain every connection we detect.** If we wanted to write about all the relationships we detect between the different points of a topic, we would have to write a book for each one. It's not just a question of time, but also a problem of efficiency. Explaining every connection we see in writing takes **time, effort, words, and cognitive effort**. When we study, we don't have time to explain every detail, every related idea, every memory or example that comes to mind.
2. **Making connections with arrows or comments between pages that are far apart** would result in very disorganized and confusing notes, which would be more of a hindrance than a help. There would be too many arrows crossing pages and comments.



EN: Figure 6: Illustration showing the difficulty of representing relationships with linear notes, separated by pages.

3. **Not writing down these connections**, since we cannot represent them and expect to remember them later.

This last option poses another problem: **our working memory cannot handle all of this.**

WORKING MEMORY

Imagine that someone dictates a phone number to you: **635-89-241**. You have nowhere to write it down, so you repeat it mentally while looking for a pen. "635, 89, 241... 635, 89, 241..." But if someone interrupts you at that moment, you may forget it immediately.

This shows how our **working memory** works: it is the system that allows us **to hold and manipulate information** for a few seconds while we do something else.

It's like a very small **mental work table**, where we place the ideas we're working with at that moment.

Here we can store a small amount of information (usually between 4 and 7 items), but if we don't actively process it or reinforce it in some way, **the information quickly disappears.**

So... how do we expand or reinforce our working memory?

Although it is limited, our brain has found strategies to prolong or strengthen this capacity. Some of the most common are:

- **Repetition aloud:** like when we say a number out loud many times: "635, 89, 241... 635, 89, 241..."
- **Visualization:** We visually represent the information we are processing to relieve our minds, such as writing down numbers on a piece of paper or jotting down ideas that pop into our heads so they don't fade away.
- **Grouping:** We convert many elements into smaller groups. For example: "6-3-5-8-9-2-4-1" → we group them as "635 - 89 - 241."

This is a problem when we take traditional notes and think of an interesting connection: if we can't represent it clearly and quickly on paper, we're likely to forget it before we can do anything with it.

And not only that. Even if we remember the connection, trying to keep it in mind while we continue writing overloads our working memory. A typical example: doing mental calculations without external support.

Imagine you have to do this multiplication mentally: " 1234×5678 ."

These are two four-digit numbers, and doing it **without paper** would be a real nightmare. You would have to remember multiple partial results, place them correctly, and add them up... all mentally. This requires a great deal of mental effort.

Now imagine you have paper and pencil: you can write down what you get, note intermediate results, and focus on only **one operation at a time**. This way, your working memory can focus on the current multiplication (such as $6 \times \times 8$), and you leave the rest of the information written down. The process **is more efficient, clearer, and less tiring**.

This is exactly what happens when **we try to represent connections between ideas without a clear visual form**. If we don't have a tool that allows us to "free up mental space" and visually represent the connections, we will end up forgetting them or becoming overwhelmed, either by trying to remember them mentally or by trying to represent them all textually.

Therefore, when we take notes in a linear fashion, **we limit our ability to think deeply**. Not because we don't have ideas or don't want to make connections, but because **the format doesn't allow us to** and our minds are not prepared to sustain all this complexity without external help.

So, is there a truly effective way to take notes?

That is...

- A way that helps us **think deeply**, not just transcribe.
- That **makes better use of our working memory**, without overloading it.

- That **doesn't take up so much space, time, or physical effort.**

A way of taking notes that **not only serves to have the information written down**, but to **truly learn it**.

It seems like a question with an impossible, almost magical answer, but it's not. This way of taking notes exists. And not only is it possible... **We are already using it, every day, inside our brains.**

When we learn new information, we don't store it in the form of paragraphs or long sentences. We don't remember every word exactly. What we do is **integrate it into the mental frameworks** we already have: we look for connections we can make with what we already know. Learning means **creating structures of meaning**, not texts.

So, if this is what our brains do... why don't we take notes this way?

Instead of filling pages with prepositions, connectors, and articles that **don't add real meaning**, we can take notes **in the same way we learn**: highlighting only the key ideas, showing how they relate to each other, and structuring them clearly and meaningfully within a space. When we remember something we know well, **we don't see a written text in our minds**. What we see is an **idea**, its **meaning**, and how it **fits with the rest of our knowledge**.

Therefore, the most effective notes are those that reproduce this **natural functioning of the mind**: they are **schematic, visible notes—non-linear** ones.

NON-LINEAR NOTES

Non-linear notes do not follow a fixed structure or a single direction. They are not limited to lines of text one after another, but **use space, shape, color, symbols, and graphic layout** to represent ideas and connections.

These types of notes offer **creative freedom** to represent meaning.
For example:

- We can **group ideas in areas of the page**, according to their relationship.
- We can **use arrows or lines** to show causes, consequences, or oppositions.
- We can **use different colors or shapes** to highlight categories or hierarchical levels.
- We can even use **drawings** to help us understand or remember an idea.

DIFFERENCE BETWEEN LINEAR AND NON-LINEAR NOTES



Figure 7: Comparative image with linear and non-linear notes.

In addition to the other differences we have seen before, it is not the **visual format** that makes notes non-linear, but the type of connections they establish and the way they structure information. We can create an outline with a general concept such as "energy" at the top and branches representing its types: thermal, electrical, nuclear energy... But that, in reality, is still a linear form of note-taking. Why?

Because it maintains a vertical hierarchical structure: from a general concept, we move on to more specific concepts, in a single direction, with a single conceptual relationship (the hypernym-hyponym relationship). This structure is very similar to that of traditional notes: it may be more visual, but it is not richer in connections. It only presents one branch of relationship: from top to bottom, or from the general to the specific.

In contrast, truly **non-linear** notes—such as mind maps or concept maps—allow for the representation of **multiple, cross-cutting, and transversal** connections between ideas. Instead of following a single direction (a hierarchy or sequence), they make visible the relationships that exist between concepts from different areas, different levels, or even different contexts. For example, we could connect "thermal energy" with "changes of state" in chemistry, or relate "nuclear energy" to "geopolitical conflicts" in geography. These types of connections are difficult to represent in linear notes, but they are essential for a deep and integrated understanding.

Thus, **interconnectivity** is the key: notes are non-linear when they allow us to **visualize and construct networks of meaning** rather than simple hierarchical lists. Their value lies not only in their graphic appearance, but also in their ability to represent how we actually think, relate, and remember information.

Thus, **many diagrams that we make, find on the internet, or that are generated by AI appear to be non-linear, but in reality they are not.** And this can lead to confusion.

For example, **tree-shaped diagrams**, which are very common in class or in support materials, tend to be limited to breaking down information into hierarchical parts, like a visual index. They summarize and organize, but **they do not bring out the connections between concepts**, nor do they force us to think deeply about their meaning or application. They are useful for observing the **overall structure of a topic** and for gaining **clarity and better situating ourselves**, but **not** for developing **deep or flexible thinking**.

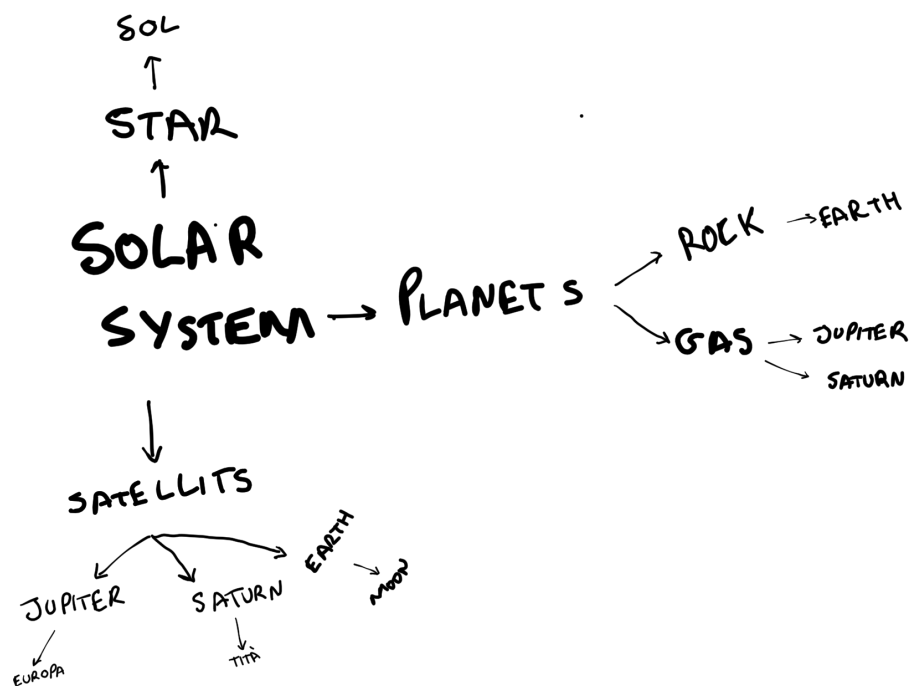


Figure 8: Represents a simple diagram of the solar system, illustrating the linearity of such diagrams.

This diagram is clear and simple, but it only shows a classification. There are no connections between the elements, nor are the relationships that could help us truly understand the solar system (such as gravitational interactions, differences in composition, or orbital movements) represented. It is a **linear** diagram, even though it is organized visually.

And this is a very common mistake: confusing **visual form** with the **type of thinking** behind it. If we are only reproducing superficial structures, we are using diagrams as another way of copying, not thinking.

DIAGRAMS MADE BY AI

In addition, it is tempting to ask AI to create a concept map, an outline of the topic, or even a graphic summary. But we must be critical: **although it may seem efficient, this has several serious drawbacks.**

First, because **we have not made the effort to think** and organize the information **ourselves**. And it is precisely this process that helps us learn: selecting, prioritizing, relating, and understanding. If AI does it, it saves us work... but it also saves us learning.

Second, because **the information it returns to us may be incomplete, partial, or simplified** in a way that does not fit our needs. AI may have eliminated relevant examples, nuances, or connections.

Third, because **many automatically generated diagrams are just as linear** as the ones we superficially create ourselves: classifications, subdivisions, hierarchies. They do not represent cross-cutting connections or encourage active reflection.

Yes, it can be useful as a starting point, to give us an overview or to see how a topic is structured. But **if we want to build mastery**, it is not enough to look at a map or copy it. It is necessary **to be actively involved**: to think, relate, transform the information, and represent it in a way that reflects how we have understood it and how we can apply it.



Figure 9: Merely illustrative diagram of notes representing the linearity of generic diagrams produced by artificial intelligence (own work with AI support, Mapify, 2025).

Under the category of non-linear notes we find:

- **Diagrams.**
- **Timelines.**
- And, above all, **mind maps**, which we will be working with specifically from now on.

SUMMARY

NOTE-TAKING

Main function

- Traditionally: to store information for later study (data storage).
- In reality, they should also help you learn, think, and connect ideas while listening or reading.

Problems with traditional note-taking.

- They are done mechanically (like a transcription).
- Very superficial thinking → just copying, without understanding or connecting.
- Linear format (sentences in a row) → prevents visualization of connections and deep thinking.
- Overloading of working memory: we forget connections because we cannot represent them clearly.

Types of note-taking.

1. Passive notes (linear and copied):
 - Simple transcriptions, without reflection.
 - Disorganized information that is not very useful for learning.
2. Active note-taking (partial improvement):
 - Writing in your own words.
 - Summarize ideas.
 - Give examples.
 - Improves learning, but still superficial.
3. Non-linear notes (effective):
 - They reproduce the natural functioning of the mind (network of connections).
 - They use space, shapes, colors, symbols, arrows, and groupings.
 - They allow multiple and cross-cutting connections to be represented.
 - Example: mind maps, concept maps, timelines, and diagrams.

Working memory

- Temporary mental system for maintaining and manipulating information (4–7 elements).
- Strategies to reinforce it:
 - Repetition aloud.
 - Visualization (notes).
 - *Chunking*.
- Limitation: linear notes saturate memory because they do not allow mental space to be freed up.

Difference between linear and non-linear notes.

- **Linear:** sequence or hierarchy (general → specific). They provide basic clarity but do not encourage deep connections.
- **Non-linear:** networks of meaning, cross-connections, multiple relationships → encourage deep thinking.

Dangers of superficial or AI-generated outlines

- They do not require personal effort to think and organize.
- They may be incomplete or overly simplified.
- They are often hierarchical and linear → they **do not represent deep connections**.
- Useful as a starting point, but insufficient for achieving mastery.

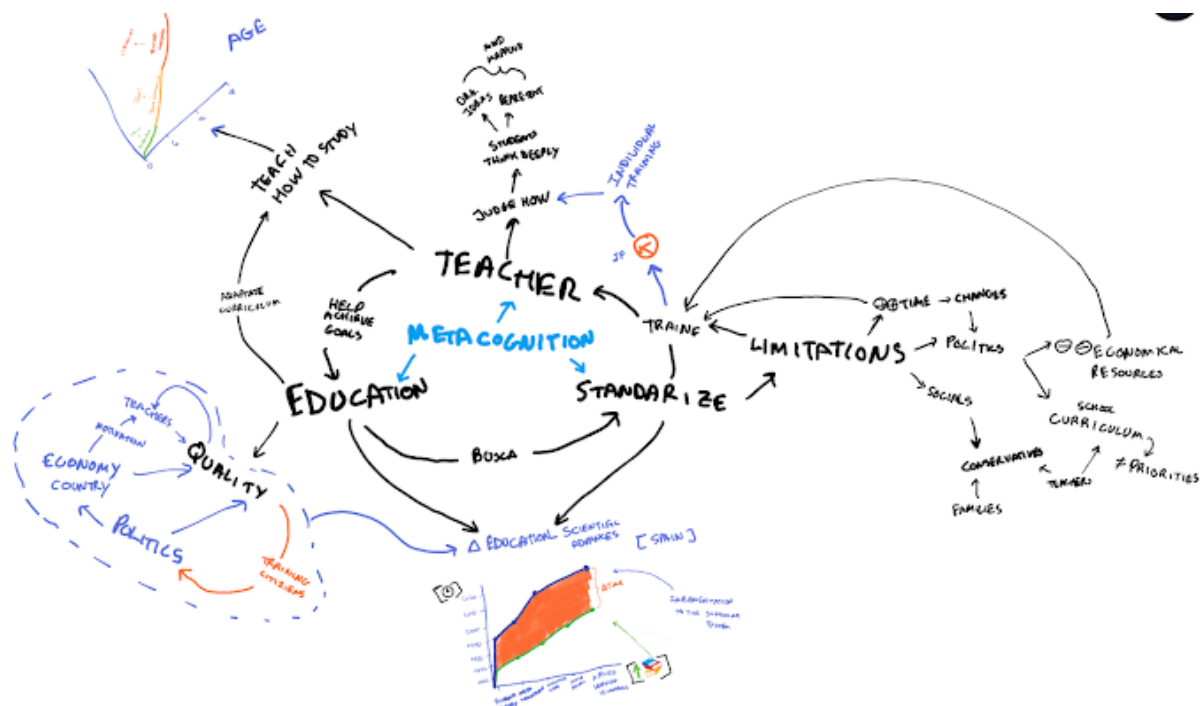
Conclusions

- Note-taking should be an active and meaningful process, not just copying.
 - Format is key: non-linear notes are what really promote deep learning.
 - Main tools: mind maps, concept maps, diagrams, timelines.
-

MIND MAPS

Imagine you want to get to a specific station in a big city. In a **linear diagram**, the route would be like a single **subway line**: you get on at station A, pass through B, C, D... until you reach Z. There are no alternatives; if you skip a stop or the train stops, **you lose track**.

In contrast, a **mind map** is like having the entire subway and bus map in front of you. You can reach the same destination by **different routes**, change lines at various points, or choose the route that best suits your needs: the fastest, the one that passes through familiar places, or the one that avoids too many transfers.



EN: Figure 10: Example of a mind map on metacognition.

This perfectly reflects what happens with **ideas**: the same conclusion can come from different paths, and at the same time, these paths can interconnect to generate new ways of thinking. Visually, a linear diagram is just a straight line with stations one after another, while a mind map is like a **complete transport network map**, with lines that **intersect, branch out, and connect**, and where each point can be both the origin and destination.

In this way, a mind map is a visual representation of how we organize and connect ideas, similar to a transport network map where each stop is a concept and the lines are the relationships that connect them. Unlike linear diagrams, which follow a single path, mind maps reflect the interconnectedness of our thinking: one concept can lead us to several others and generate new connections.

This process resembles that of our **mental schemas** according to **schema theory**: information is not stored in an orderly and rigid manner, but rather within networks of pre-existing knowledge that **expand** and **interconnect**. Thus, a mind map is not only a tool for organizing information, but also an **external mirror** of how the brain integrates new ideas

with those we already have, creating a flexible system that is open to new paths of understanding.

WHY DON'T WE USUALLY MAKE MIND MAPS?

If mind maps are really as useful as many studies have shown, why are they so rarely used? Why, when we hear them mentioned, do they often seem complicated, unhelpful, or simply a waste of time?

1. Lack of awareness

Most of us **have never heard about them in depth**. Perhaps they have been mentioned briefly in class, or we have seen a superficial example in a book or on a website, but we have never been explained **what they really are** or **how they can help us**. And if no one has taught us properly, it is very difficult for us to even have the curiosity or motivation to try them. Without stimulus, there is no action.

Now, even if we have been taught how to do them, perhaps the explanation was very superficial or even incorrect. This happens because, as we explained earlier, many people make mind maps in a very linear way: they only organize information hierarchically, as if it were a diagram with pretty lines. There are no connections between ideas, no reflection, no depth. The result is visually appealing, but very superficial. These are usually easy to make and, as we have already seen, that does not help us much. In this way, we often do not get the results we expected, but instead end up demotivated. Even for the person who taught us, it worked, but the results were based solely on their intelligence and ability to process information, not necessarily on the technique.

Now... what if they explain it to us correctly? Even when someone explains it to us correctly—as may be the case with this manual—there are still **deep barriers**. Because making a **quality mind map** is **not** a **mechanical technique**, but a complex skill that requires **mastering the basics of metacognition** (basically the theory I explain in the manual). It is necessary to understand how we organize our thinking, how we make it conscious, how we construct meaning from information. And that requires **time, practice, and patience**.

2. Old habits

Furthermore, **it goes against our most ingrained habits**. We are used to studying sequentially, linearly, following classic outlines or reading and underlining. In addition, when we summarize or represent information in a different way, we feel that **we are leaving out important things** or **simplifying too much**, and that makes us afraid of losing information.

Creating a well-designed mind map **is a completely different way of thinking**, and that can cause us **to feel confused, afraid of failure, or afraid of doing it wrong**. Since there is no 100% objective way to do it, even though there are quality criteria (which I will explain later), **we feel insecure**: and in the face of uncertainty, we often prefer to return to old methods, which at least gave us an **illusion** of **control** and **results**.

3. Effort ≠ results

And finally, there is a very human reason: **we put in a lot of effort and don't see immediate results**. Making a well-crafted mind map can take time. And the benefits are not always apparent right away, because **it is a skill that develops with practice**, like playing an instrument, writing well, or even learning to speak a language. The first few times we try, even if we put in a lot of effort, we won't see very obvious results. These usually appear with constant practice. Trying to improve our methods is an investment of time that will eventually allow us to progress. If we only do it once and don't get great results, it's easy to feel frustrated, think that "it doesn't work for me," and go back to our old methods.

4. Perfectionism

But this is where we must remember something essential: **the value of mind maps does not lie in making them perfect, but in learning to think better while we create them**. It is not the final drawing that matters, but the process of constructing it: reflecting, relating, connecting. And this process, although it does not always produce immediate results, **is one of the most powerful ways to truly learn**. Therefore, copying a ready-made outline will not bring us many benefits, as we would not even know how to justify why it is structured that way.

HOW TO MAKE A GOOD MIND MAP?

You're probably wondering: *how can I create something that seems as complex as a mind map?*

The truth is that there are many types of mind maps, but not all of them are effective. Some are only linear and therefore do not take advantage of their real potential. Although mind maps are very personal and can vary greatly in the way they are made, a mind map that helps us think efficiently meets a number of requirements. These requirements, together, form the acronym "**GRINDE**." Each letter comes from English and reminds us of an essential principle:

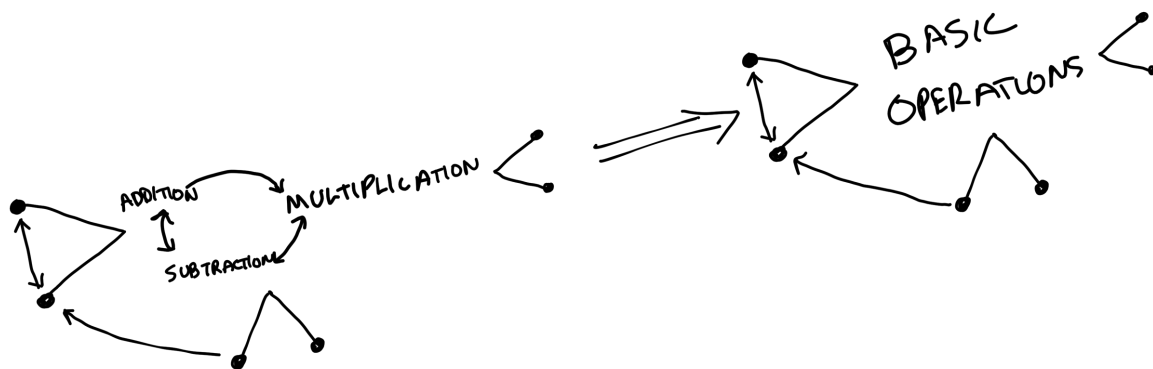
- **G – Grouped**: ideas should be organized into clear and related groups.
- **R – Reflective**: the map should encourage thinking and reflection on connections.
- **I – Interconnected**: each idea should be linked to the others, forming a network of meaning.
- **N – Non-verbal**: images, symbols, and colors should be incorporated to reinforce ideas beyond words.
- **D – Directional**: ideas should have a meaning and a hierarchy that guides the reader.
- **E – Emphasized**: the most important elements should be visually highlighted (colors, shapes, sizes).

G → Grouped

As we saw in the section on **working memory**, it is easier to process and retain information when it is **grouped together** than when it is scattered across many individual pieces. Therefore, when creating a mind map, it is necessary to analyze all the elements we want to include and ensure that those that are **similar** are grouped together, both **in space** and in meaning.

This grouping can be done in two main ways. The first is **spatial**, placing related information close together within the map. The second is through **conceptual reduction**: grouping several closely related terms into a more global and representative one, a process called *chunking*.

For example, if we have written the words "addition," "subtraction," and "multiplication," we can replace them with a single concept such as "basic operations." In this way, we achieve a kind of "linguistic economy" that allows us to think about the three elements at once without losing meaning.



EN: Figure 11: Representation of the grouping of the concepts “Addition”, “Subtraction” and “Multiplication” into a more general concept: “Basic operations”.

This technique is especially useful when **we reorganize** our mind map to make it **clearer** and improve the quality of our thinking. However, applying it is not always easy, especially when combined with the **synthesis of information**. We often feel that if we summarize too much, we are "losing" important information that we will not remember later.

What we need to keep in mind is that, in general, what we have reduced or eliminated can be consulted again in other sources, such as books or the internet. In a mind map, the goal is not to save everything, but to achieve the **maximum possible understanding** of the topic. This confidence in grouping and reducing concepts develops with time and practice, and is essential for creating truly useful mind maps.

R → Reflective

As the very definition of a mind map indicates, the outline we create should always be a **reflection** of our own understanding. In other words, what we write and organize should be

similar to how we think about and understand the topic while we study. The quality of our learning will depend directly on how well we manage to make the map a true reflection of what we understand.

To achieve this, we can take a few steps:

- **Organize the outline in the order and form that makes the most sense to us:** This means that we can follow the order used in the book or by the teacher, or change it if we believe that another order is clearer and facilitates a better understanding of the topic.
- **Use concepts and words that are familiar and meaningful to us:** Although when we study theory it is often necessary to be rigorous and remember the exact names of the concepts provided in the book, when it comes to understanding complex topics in depth, it is very useful to replace the most difficult or technical terms with words that are closer to us and loaded with meaning. This greatly aids memory and the learning process, because we use language that better connects us with what we are thinking.

For example, here are some equivalents that can facilitate understanding in different areas:

Learning

- Working memory → Tablet / Space where we work
- Long-term memory → Storage / Archive
- Selective attention → Focus / Light
- Prior knowledge → Base / Starting point
- Metacognition → Mirror / Control
- Cognitive load → Amount of thinking
- Cognitive effort → Effort to think

Language / Communication

- Omniscient narrator → God / The one who knows everything
- Textual coherence → Thread / Logic
- Specific lexicon → Vocabulary / Keywords
- Formal register → Seriousness

Science / Physics

- Inertia → Laziness / Resistance to movement
- Acceleration → Thrust / Change
- Friction → Brake / Resistance
- Gravity → Weight

Mathematics

- Function → Machine
- Derivative → Change / Slope

- Integral → Total / Accumulation
- Variable → Changing
- Parameter → Factor
- Equation → Formula / Equality

This technique of replacing complex concepts with words or images that are easier and clearer for us to understand is a powerful tool for making mind maps truly useful and reflective of how we actually think.

I → Interconnectivity

Interconnectivity means that the different parts of a mind map are connected to each other. It is not just a list or notes in a row, but rather information from different categories or topics that are related and intertwined. This idea stems from the basic way of **breaking down information**: we take a large concept and divide it into smaller parts, but these parts are not isolated; rather, they are interrelated.

This connection between ideas is the main feature of **mind maps** and, in general, of **non-linear** notes. It is also one of the key points that helps us think **deeply** about a topic, because it forces us to look for how different ideas come together and influence each other.

The problem is that, often, when we take notes or make maps, we only connect what is very obvious. For example, if we see "water," we directly connect "blue." But that doesn't make us think much or strain our minds. We only really increase our **understanding or mastery** of a topic when **we try to find connections** that are **not** so obvious at first glance, when we look for relationships that do not come to us automatically, but rather actively seek them out.

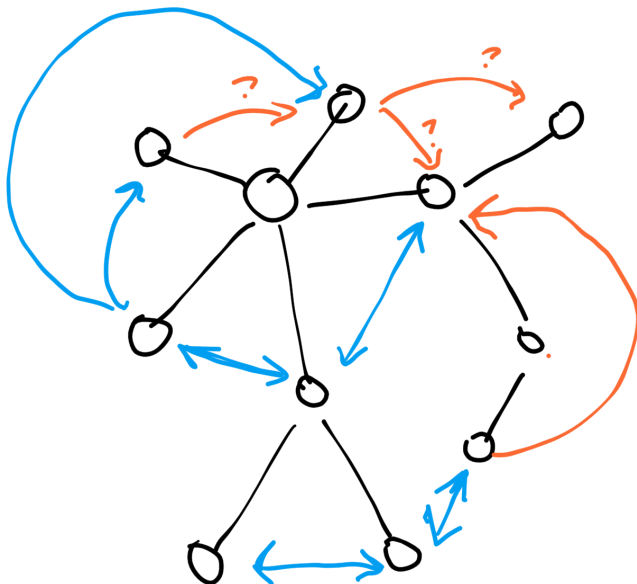


Figure 12: The image represents an interconnected mind map. The blue arrows represent meaningful (non-obvious) connections, the black lines are decomposition

relations (General term → its derivatives), and the red arrows are attempts to find new relationships between the concepts.

This effort, when we finally find an unexpected connection or a new similarity, is when **we** really **learn**. Often, in those moments, we feel a kind of surprise or joy, thinking, "How did I never see that before?"

Here are some examples:

- **Rain and mood:** At first glance, rain and mood seem unrelated. But if we think about it, rain can influence our mood, making us feel calmer or, conversely, sadder. This connection is not immediate, but it is real and helps us understand how our environment affects our feelings.
- **Sport and memory:** It may not seem obvious that playing sports can influence memory, but physical activity improves blood circulation and oxygenation of the brain, which makes it easier to learn and remember things better.
- **Cooking and math:** At first glance, cooking and math are different activities, but when we cook, we have to measure ingredients, calculate times, and adjust proportions; this is applying math in everyday life.

Doing this consistently while creating a mind map helps us develop the ability to **analyze** and compare information. And with practice, this becomes less difficult and almost automatic. What was once unclear gradually becomes intuitive and natural.

It is important to understand that **learning** is not just memorizing or making superficial connections; this **deep interconnection** is the essential pillar of mind maps. The other techniques we use to build maps only serve to facilitate interconnection: making them **clearer, more orderly, and faster**.

When we find relationships that we didn't see before, we are giving more importance and **relevance** to the information we learn. And that is precisely what makes us remember better and truly learn, as I explained in the first part on "Why and how do we learn new information?"

One of the most common problems when mind maps don't work is that they lack this **interconnectivity**. When notes are too **linear**, with no connections between different ideas, deep learning becomes difficult.

N → Nonverbal

The **importance** of summarizing content in **keywords** and using **symbolism** lies in avoiding adding unnecessary elements that do not add **meaning** or **clarity** to our mind map. Although we talk about "nonverbal," this does not mean completely eliminating words, but rather including the **synthesis of words** as an essential process, since we normally work with keywords that condense information.

As we saw in the reflective section, when we group ideas into a single word or look for synonyms that are closer to us, we are using forms of symbolism. This means that we want to convey **meaning** in different ways: not only with complete sentences, but also with

keywords, drawings that represent a process or concepts, or the geographical location within the map that helps to better understand the relationship between the elements.

SYMBOLISM

Symbolism is a process in which we replace groups of words or ideas with symbols, abbreviations, or graphic elements that represent their meaning in a **faster**, more **compact**, and **visual** way. This substitution is not literal, but requires understanding what lies behind these symbols or shapes. It serves to give **indirect meaning** to figures, words, or elements that do not always mean exactly what they represent, but convey ideas without the need to write complete sentences.

For example, think of **traffic signs**: just by seeing a symbol, such as a red triangle or a blue circle with an arrow, we understand commands or warnings without having to read any long sentences.

This process is very **personal**, as each person can give different meanings to the same symbol or figure. This is a great advantage of mind maps: they are completely customizable and depend on the creativity of the person making them. Thus, we can create mind maps in many different ways, and the act of choosing how to represent each idea is, in itself, a process of deep thought, since we evaluate which form best expresses how we think and what we find most understandable.



Figure 13: Image representing proposed symbols to help represent ideas non-verbally. They are divided into four groups, each with its own meaning.

Although the symbols we use depend on each person, the image above proposes some general and more commonly used symbols that can help us in our process of using nonverbal language. Group 1 shows intensifying symbols, such as the star for importance, the upward arrow for increase, and the downward arrow for reduction. The figures with circles follow the same logic. The + means more, ++ means much more, and +++ means too much. The - means less, -- means much less, and --- means very little.

In group 2, we find equalities (=) and inequalities ($\neq$). In addition, in the group of union symbols, such as parentheses "()", "[]", "{}", etc., we can join different elements, as in a sum, with a normal +, or a - to make exceptions (Example: all people - over 70).

Finally, we have the causative symbols, which indicate the consequence of an action, and the arrow pointing in both directions when the elements are mutually related.

Doing this helps **working memory** because it's based on reducing words and grouping information (as explained above), using small graphic symbols, and also giving meaning to the information through **spatial positioning** on the page. This combination makes it easier for our brain to process information more clearly and efficiently.

D → Directionality

Directionality is a key concept for bringing clarity to our mind map. It consists of organizing information in such a way that the reader can easily follow the **flow** of ideas, from the most **general** to the most **specific** concepts, or by following an established **logical order** (temporal, causal, process, etc.).

This is one of the most difficult requirements to apply because it involves not only placing concepts on the page, but also reflecting on how they **interconnect** to avoid confusion. It requires constant reorganization and restructuring until the flow of ideas is **fluid** and **natural**.

Generally, this effect is created with **arrows** or lines connecting the elements. The challenge is to avoid an excess of cross-connections: if too many arrows intersect, the map becomes a chaotic web where it is difficult to identify which **path** to follow. This diminishes the map's comprehensibility and usefulness.

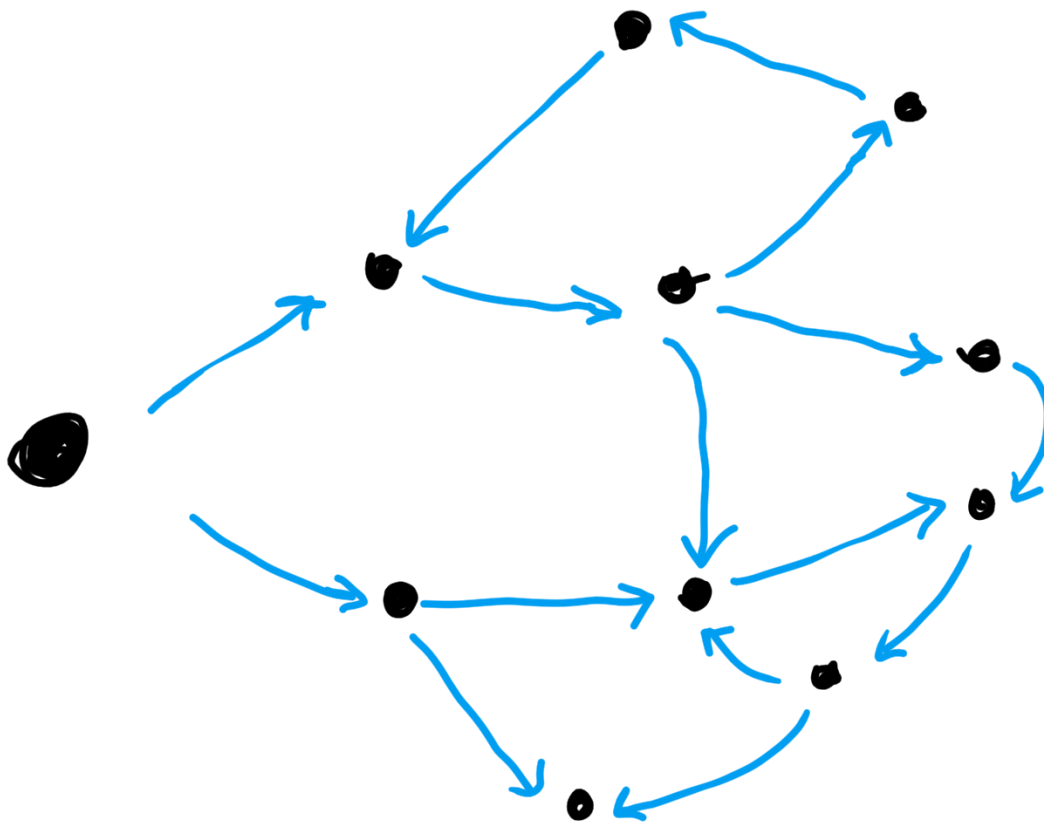


Figure 14: Illustration clearly representing the flow between different concepts.

Directionality also involves establishing a clear visual **hierarchy**: some concepts are more **important** than others, and this should be reflected in the size, color, or position of the elements as well as in the way they are connected. When the hierarchy and flow are well defined, the reader can "navigate" the map as if reading a well-structured text, without getting lost.

We will address this process of hierarchical construction and optimal connections in more depth later, in the section on *Layers*, where we will look at specific techniques for **prioritizing** information and defining clear reading paths.

E → Emphasized

Emphasizing a mind map means that the **most relevant** parts of the content are visually highlighted. This is achieved by **making** the connections or elements that are **fundamental** to understanding a concept **thicker**, more vividly colored, or using other visual resources that differentiate them from the rest.

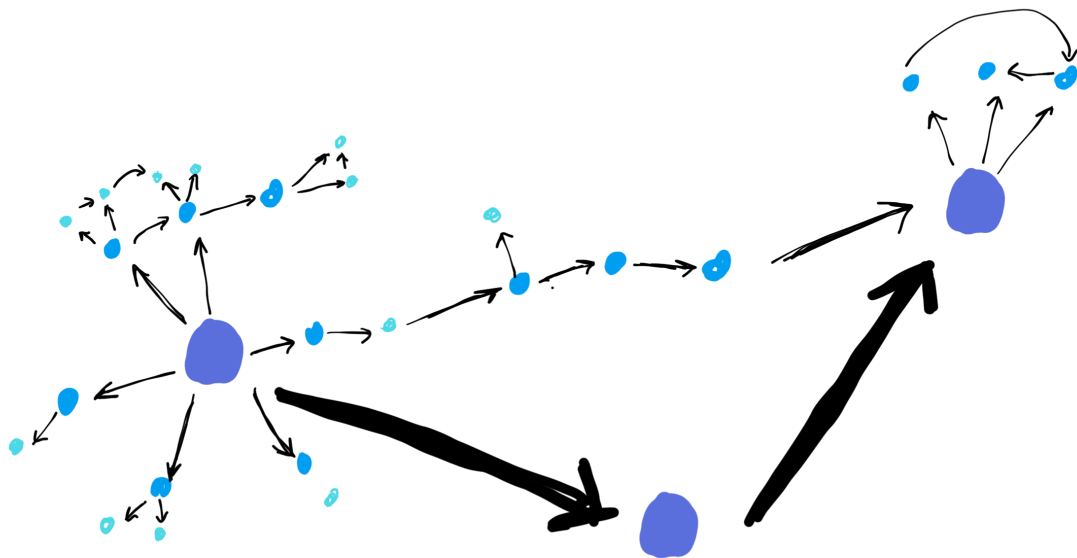


Figure 15: Illustration representing a mind map with emphasized parts.

This technique acts as a **visual guide** for the brain: at a glance, it allows us to identify which parts deserve more attention. Emphasis is also an extension of **hierarchy**, but in a more immediate and obvious way.

Directionality and emphasis complement each other, since in order to mark a good flow of ideas, it is often necessary to visually highlight the key points that support it. Without emphasis, it is easy for all connections to seem equally important, which can lead to **confusion** or **cognitive overload**.

On a practical level, emphasis improves **information retention**, reduces search time within the map, and helps us quickly retrieve the main ideas, even after some time has passed.

Where can we make mind maps?

We can create a **mind map** on virtually any medium: a **sheet of paper**, a **notebook**, a **whiteboard**, or even directly **on the floor** if necessary.

It is true that **digital devices** can offer **additional features**. For example, some tablet applications allow you to work with **infinite sheets**, where the only limit is your imagination. These digital tools make it much easier **to restructure elements**, as they can be selected, modified, and reorganized quickly without having to start over.

However, **this is not essential**. The real key to a mind map is the **mental process** behind it. It doesn't matter whether we work on **A4**, larger **A3**, or any other surface: the important thing is **to think clearly** and **remain consistent**.

The physical or digital medium may influence **comfort**, but **it does not determine the quality of thought**. As I have said on other occasions, **it is not so much what we do with our hands**, but **how we structure ideas** in our heads.

Although the digital format offers **practical advantages**, **we should not limit ourselves** exclusively to it.

DIFFERENT LEVELS OF MIND MAPS

To recognize our **level of skill** in note-taking, we will classify notes according to their **degree of effectiveness**. This will help us understand **what we are doing** and **how we can improve**, using **critical thinking** to "level up."

LEVEL 0

This is the level where most people find themselves. Taking completely **linear** notes, like a text, with an excess of **information** (prepositions, connectors, etc.). This is what we most often find in **high schools** or **universities**.

These notes have a number of characteristics:

- Too **linear** (we may find small drawings to connect ideas, but this is not the main focus).
- Too many **words**, it looks like continuous text.
- They are **superficial** notes that do not address relationships between concepts. We do not use **deep thinking**, and sometimes not even superficial thinking, to produce them. They can be copied passively and are **easy** to make, as they require no mental effort.
- We usually make them to **study** later, not to **learn** at the moment.
- They may have some **notes** in the margins and **underlined** information.
- They take **a long time** to make.

Level 0.5

This is an **intermediate** point between **linear** and **non-linear** notes. At this level, there are two small **gradual transitions**.

Level 0.5.1

To begin the **transition**, it is important to get into the **habit** of **summarizing** what we write:

- Do not copy **word for word**.
- **Simplify** the information.
- Use **bullet points** and **keywords**.
- Write as a **list of ideas**.

Here is an example using the requirements for creating a mind map as a basis:

"G → Grouped

- It is easier to remember grouped information than scattered information.
- We can group in two ways: spatially (placing related elements together) and conceptually (chunking: reducing several terms into a more general concept).
- Example: "addition, subtraction, multiplication" → "Basic operations."
- This technique helps to clarify and organize thinking, but it can generate a fear of losing information.
- The purpose of a mind map is not to store everything, but to achieve maximum understanding.

R → Reflective

- The mind map should be a reflection of our own understanding.
- It should be organized in the order that makes the most sense to us (not necessarily the order in the book).
- We can replace complex technical terms with familiar words that facilitate memory and learning.
- Examples of equivalents:
 - Working memory → "tablet"
 - Derivative → "slope"
 - Omniscient narrator → "God"

I → Interconnectivity

- The parts of a mind map should be connected to each other, not just a list.

- We learn better when we look for connections that are not obvious (rain ↔ mood, sports ↔ memory, cooking ↔ math).
- Deep connections are what promote real learning.
- Without connections, mind maps lose their usefulness.

N → Nonverbal

- This consists of reducing information to keywords and symbols, avoiding long sentences.
- Symbolism can be graphic (drawings, icons) or verbal (abbreviations, keywords).
- Symbols are personal and allow you to customize your mind map.
- This method improves memory and facilitates clarity.

D → Directionality

- The map must have a clear flow: from general to specific ideas or according to a logical order (causal, temporal, etc.).
- Arrows and lines are used to guide the path, but chaos due to excessive connections must be avoided.
- Visual hierarchy (size, color, position) helps to establish order and clarity.

E → Emphasis

- This consists of visually highlighting the most important points.
- It serves as an immediate visual guide to know where to focus attention.
- It complements directionality and facilitates retention and speed of consultation.

Level 0.5.2

Here we begin to use **symbolism** and **organize** ideas in space in a **meaningful** way.

- We take **lists of keywords** and short phrases and **relate** them to each other.
- We reduce words that do not contribute meaning (prepositions, connectors, etc.).
- In addition to the copied information, we add **our own comments** and **conclusions** as a result of reflecting on these relationships.

Here is an example of the requirements for a good mind map:

"G → Grouped

- Grouping information = greater understanding.
- [Chunking] = reduce + group terms.
- Example: addition + subtraction + multiplication → [Basic operations].
 - Clarifies and organizes thinking.
- – May give the impression of information loss (but can be consulted in external sources).

R → Reflective

- The map should be a personal reflection → organize according to your own logic.
- It is not necessary to follow the order of the book → better if it is meaningful to us.
- Replace technical terms → familiar words:
 - Working memory = tablet
 - Derivative = slope
 - Omniscient narrator = God

I → Interconnectivity

- Map ≠ list → needs connections.
- Deep learning → connections that are not obvious.
- Examples of relationships:
 - rain → mood
 - sports → memory
 - cooking → math
- No connections → superficial map.

N → Nonverbal

- Reduction to [keywords] + [symbols].
- Avoid long sentences/connectors.
- Symbolism can be graphic or verbal (abbreviations, icons).
- Symbolism = personal and creative → improves retention and clarity.
- Example: traffic signs = instant message.

D → Directionality

- A clear flow is required: [general → specific] / [cause → consequence].
- Use arrows and lines → guide the reader.
- Avoid excessive connections → chaos.
- Visual hierarchy = size / color / position.

E → Emphasized

- Key elements should stand out → bright colors, thickness, size.
- Function = immediate visual guide.
- Complements directionality.
- Result → better retention + quick reference.

LEVEL 1

At this level, we begin to think a little more about the information we collect. We don't just copy or make lists, we try **to understand** what we write, even if it's only in a basic or superficial way.

The main characteristics are:

- We do away with total **linearity**: now we use the **space** on the page to give **meaning** to the way we organize ideas.
- We write very few words, only **keywords** grouped in different areas of the paper.
- We use more **symbolism**: we use symbols, arrows, and organize information to show relationships and hierarchies.
- Arrows and connections between ideas can be of two types:
 - The most **obvious**, which simply break down a large concept into smaller parts (for example, "energy" divided into "thermal energy," "wind energy," etc.).
 - The less obvious ones, which appear when we think deeply and discover new connections between concepts that we had not seen before.
- Often, these connections are poorly organized, overly intertwined, and can make the mind map difficult to understand. Therefore, clarity and order are still lacking.
- Most of the connections come from breaking down broader ideas, but we still do not connect as much between different concepts.

However, at this level, we do not yet reap the full benefits of deep thinking, as the lack of organization hinders in-depth analysis. Nevertheless, it is a necessary stage in order to evolve.

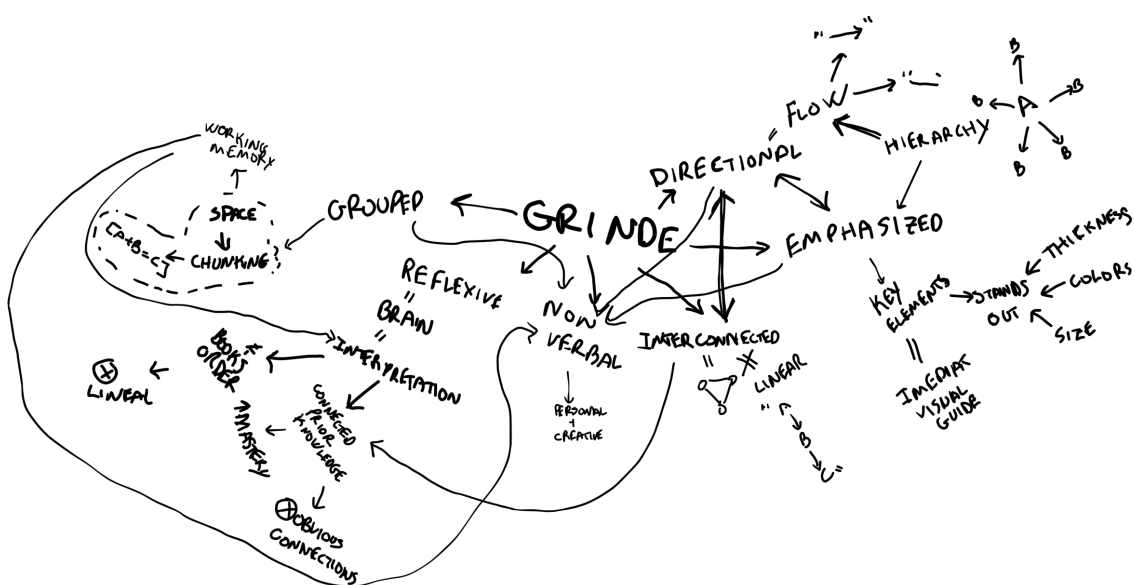


Figure 16: Example of a level 1 mind map on GRINDE requirements in English.

How to reach level 1

To move from level 0.5.2 to level 1, it is necessary to change the way you take notes:

- **Greatly reduce the words** we use, writing only the essentials.
- Break down the information into **smaller, more manageable blocks**, or divide large concepts into specific parts.
- Use more **symbols**: arrows to show causes, effects, or relationships; signs that intensify an idea (such as "+" to mean "more"); parentheses to link elements; and use space to indicate, for example, time or cause and effect.
- **Actively seek connections between concepts**, especially those that are not immediately obvious. Try to find new relationships and establish real interconnectivity.

As we do this, we become accustomed to thinking more actively while taking notes and organizing ideas better, preparing ourselves to reach a deeper level.

LEVEL 2

At this level, we are already beginning to experience many of the benefits of deep thinking that mind maps provide. We are already very accustomed to using **symbolism** to avoid writing too many words, as we find it impractical and a waste of time. We know that we can express the same thing with much less effort and in less space.

The main characteristics of this level are:

- The maps are **much clearer and more visual**, with a structure that allows us to easily see the **flow** of information. There are no excessive crossing arrows, which helps us to orient ourselves.
- The predominant thinking is **analysis**: we actively seek **less obvious** connections between concepts and want the information to be interconnected.
- We naturally group similar concepts together, forming small groups of words that, when we want greater clarity, we summarize in a general word (for example, "addition," "subtraction," and "multiplication" can be grouped under "basic operations").
- We significantly improve our **working memory** thanks to the clarity of the map, which facilitates the retention and manipulation of information.

- We begin to visualize a clear **hierarchy** in the information: we can distinguish which concepts are more important or general and which are more specific.

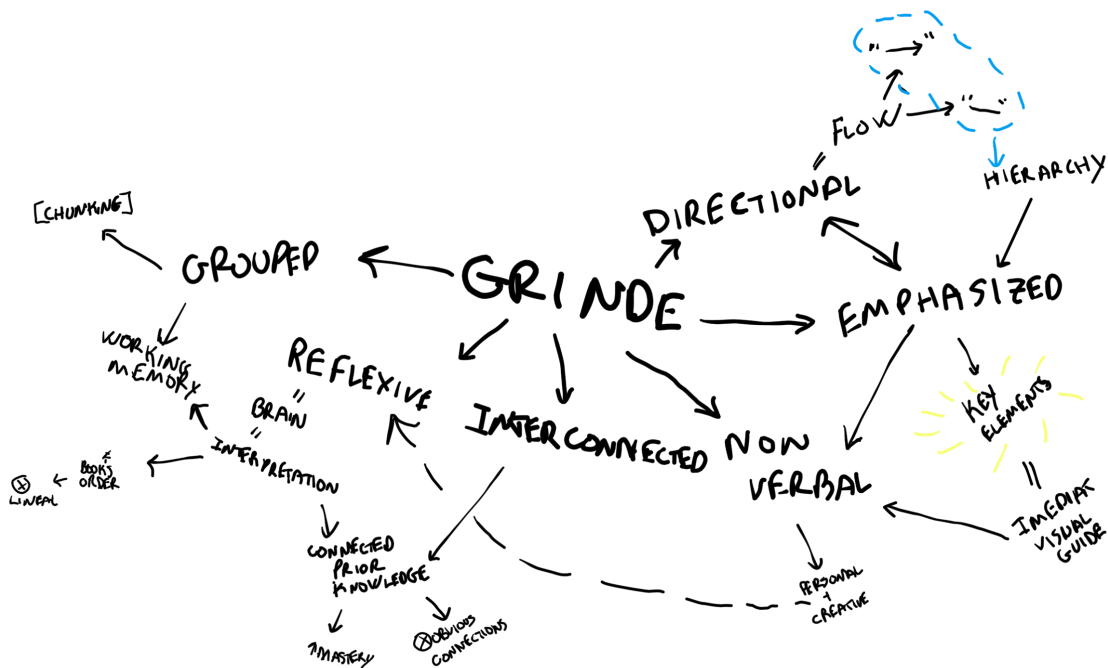


Figure 17: Example of a Level 2 mind map on GRINDE requirements in English.

How to reach level 2

To reach this level, it is necessary to:

- Analyze information more actively and quickly group similar concepts.
- Think more consciously about how to distribute groups of information in space, so that it is coherent and easy to understand.
- Prioritize **clarity** in the structure of the maps, avoiding arrows crossing or causing confusion.
- Above all, **repeat** and **review** mind maps very often, redoing them with a clearer and more orderly structure once we observe that our mind map is not clear enough and we detect a defined flow. This may require **more time** and **effort**, especially on paper, but it considerably improves understanding and mastery of the subject.

LEVEL 3

Reaching this level means completely mastering the use of mind maps as your primary tool for thinking and learning. At this point, you have a clear understanding of metacognition, that is, the ability to observe and manage your own learning and thinking process.

A level 3 mind map meets all the important requirements: it is **grouped**, **reflective**, **interconnected**, uses symbols and keywords (**nonverbal**), has a **clear directionality**, and is **emphasized** to show what is most important.

This level is not achieved overnight, but requires **conscious and constant practice**, like any skill we want to perfect (e.g., writing well or playing a sport).

The main characteristics of a level 3 mind map are:

- **Evaluation:** This is the key part. Not only do you understand and organize the information, but you also evaluate and choose what is best or most important according to your goal and understanding.
- **The flow** of information is **clearly** visible, following a logical and easy-to-follow path.
- The map is **very visual and intuitive**, with a clear hierarchy showing what is essential and what is secondary.
- The information is highly **grouped and simplified**, allowing you to clearly express your overall understanding of the topic.
- Each position and connection on the map has a **unique and essential meaning** to accurately represent how you understand the topic.
- The outline closely reflects the **actual mental** structure you have created of the topic by constructing the map.

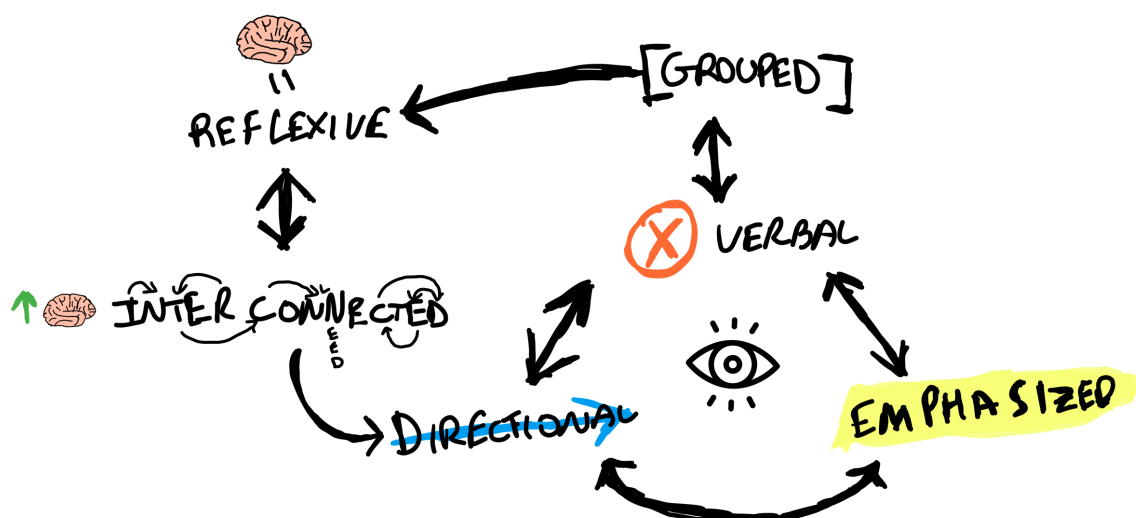


Figure 18: Example of a Level 3 mind map on GRINDE requirements in English.

How to reach level 3

- Get into the habit of **continuously restructuring your mind map**, always improving the way you group and organize information.
- Improve the quality of the connections and always think about the **intention of each element** you add to the map.
- Be **critical of what you do**: learn to evaluate your ideas, think of different ways to present the same information, and choose the one that best suits your way of understanding.
- Unlike level 2, where you usually find a single appropriate way to organize information, at level 3 you must be able to generate **several structural options and select the best one**.

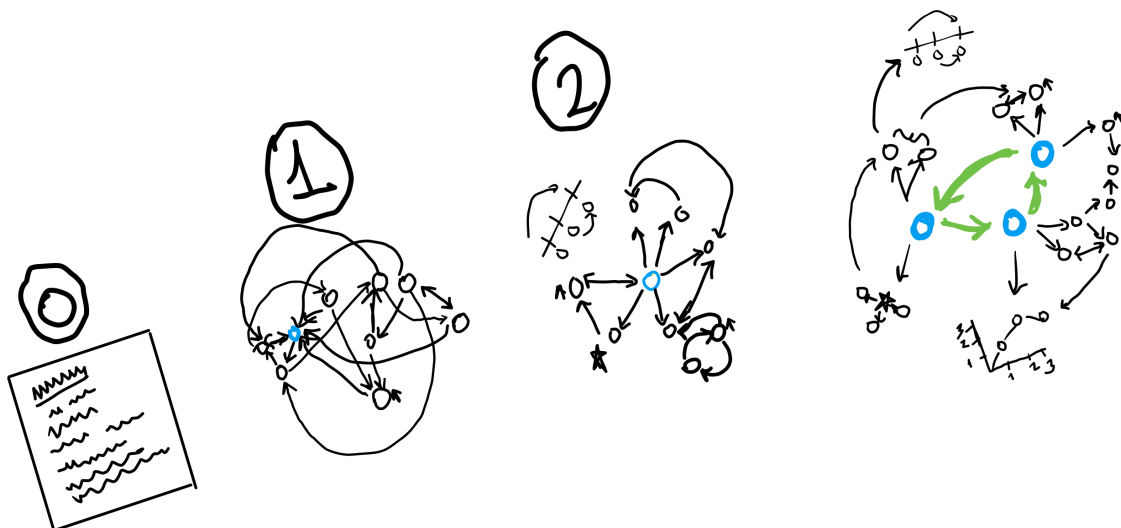


Figure 19: Image intended to represent and compare the structure of the different levels of mind maps, with their main visual differences.

In conclusion, to reach this level, it is not enough to find a **single clear and meaningful way to organize information**. What really moves you forward is being able to **think of different ways to structure the same topic**, evaluate each one, and choose the one that **best expresses your understanding** and has **the most meaning for you**.

This involves an **active** and **critical** process, in which you do not settle for the first option, but rather seek alternatives, compare them, and decide on the best way to present and understand the information. This ability to generate and evaluate different structures is one of the keys that differentiates level 3 from the previous levels.

AND AS A TEACHER... HOW CAN WE EVALUATE MIND MAPS?

Evaluating a mind map is not as simple as correcting a traditional exam. It is not a question of seeing whether a student has answered correctly or incorrectly, but of analyzing **how they have organized and understood the information**. A mind map is a personal representation of knowledge; therefore, each student can construct it in a different way. What may seem chaotic to the teacher may actually be the most meaningful and intuitive way for that student to understand the subject.

Therefore, the assessment should not focus on whether the map matches what the teacher would do, but rather on whether the student is able to **justify** their organization: why have they connected two concepts in this way? What do they want to express with the visual relationship they have chosen? Why have they placed one concept as the central idea and not another? This exercise in justification is as valuable as the map itself, because it forces the student to become aware of their mental processes and to make their understanding explicit.

A practical guide for evaluation can be based on the **GRINDE** criteria (Grouped, Reflective, Interconnected, Nonverbal, Directional, and Emphasized).

Based on these criteria, the teacher can offer more constructive feedback. For example:

- If the groups are unclear, you can suggest reorganizing them into more coherent categories.
- If reflection is lacking, you can ask the student to explain in their own words why they have connected the concepts in that way.
- If there are no connections, you can encourage them to look for new relationships between the parts of the map.
- If emphasis is lacking, they can suggest visual techniques to make key ideas stand out more.

Ultimately, one thing is certain: thinking so much and creating such complex mind maps tires us out mentally, as we are making a great **mental effort**. Therefore, in order to use mind maps effectively and without collapsing from mental exhaustion, we will now take a closer look at what **cognitive load** is.

ANSWER THE ACTIVITIES 5 and 6

SUMMARY

MIND MAPS – Schematic summary

Definition:

- Visual and non-linear representation of ideas

- Shows concepts as points and relationships as connections
- Reflects the organization and interconnection inherent in thought

Function:

- Organize information
- Promote understanding, memory, and critical thinking
- Make connections and alternative paths to conclusions visible

Characteristics:

- Not sequential, unlike linear diagrams
- Flexible, open, and customizable
- They function as a mirror of thought according to schema theory: interconnected knowledge networks

Why don't we make mind maps regularly?

- **Lack of awareness:** little real training on what they are and how they work
- **Superficial explanations:** many people make them as disguised linear diagrams
- **Old habits:** we prefer sequential methods (underlining, copying notes)
- **≠ effort and immediate results:** they require constant practice
- **Fear and perfectionism:** insecurity in the absence of a "single method"

Quality criteria (GRINDE):

- **G – Grouped:** organize into clear groups, perform chunking
- **R – Reflective:** the map should be a reflection of one's own thinking; use familiar words
- **I – Interconnected:** establish connections between ideas, especially those that are not obvious
- **N – Non-verbal:** use keywords, symbols, images, and colors (symbolism)
- **D – Directional:** clear flow, hierarchy, and logical path with arrows/structures
- **E – Emphasized:** visually highlight the most relevant information with color, size, or thickness

Symbolism

- Replace words or ideas with symbols, icons, or images
- Personal and flexible, facilitates memory and understanding

Levels of mind maps

- Level 0: linear notes, too many words, no connections
- Level 0.5:
 - 0.5.1 Simplification and use of bulleted lists
 - 0.5.2 Beginning use of symbolism and simple connections
- Level 1: use of space to organize, keywords, symbols, and basic connections (especially obvious ones), little order

- **Level 2:** clearer and more visual maps, natural grouping, analytical connections, visible hierarchy.
- **Level 3:** complete mastery, integrated use of GRINDE, reflection of mental structure, capacity for critical evaluation and reorganization.

Support and tools:

- Can be done on paper, whiteboard, or digitally.
- The value lies not in the format, but in the process of thinking and organizing ideas.

Mind map assessment:

- It is not about correct answers, but about assessing organization and understanding.
 - It is necessary to request justification for the connections.
 - Assessment criteria: GRINDE (grouping, reflection, connections, symbolism, directionality, emphasis).
-

COGNITIVE LOAD

Have you ever found yourself in this situation?

You've been studying for a while. You've been very focused. You've made outlines, you've tried hard to understand the subject matter... but after an hour, you start to notice that **it's harder to retain the information, your mind wanders, everything seems more difficult**. And yet, you continue studying for another two or three hours.

But in reality, the last few hours **have not been very useful**. You've kept looking at the book, yes... but you haven't taken in much. What exactly happened?

What you have experienced is an example of **high cognitive load**. When we study or think intensely, the brain makes a real effort, as if it were lifting weights. This effort is what we call **cognitive effort** (*thinking effort*), and **cognitive load** (*thinking load*) is the amount of mental effort required for a specific task at a given moment.

Imagine that your brain is like a **rechargeable battery**.

- If you study very intensely, the battery will drain quickly.
- If you prolong the effort too long without taking breaks, the system **overheats**, like an engine that runs too long without stopping.
- But if you don't use the battery enough—if you study passively, just reading or copying without thinking too **much—it stays full... but it's useless**.

And here's a very common mistake: **thinking that not feeling tired is a good sign**.

In reality, if you don't notice **any mental effort** after studying for a long time, **you're probably not really learning**.

This usually happens when we stay at the **lowest levels of thinking**, such as remembering literal information, understanding concepts superficially, or simply copying what we read.

On the other hand, when we start to really think **deeply—when we relate, apply, connect ideas, analyze, or evaluate**—that's when we notice that the **brain is working**. This is where **healthy mental fatigue** comes in, indicating that you are operating at **higher levels of thinking**, where solid and transferable learning is truly built.

This leads us to a key idea:

Without effort, there is no learning. But neither is there with excessive and continuous effort.

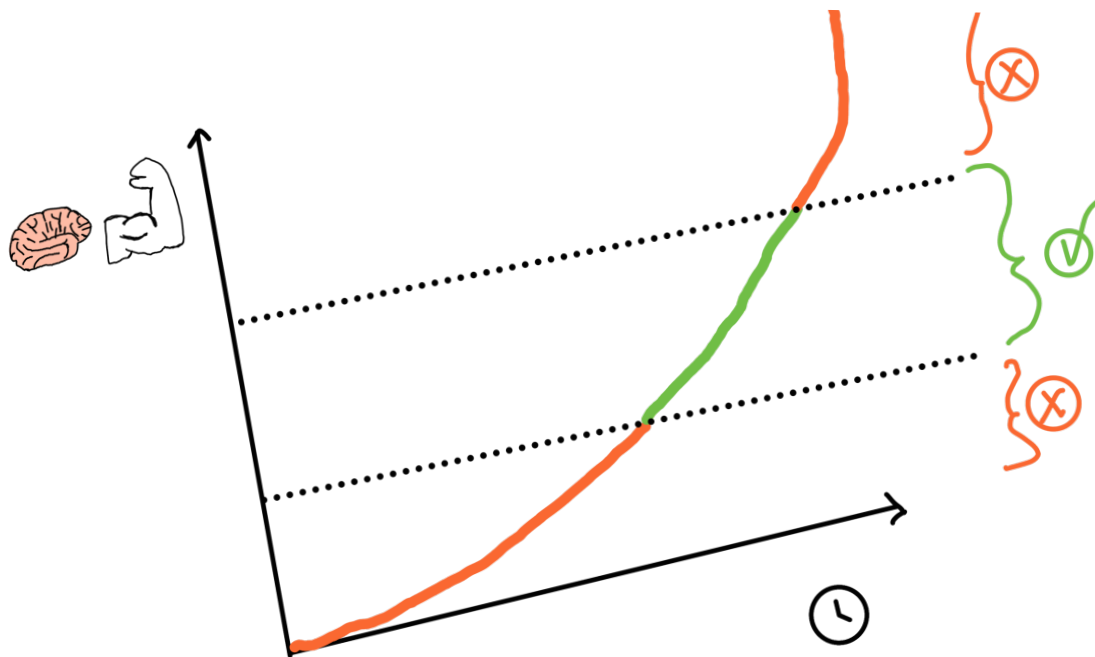


Figure 20: Graph representing the effectiveness of cognitive effort over time. This graph illustrates the idea that too little or too much effort is ineffective.

Not too much and not too little: **the key is balance.**

Many people study for hours on end, thinking that the more time they spend in front of their notes, the more they will learn. But the brain **doesn't work that way.**

Active studying involves concentration, analysis, connections, questions... and that **consumes a lot of mental energy.**

If we ignore fatigue and keep going, the brain **stops absorbing** information and we are just pretending to study.

But if we ever get tired—if we don't feel any effort—it's because **we're not really thinking deeply** about what we're reading or doing.

That's why it's essential **to regulate cognitive effort:** use enough to learn, but without becoming overwhelmed.

And... how can we **manage this effort?**

This is where two techniques for managing time and mental energy come into play: **Pomodoro** and **Fowmodoro.**

POMODORO

One of the best-known techniques among students who want to improve is the **Pomodoro** technique. And it's understandable: it's simple, concrete, and easy to start applying.

It consists of dividing study time into cycles of:

- **25 minutes of intense work**
- **5 minutes of short breaks**
- After 4 cycles, **a longer break** (15 to 30 minutes)

This structure helps you to start being consistent, overcome procrastination, and keep your brain active on a regular basis. Many people who did not have a routine have used it successfully to establish one.

But... where does this technique actually come from?

The Pomodoro Technique is not based on scientific research. It was created in the 1980s by an Italian named **Francesco Cirillo**, who used a tomato-shaped kitchen timer ("pomodoro") to divide his time while studying. It worked well for him, and years later he decided to structure this method and share it.

Since then, thousands of people have adopted it... but without a solid experimental basis. In other words, **it is not a scientific technique, but an empirical one**: it can work, but **it is not suitable for everyone**.

Limitations of the technique

Some people need more time to enter a state of deep concentration. It may take them 15 or 20 minutes just to connect with the task. And just when they start to get immersed... the timer goes off.

Others, however, can stay focused for an hour or more without any problems. Forcing yourself to take a break every 25 minutes **interrupts your natural state of productivity**.

In addition, some people experience these 25 minutes as a **race against time**. They set unrealistic goals for that period and put extra pressure on themselves to complete them within that time limit. When they fail, **they feel frustrated or like they have failed**, and that can fuel feelings of disappointment or anxiety.

What was supposed to be a tool to facilitate study can end up generating more stress if it is not used flexibly.

Therefore, although the Pomodoro Technique can be a **good starting point** for those seeking consistency, **it should not be considered a universal system**. If you find that it limits you, slows you down, or causes you distress, it is time to look for alternatives.

FOWMODORO

One of these alternatives is what we call **Fowmodoro**: a more flexible and intelligent way to regulate mental effort.

What is "flow"?

Flow is that state of deep concentration in which:

- You are totally connected to what you are doing.
- You are not easily distracted.
- Time seems to disappear.
- You feel motivated, immersed, and even enjoy the task.

It's like being **in the zone**: that moment when everything flows. It can happen when you're solving an interesting problem, writing clearly, reading an exciting book, or creating something that interests you.

For example: imagine you're playing a video game you love. You're focused, your whole mind is present, you make decisions quickly, and you don't notice time or hunger. When you study in *flow* mode, something very similar happens.

Taking advantage of this state is key to achieving better performance. And this is where the Fowmodoro comes in.

How does it work?

Instead of following a fixed structure, the Fowmodoro suggests the following:

1. Choose the task and **start working**, setting a timer or noting the time.
2. Work for **as long** as you can **maintain real concentration**.
3. When you notice that your attention is starting to wane—you are no longer in the same state of **concentration—stop and take a break**.
4. Calculate the length of the break based on how long you have been focused.

How do you calculate the break?

There is a rule of thumb: take a break proportional to the time you have been focused.

You can rest between $\frac{1}{5}$ and $\frac{1}{2}$ of the time you have spent studying. The fraction of time varies greatly depending on the person and the context. Therefore, start by resting $\frac{1}{5}$, and if you feel that this has not been enough to recover, increase to $\frac{1}{4}$, $\frac{1}{3}$, or even $\frac{1}{2}$.

For example:

Time worked	Recommended break	Fraction
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20 min	5 min	1/4
40 min	10 min	1/4
60 min	15–20 min	1/4–1/3
90 min	25–30 min	1/3 – 1/2

This ratio is flexible, because **everyone has a different pace**.

And... how should we rest?

When we think about "taking a break from studying," we often misunderstand it. We believe that stopping studying is equivalent to resting, and so we use that time to look at our phones, check social media, or watch short videos on TikTok, Instagram, or YouTube. The problem is that this is not a real break: even though we change activities, our brain continues to receive constant and intense stimuli, and does not have a chance to truly recover. It's as if, after running a long race, instead of stopping to drink water and sit down, you start jumping and sprinting. It may seem like a break because you're not exerting yourself as much, but in reality you're still exhausting your body.

The brain needs different kinds of breaks. After a study session, what we need is not to fill ourselves with more information or rapid stimuli, but to give ourselves space to breathe and reorganize everything we have processed. That way, when we sit down to study again, our minds are fresh and ready, and the time we invest is much more productive.

So, what should a "proper break" look like? It doesn't have to be anything complicated. The important thing is to do activities that don't require a lot of mental effort, but at the same time break the monotony of sitting and concentrating. You can, for example:

- go for a short walk,
- lie down for a while or move your body,
- do a small household chore (tidy up, fold clothes, clear the table),
- organize your study space,
- hydrate well or eat something light.

These types of activities act as a real "break" for the brain: they don't require a lot of cognitive energy, but they allow you to disconnect enough to come back with a clearer mind and greater ability to concentrate.

Why is it important not to wait until you are tired?

One of the most common mistakes we make when studying is **waiting until we feel exhausted to take a break**. But by that point, we've already been working **at half speed** for

a while. The quality of our thinking has been declining, but we keep pushing ourselves. This causes us to:

- We lose efficiency: the last few minutes before the break **don't contribute much**.
- It takes us longer to recover: our "mental battery" is much more depleted.
- The break must be longer in order to perform well again.

The **key** is to detect the **moment** when **concentration** begins to **wane**, not when it has already vanished.

This point is difficult to identify, but learning to recognize it is one of the most useful skills for studying effectively.

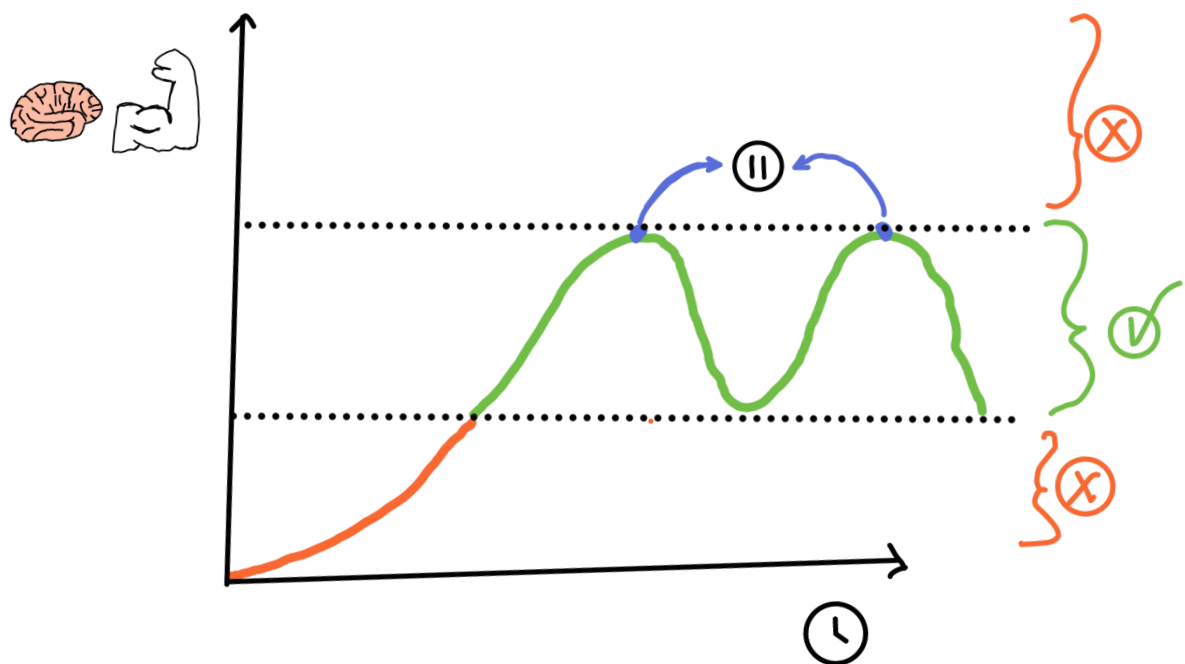


Figure 21: Graph showing the benefits of taking a break when our cognitive load increases significantly.

So, what technique should you use?

There is no single answer. It depends on your situation and your goals.

- If you are just starting to study consistently, find it difficult to concentrate, or are looking for a simple structure, **the Pomodoro Technique can be useful for getting into a rhythm.**

- But if you already have some discipline and want to make the most of your time, **Fowmodoro is more effective**, as it respects your natural rhythm of concentration and avoids unnecessary interruptions.

The most important thing is to have a critical attitude. No technique is magical. If you find that one limits you, interrupts you, or prevents you from progressing, **try alternatives and adapt them to yourself**.

Studying well is **not** about following a **fixed formula**, but about learning to understand your brain.

What if we could think better... without getting so tired?

We have already seen how we can regulate our effort to keep the brain active without exhausting it.

But... what **if there were another way to improve this balance even further?**

What if we could make **the same amount of effort take us further?**

Or even... **learn more with less mental fatigue?**

We're not talking about thinking less, or cheating the brain.

On the contrary: it's about making **deep** thinking—the kind that makes us grow and transforms **us—sound less exhausting and more efficient**.

As if learning were like climbing a mountain, but with a better-marked trail and less weight on our backs.

This is possible when our brain **knows what to do, what is relevant, and how to connect new information with what we already know**.

To achieve this, we need metacognitive strategies that **pave the way before we begin**.

In the following sections, we will discover how:

- The **foundations** of learning provide us with a solid footing on which to build knowledge.
- The technique of **layering** (or layers of information) allows us to better assimilate complex details.
- **Priming** mentally prepares us so that new information is easier to understand and retain.

All of this will help us not only learn more, but **also** do so **with less cognitive effort**.

SUMMARY:

COGNITIVE LOAD

Definition:

- When we study for a long time, our minds become fatigued and retain less information → this is cognitive load.
- It is the mental effort required for a task.
- Too much effort = overload, less learning.
- Too little effort = no deep thinking.
- Real learning = moderate and deep cognitive effort (analyzing, relating, evaluating).
- Key: balance between intensity and breaks.

Common mistakes

- Thinking that not getting tired is a good sign.
- Without effort there is no learning, but with too much effort there is no learning either.
- Mental fatigue is a symptom of deep work, not a problem.

Pomodoro Technique

- 25 minutes of intense study + 5-minute break.
- Every 4 cycles, take a long break of 15 to 30 minutes.
- **Advantages:** easy to apply, helps with consistency, and is useful against procrastination.
- **Limitations:** can interrupt the "flow" and generate pressure or frustration if it does not suit your personal rhythm.

Fowmodoro technique

- Based on the state of "flow" (deep and motivating concentration).
- Work while maintaining real focus.
- When attention wanes, stop and take a break.
- Pause proportional to the time spent concentrating (between 1/5 and 1/2).
- Example: 60 minutes of work → 15-20 minutes of rest.
- More flexible and adapted to individual pace.

Proper breaks:

- They should be activities that are not mentally demanding (walking, stretching, moving your body, small tasks, hydrating).
- Do not look at social media or videos, as they keep the brain active and do not allow it to recover.

When to rest

- Don't wait until you are exhausted.
- If you push yourself too hard, your performance will decline and recovery will be slower.
- Stop when your concentration begins to wane.

What technique to use

- Pomodoro: useful for getting started and establishing a routine.
- Fowmodoro: better for those who are disciplined and want more flexibility.

- No technique is universal; they need to be adapted to each person.

Ultimate goal

- Regulate mental effort.
 - Learn how the brain works.
 - Use metacognitive strategies to learn more with less effort.
-

BASICS

Imagine you are playing a video game. You skip the first levels and go straight to the final boss, the most difficult part of the game. When you get there, you realize that you don't have enough skills, weapons, or strategies to beat it. You get frustrated, fail, and maybe end up thinking that you are not good at this game.

But in reality, the problem isn't you. **The problem is that you weren't prepared.** You hadn't gone through the previous levels that help you build the necessary skills. And that doesn't just mean you lack knowledge, it means you **don't** have **enough of a foundation** to be able **to tackle that task with mastery.**

On the other hand, you've probably had the opposite experience: you learn a new subject and... everything flows. It seems easy, you understand it instantly, and it even seems obvious to you. Why?

Because you already knew a lot of related things. You already had a **foundation in place**: well-organized prior knowledge that allows you to easily connect the new information and give it meaning.

That's how learning works. The difference between understanding and not understanding does not always depend on the subject itself, but on whether you are **sufficiently prepared to learn it.** In other words, whether you have the **foundations** that make it possible.

What are the foundations?

We call "foundations" the set of prior knowledge that **must be mastered** in order to understand and retain new information.

If prior knowledge is weak, scarce, or poorly learned, new information will have difficulty "sticking" or making sense.

This concept connects with **schema theory**: we learn better when new information can be connected to existing mental structures that are well organized and rich in meaningful connections. Creating a new schema is much more complicated than completing an existing one.

For example:

- **In mathematics:** if you have not fully mastered basic operations (addition, subtraction, multiplication, etc.), understanding quadratic equations will be an almost impossible task.
- **In languages:** if you have not fully assimilated the basic structures of a language, learning more complex verb tenses will be frustrating, even if you spend many hours on it.
- **In manual trades:** if you don't know how to use basic tools, you can't do precise work. A carpenter who doesn't know how to make a simple joint will have problems with more advanced constructions.

- **In sports:** if you don't automate basic posture or movement well, you will carry mistakes over into each new technique. And correcting them later is much more difficult.
- **In cooking:** if you don't understand how basic cooking techniques work, you can follow an advanced recipe and still get it wrong.

The same thing happens in all areas: **without a foundation, there is no mastery.**

All this may seem like common sense. It's almost obvious: **if we don't know how to do the easy things, we won't be able to do the difficult things.** If we don't master the essentials, how can we understand what is more complex? And yet, in practice, we often ignore this basic principle.

We face a difficult topic and try to understand it directly, without checking whether we really have the necessary knowledge to do so.

It's like trying to read a book in a language we don't know: the problem isn't with the book, but with our lack of the minimum vocabulary needed to understand it.

It makes sense that we first need to build a solid foundation. We all know this, but when we study or work under pressure, we forget this step and want to get straight to the end. The result is frustration, repetition, and the feeling of "I'm no good at this," when the real problem lies in the foundation.

Now, think of your knowledge as a tiled wall. Every concept you learn is another piece you place on the wall.

What happens if the first tiles—the ones at the base—are broken, poorly placed, or simply don't exist?

You can continue building on top of them, but the wall will be unstable. In the short term, it may seem to hold up, but as you add new layers, everything starts to wobble. It becomes increasingly difficult to keep the new pieces in place, and you end up expending a lot of energy just to keep them from falling.

There comes a point when you can't add anything else. And even worse, the whole wall may start to collapse.

This represents the moment when **the accumulated weight of what you are trying to learn exceeds what your foundation can support.** Not only can you not move forward, but the knowledge that seemed consolidated also begins to unravel. The result is a kind of **mental or emotional collapse:** deep demotivation, feelings of failure, distress, and burnout.

And then, learning becomes impossible.

So, what good is it to know this?

Now that we know that when we don't understand a new topic, it may be the fault of our foundations, no study method, technique, or trick will work completely.

So, we must take a series of steps:

1. REVIEW THE BASICS

The **first** and most important step is not to look for new techniques, but to look back and **make sure that the fundamentals are well established**.

This means **reviewing, understanding, and rebuilding** those basic concepts that we may not have fully mastered.

Now, this is where we encounter a very common resistance:

One of the reasons we don't improve our basics is because **we are in a hurry to move forward**. We feel that reviewing concepts that "we should have already learned" is a waste of time.

But we must understand something fundamental:

What we learn today in a confusing or incomplete way does not disappear. On the contrary: it becomes the basis for what we will have to learn tomorrow.

For example, if you don't understand **division** well today, the problem is not just that you will fail at doing divisions. When you have to **solve first-degree equations**, you will be missing a fundamental foundation and, therefore, you will only understand these equations partially.

Later, when it's time to learn quadratic equations (or **even more advanced concepts**), you'll not only have to review the division you didn't understand at first, but also relearn the linear equations you built on that weak foundation.

That means that the longer you wait to review the poorly learned basics, the more work you will have to do in the future. It's like a snowball that grows or a time bomb: problems accumulate until they reach a point where they completely block your learning.

Every time we let this happen, **the debt accumulates**. And so does the cost.

2. ALWAYS LEARN AS MUCH AS POSSIBLE

Sometimes, when we study, **we do the bare minimum necessary to pass**. We do this because we are in a hurry, because we lack motivation, because our foundations were weak, or simply because no one has taught us any other way.

But now, once we have reviewed our foundations, the next fundamental step is to learn each new piece of content to the highest level of mastery possible, regardless of whether it requires **less mastery than we are capable of achieving**. In other words, **don't** just understand it **superficially** or remember it **to pass an exam**, but integrate it deeply, be able to apply it, explain it, and remember it in the long term, with great mastery. Doing this may take more time at the moment, but it represents one of the best investments we can make in our learning process.

This is important for two main reasons:

1. Because the content we are learning today will be the new foundation for what we will learn tomorrow.

It's as if each topic were a step: if one is weak or poorly placed, the next one cannot be

sustained properly. If we only half understand today's topic, tomorrow we will have twice as much work: reviewing what we didn't understand well and trying to learn the new content, which builds on it. But if we achieve a good level of mastery today, tomorrow we will be able to move forward much faster and with more confidence, as if we were carrying a lighter backpack. Having a good foundation means learning more details easily and intuitively. If we constantly maintain the quality of our foundation, it is easier to learn new information about it. This is what we are looking for: **to use less cognitive effort to learn more information.**

2. Because standards can vary.

The second reason why it is worthwhile to learn each piece of content to the highest level of mastery is that the level of demand can change from one teacher to another, or even from one year to the next. And if we only learn the minimum necessary to pass today, it may not be enough tomorrow.

For example, this year you may have a teacher who only asks you to know how to divide and multiply with a calculator. But next year, the new teacher assumes that you already know how to do these calculations mentally, without help. In other words, they assume that you have a much higher level of mastery than was previously required of you. If you only learned the minimum, you will find yourself with a gap: you will not have the skills that everyone will assume you already possess.

Therefore, if every time we learn a subject we strive to understand and master it thoroughly—going beyond the minimum required of us—we will be preparing ourselves not only to pass, but to face any future demands. This gives us flexibility, security, and independence.

In short, there is a very important phenomenon that helps us understand why it is so useful to build a solid foundation and learn each piece of content with the highest level of understanding: the so-called snowball **effect**.

Imagine your knowledge as a small **snowball** that starts rolling down a mountain. At first, it is small and collects little snow. But as **it moves forward, it grows**: the bigger it gets, the more surface area it has to touch the snow on the ground and, therefore, the more snow it can collect. And so it gets bigger... and bigger... faster and faster.

The same thing happens with **knowledge**. When we know a lot about a subject, it is much easier for us to learn new information because we have more references, more context, and more points of connection. We can associate the new with what we already know. The new information "fits" like a piece of a puzzle and does not require as much mental effort to understand. On the other hand, if we have a limited foundation, each learning experience is more difficult and slower, since we have less prior knowledge to relate to.

This effect is very noticeable, for example, among **advanced university students** or people who already have a **high level of mastery in a subject**. Once they have a solid knowledge base, they can **assimilate new details and concepts** much more **easily and deeply**. **The more you know, the easier it is to learn.** Sometimes it seems like they understand difficult topics "effortlessly," but it's not magic: it's the result of years of solid, intentional building.

This is precisely the path we want to follow. By reviewing the basics and learning with mastery, we not only solve current problems, but we also activate that snowball effect that will make us learn more and more easily and quickly. It is an exponential investment.

From this understanding of the importance of the basics and how the quality of our prior knowledge determines how easily we assimilate new information, a key technique emerges: **Layering**.

SUMMARY:

BASICS

Definition

- **Foundations:** a set of prior knowledge that must be mastered in order to understand and retain new information.
- Without a solid foundation, learning is blocked or leads to frustration.

Characteristics

- Prior knowledge acts as the foundation on which new learning is built.
- If it is weak or incomplete, new information will not be retained well.
- This connects with schema theory: it is easier to complete existing mental structures than to create new ones.

CONSEQUENCES OF HAVING A WEAK FOUNDATION

- Knowledge is built like a wall of tiles: if the first ones are poorly placed, the wall is unstable.
- In the short term, it may seem to hold up, but in the long term:
 - Increasing difficulty in learning new things.
 - Demotivation, frustration, and a feeling of failure.
 - Possibility of collapse (burnout).

WHAT TO DO?

1. Review the basics

- Essential first step: review and rebuild the basic concepts that have not been learned well.
- Common resistance: rush to move forward.
- Confusing knowledge today = multiplied problems tomorrow (negative snowball effect).

2. Always learn with the best teachers.

- Don't just do the minimum to pass: it is necessary to deeply integrate each piece of content.
- Reasons:
 1. New foundations: what we learn today will be the foundation for tomorrow.
 2. Variable requirements: requirements may change (teacher, level, context).

SNOWBALL EFFECT

- Knowledge is like a snowball that grows as it rolls.
- The more we know, the easier it is to learn:
 - More connections, more context, more points of reference.
 - Less mental effort is required to understand new things.
- **Result:** increasingly faster, deeper, and more efficient learning.
- Optimal strategy: review the basics and learn with mastery to activate this positive effect.

LAYERING

Imagine you want to assemble a thousand-piece jigsaw puzzle. If you wanted to assemble it in the most difficult way possible, you would look at each piece one by one, try to memorize what it looks like, and then leave it in some corner of the room. After a while, you wouldn't remember what the pieces looked like or where you had left them. When it came time to assemble the puzzle, you would feel lost: lots of information swirling around in your head, but not knowing where to put it.

This is actually very similar to what we often do when we study: we read page after page, try to memorize definitions and details, and end up with our heads full of disconnected facts. When we need to use them later, we have a hard time retrieving them or making sense of them.

Now, think about how we actually put together a puzzle. We don't usually start with random pieces: first we look for the corners, then the edges, and so we create a structure that serves as a guide. As the image takes shape, each new piece fits more easily, because we can already see clearly where it should go. The process becomes more intuitive and, at the same time, more satisfying.

Well, the **Layering method** works exactly the same way, but applied to learning.

What is "Layering"?

Layering is a way of organizing study that consists of dividing the information we are going to study into different levels of importance. In this way, we always start with the most general, most essential pieces, and gradually add layers of detail. It's as if we first make a rough draft of the drawing and then, little by little, add colors, shadows, and details until we get the complete image.

When we study **linearly**, we follow the order of the book as it is written, page after page. This causes us to accumulate data without knowing exactly how it fits together. It's like

putting together a puzzle without seeing the picture on the box: you have the pieces, but you don't know what picture you're forming.

On the other hand, when we study **in a non-linear way** (such as layering), we first look for the big picture and then add details. Each new piece of information has a place to fit because we already have the outline prepared. It's like putting together a puzzle after seeing the picture and starting at the edges: the whole thing makes sense from the beginning.

This technique follows the same principles as the **basics**. If we have a good foundation, a good place to put the information, we will learn it more easily. First, we seek to understand the general concept in order to create the **perfect place** for the information to fit.

For example, instead of starting to furnish a house with furniture such as sofas or beds (the details), we start with the walls, then the ceiling, and only at the end do we add the furniture and decorations.

Another example is how we draw a picture: if you try to start by drawing an eye with all the details and then try to add the rest of the face at the end, it will probably end up disproportionate and you may not even have time to finish it. In this case, you may not even have an idea of what the finished drawing would look like, since you may not have drawn the lips, ear, nose, or mouth. On the other hand, if you first make a simple sketch with the general shape of the face and the main features (eyes, nose, mouth), you can then add details and shadows in an orderly fashion. Even if you didn't finish it, at least you would have a rough idea of what it would look like if it were complete.

Well, studying in layers is just that: **first making a draft of your knowledge and then enriching it.**

HOW TO DISTRIBUTE INFORMATION IN LAYERS?

When we are faced with a new topic, our first impulse is usually to start reading it word by word to try **to understand** everything at once. But this is not the best approach: if we do that, it is easy to get lost in the details, confuse the essential with the incidental, or end up tired before reaching the end.

Instead, we suggest **a much lighter and more superficial first step: an initial overview.** We should look for **words and key concepts** that we will study in that topic. This work is more passive: just scanning the topic, looking for words, and making a list of them. It is not about reading or memorizing, but about detecting those elements that stand out:

- **Titles and subtitles:** these show you the general structure.
- **Bold or highlighted concepts:** these indicate central ideas.
- **Lists of objectives or indexes:** they offer you a summary of what you want to learn.
- **Words that are repeated a lot:** these are usually the pillars of the topic.

For example, imagine you have a natural science topic on **"Electrical Energy."**

If you do this initial scan, you will probably pick up words such as *electric current, voltage, generators, history of electricity, accidents, risks*. You don't yet know exactly what each one means, but you know that you will eventually learn about them in this unit.

Another example: if we take a history book on **"The French Revolution,"** the words that will stand out are *1789, people, monarchy, guillotine, human rights, assembly*. We have not yet delved into the causes or consequences, but with these words we already have a compass for what will be central.

Taking this step is essential, because these keywords will be the basis that will allow us to later **classify and prioritize the information in layers**.

TYPES OF LAYERS

Now that we have the list of content we will study on the topic, we will classify it according to its level of importance, which are as follows:

1. LAYER 1 – The logical layer

The first layer is like a map of a city before you start exploring it. It does not show every store or every alley, but it does show the main avenues and neighborhoods, and that already provides basic orientation.

In the study, these layers correspond to the **general titles and sections**. It is as if you had an index that points out the major blocks of the topic.

For example, if the topic is *History of the French Revolution*, here you only need to be clear about:

- **Causes of the Revolution**
- **Development of events**
- **Social and political consequences**

Here's another example: it's like packing a suitcase by first making a list of categories: clothes, hygiene, technology. Then you'll decide which T-shirt or charger to pack, but first you need to have the general categories.

You don't know the details yet, such as the price of bread in Paris or the role of a specific deputy, but you do have an overview of what you need to study. This allows you to place any new information within a pre-planned section. That's why it's called the **logical layer**: it allows you to think about a topic in general terms, even if you don't know many specific details.

Sometimes logic becomes even clearer with examples that everyone knows. Imagine this statement:

"The philosophers of ancient Greece, such as Socrates and Plato, lived alongside dinosaurs."

You don't need to be an expert in history to see that this is **impossible**:

- Even if you have studied the Jurassic period in detail, you know that dinosaurs became extinct about **65 million years** ago. You also know that classical Greece dates **back** about **2,500 years**. With just this basic information, you can deduce that it cannot be true, without needing to know who the main philosophers of Ancient Greece were.

Therefore, you could intuit the answer through **logic**, which is what we are looking for with this first layer.

2. LAYER 2 – The conceptual layer

Once you have the map, you begin to delve deeper. Here, you don't just learn the names of the neighborhoods, but you also learn which important streets connect them, where the central square is located, and which areas are most lively.

In your studies, this means learning the **main concepts and classifications**. This is the layer you spend the most time on, because it is where the bulk of your knowledge is built.

- In *biology*, it would be learning what a cell is, what types exist, and what basic functions each organelle has.
- In *French Revolution history*, you would learn concepts such as "estate-based society," "Third Estate," and "National Assembly," and you would learn the basic chronology of events.

To make it less overwhelming, this layer can be divided into layers:

For example: in biology → The digestive system:

- **2.1 (very general):** "The body has different systems: digestive, respiratory, circulatory..."
- **2.2 (more specific):** "The digestive system is made up of organs such as the mouth, stomach, and intestines."
- **2.3 (detailed but central):** "The stomach secretes acids and enzymes that break down food before it passes into the small intestine."

Another example: it's like learning a new sport. First you understand the general rules (how to win the game), then the main rules (what is allowed or prohibited), and finally the basic technique (how to hit the ball).

3. LAYER 3 – Significant details

Once you have a clear conceptual foundation, it's time for the **details that add depth**. These are small pieces that, if you fit them together correctly, allow you to better understand what you already know.

- In *history*, it could be that Sieyès' pamphlet "What is the Third Estate?" was key to mobilizing the population. This detail is not essential to understanding what the Third Estate was, but once you know it, this example illuminates and enriches the concept.
- In *science*, it could be learning that mitochondria are often called "the powerhouse of the cell." You don't need this detail to define what a cell is, but it makes the understanding much more vivid and concrete.

For example, it's like remembering anecdotes from a trip. You can explain what you did in general (layer 2), but the specific details—the day you missed the train or the typical food you tried—make the story more memorable and meaningful. They help you understand what the experience was like.

4. LAYER 4 – Insignificant details

Finally, there are details that don't have much logical connection to the whole, but may **need to be memorized out of obligation**. The big difference between layer 3 and layer 4 is that significant details help us understand the subject in some way, some nuance, to understand it more deeply. However, the details in layer 4 do not contribute to any deeper conceptual understanding.

For example:

- In *physics*, remembering that absolute zero is -273.15°C .
- In *history*, memorizing the exact date of birth of a king who does not have much weight in the overall understanding of the subject.

These details are like small loose stones: they are not part of the main structure, but sometimes it is necessary to keep them. The key is not to start here, because if you focus on these details before you have the outline, everything becomes heavy and incoherent.

Another example would be learning a friend's phone number. It doesn't help you better understand who they are or what they do, but it can be useful at a specific moment.

And... what happens if we don't follow this order?

- If you don't understand layer 1 well, the concepts in layer 2 will float around without order.
- If you don't have layer 2, you won't be able to distinguish whether a detail is significant (layer 3) or insignificant (layer 4). First, we select the details that help us

understand the topic; the rest automatically belong to layer 4.

- And if you try to start with layer 3 or 4, you will get lost in a forest of unconnected data.

CONSUME AND DIGEST

Imagine you go to an all-you-can-eat buffet and eat nonstop. At first, everything is enjoyable: you try new dishes, taste different flavors... but there comes a point when you can't eat any more. Even so, you keep eating, and your body, unable to handle so much food, ends up rejecting it. You've eaten a lot, but in reality, you've absorbed very little.

The same thing happens with learning. If we devote ourselves to **consuming information** nonstop—reading pages and pages, watching videos, or listening to lectures without reflecting—there comes a point when our brain can no longer absorb any more. The result? We forget much of what we have seen or understand it only superficially. It's like having eaten a lot and not digested anything.

Learning is not just about "swallowing" data, but about **digesting it**: pausing, reflecting on it, connecting it to what we already know, asking questions, and checking that we really understand it. If we only consume and don't digest, we don't build a solid foundation and we have to go back, waste time, and study everything again because we no longer remember what we've "studied." On the other hand, if we maintain **a balance** between consuming and digesting, what we study once is consolidated, and the next time we can move forward without difficulty.

When we talk about **studying in layers**, this balance becomes even more critical. **We never leave a layer until we have digested it as well as possible.** It makes no sense to move on to the next one if the first one is not well understood. It would be like building a building on weak foundations: everything that comes after will be at risk. So it is not enough to understand it superficially; we must go further.

It's an almost compulsive attitude: we seek to squeeze the layers until they become a solid and unquestionable foundation.

That's why, once we've captured the keywords and classified them according to their importance (the layers), we need **to digest each layer**. This means analyzing the keywords, looking for similarities and differences, critiquing and evaluating the structure and order in which the author has explained them to us, grouping them by similarities, etc.

When we do this, we are not just memorizing: **we are training our brains so that each new layer adheres better to the previous one.**

THE SNOWBALL EFFECT

As we learn with this methodology, a multiplier effect occurs. At first, it takes more effort:

- In the **first layer**, one hour of study can give us five basic concepts.
- But when we move on to the **second layer**, thanks to the previous foundation, with the same hour and the same effort, we can assimilate ten concepts, since we have more information with which to relate the new concepts.
- In the **third layer**, the same effort still allows us to understand 15, because everything flows more intuitively.

It's like a snowball that keeps growing: every time it rolls, it picks up more and more, allowing us to learn more with less effort.

HOW TO PROCESS THE MOST SUPERFICIAL LAYERS?

Many of you may ask yourselves, *"But... if this is the first time I've seen these concepts and I don't know anything about them, how can I think deeply about them? How can I relate or contrast ideas that I don't yet understand?"*

This situation is completely normal and, in fact, it is a golden opportunity. When we are faced with a new topic, the first layers of information are not meant to turn us into experts, but rather to **pave the way** and build a first mental map, even if it is schematic and incomplete.

1. Formulate hypotheses

Even if we don't know exactly what the concepts mean, we can start by asking ourselves questions and **creating provisional theories**:

- "Would this be more like... or...?"
- "Perhaps this term is a cause and the other a consequence?"
- "It seems that this concept is a smaller part of this other one..."

These hypotheses don't have to be perfect; they just need to help us **activate our brains** and start making connections. If they're correct, great. If they're wrong, it will still be beneficial, because we will establish a relationship of difference, contrast, with what we thought at the beginning.

2. Use external resources

If the study material does not provide us with basic definitions, we can turn to other sources: a dictionary, a simple article, an introductory video, or even artificial intelligence that provides us with a superficial and accessible explanation. The goal is not to delve deeper yet, but to get an **initial overview** that helps us situate ourselves.

3. Ask simple questions

At this initial stage, there is no need to go into technical details. We focus on basic questions:

- What exactly is this concept?
- What is it similar to? How is it different?
- Where could it fit within the overall topic?

Each answer, even if incomplete, helps us fill in pieces of the puzzle.

4. Building the first overview

With provisional hypotheses, simple questions, and basic information, we create an **initial map**. It may have gaps and errors, but that doesn't matter: it is the first draft on which we can later add more precise and solid layers.

HOW TO PROCESS THE DEEPER LAYERS?

Once we have gone through the first layers of information—those that provide us with an overview and the basics of the topic—we face a new challenge: how to work with the more specific details and pure memorization. This is where layers 3 and 4 come into play.

1. Layer 3: Applicable details

In layer 3, we find information that we can still **connect to the previous layers**, but which requires greater effort to integrate. These are details that, on their own, may not seem very important, but which may appear in exam questions, practical problems, or specific applications.

Here, the most useful thing is **to project ourselves into the future** and ask ourselves:

- "In what context will I have to use this information?"
- "How might I be asked about this in class or on an exam?"
- "What broader concept is enriched by this detail?"

An example: if we are studying biology and already have a clear general idea of what a cell is (layers 1 and 2), layer 3 could be learning the names and functions of organelles such as the "endoplasmic reticulum" or the "Golgi apparatus." These terms are not as basic as "cell," but they are not pure memorization either: we can still relate them to the general function of the cell.

To fix this type of detail, **mind maps and flashcards** are great allies:

- Mind maps help us see how the detail connects to the broader concept.

- Flashcards force us to practice active retrieval, a fundamental technique for long-term memory. (*I explain this technique in the Flashcards section*).

2. Layer 4: pure memorization.

Finally, we reach the deepest layer: pure memorization. Here we find information that **cannot be easily understood or deduced**, but must be memorized.

Examples include:

- Very specific mathematical formulas.
- Historical dates.
- Vocabulary from a new language.

Since they don't always have a natural connection to general concepts, it's best to look for **tricks and associations** to help you remember them:

- Create little absurd stories or mental images that make them memorable.
- Reinforce them with **flashcards** and space repetition.

This type of information is often abundant and fragmented. Therefore, it is advisable **to separate it from the main notes** or mind map: having a separate sheet or a section exclusively for pure memorization helps to avoid saturating the conceptual base.

INFLUENCE ON MIND MAP FORMATION

Studying in layers not only helps us understand and memorize better, but also has a direct impact on how we construct mind maps. The benefits of this methodology are fully in line with the requirements that define a good mind map. Let's look at it point by point:

1. More thoughtful and personal mind maps

When we study in layers, we break the linearity typical of conventional notes. We no longer follow the order decided by the author to the letter, but rather we are the ones who decide how to organize the information.

This forces us to think **reflectively**: to question how we interpret the text, to decide what is essential and what is secondary, and to give it a form that best suits our way of understanding the subject.

As a result, the mind map is not a copy, but a **personal translation** of knowledge. This reflexivity is essential, as it ensures that each branch and each connection responds to our own learning process and not to an external outline.

2. Hierarchical organization and visual emphasis

The layered structure makes it easy to order concepts according to their importance and graphic representation. The **surface layers (1 and 2)**, which contain the fundamentals, can be placed in the center of the map with larger letters, brighter colors, or thicker lines. The **deeper layers (3 and 4)**, on the other hand, are located in the outermost branches, with thinner lines or softer colors.

This creates an immediate visual effect: the reader of the map knows at a glance which concepts are central and which are secondary.

Example: on a map about the French Revolution, "Social, political, and economic causes" would occupy the center (layer 1), while details such as "wheat prices" or "revolutionary pamphlets" would be peripheral branches (layer 3 or 4).

3. Grouping and non-linear relationships

Layer thinking encourages us to group similar concepts from the outset. We are not obliged to follow the order of the book or the teacher, but can **reorganize the elements according to the connections we discover**. This makes the map much more faithful to the functioning of our (reflective) memory, which tends to create networks of interrelated ideas rather than rigid sequences.

In addition, the graphic format of the mind map—colors, symbols, shapes—allows us to incorporate **nonverbal** language that makes it easier to visualize these groupings.

For example, in a map about ecosystems, we can place "forests" and "jungles" together because they share characteristics, even though they appear in different chapters in the book. With a common green color, the connection is immediately apparent.

4. Directionality and fluidity of knowledge

The layers arrangement fits perfectly with the **directionality** of mind maps: from the center (general and basic ideas) to the edges (details and exceptions). This organization allows us to visualize information as a flow that advances and unfolds.

In addition, studying in layers helps us not to get lost: we know that we must first understand the center and then expand toward the margins.

Example: in a map of the anatomy of the heart, the center could be "main function: pumping blood," and from here branches lead to the more general parts (atria and ventricles) and, finally, to details such as "tricuspid valve" or "sinus node."

5. Constant interconnectivity

Layered progress allows us to maintain **maximum clarity** in the learning process. As we advance gradually, we can always adjust the structure of our mind map without having to start over, and each new idea connects seamlessly with the previous ones. This **constant interconnectivity** between surface layers and deeper layers ensures that our knowledge grows in an orderly and coherent manner. In addition, respecting the balance between **consuming information and digesting** it is key: we do not move on to a new layer until we have fully integrated the previous one. This forces us to look for non-obvious connections between all concepts—both those we have already assimilated and those we have just

learned—and ensures that each new step strengthens the overall knowledge network, resulting in maximum interconnectivity.

Here, two key concepts come into play when applying Layering: **expanding** and **zooming out**.

EXPAND AND ZOOM OUT

Imagine you have a camera or cell phone in your hand. You can use it in two ways:

1. **Zoom in:** when you want to see a specific detail. Perhaps you notice a single leaf on a tree, a small flower by the side of the road, or a word engraved on a stone monument. When you zoom in, you stop seeing the rest and focus only on that detail. The world is reduced to the piece you have decided to observe.
2. **Zoom out:** when you want to see the whole picture. Suddenly, you stop looking at just the leaf and see the whole tree. You stop looking at just the word and see the whole sentence that is part of the monument. Instead of a single flower, you see the whole field full of colors. At this point, you are no longer interested in just the detail, but in understanding how that detail contributes to a larger and more meaningful reality.

This constant movement—zoom in and zoom out—helps us **change our perspective**. And that is exactly what we must do when we build a **mind map** and want to learn effectively in layers:

- **Zooming in** is equivalent to developing a detail of our outline: it is when we open a branch and add specific information.

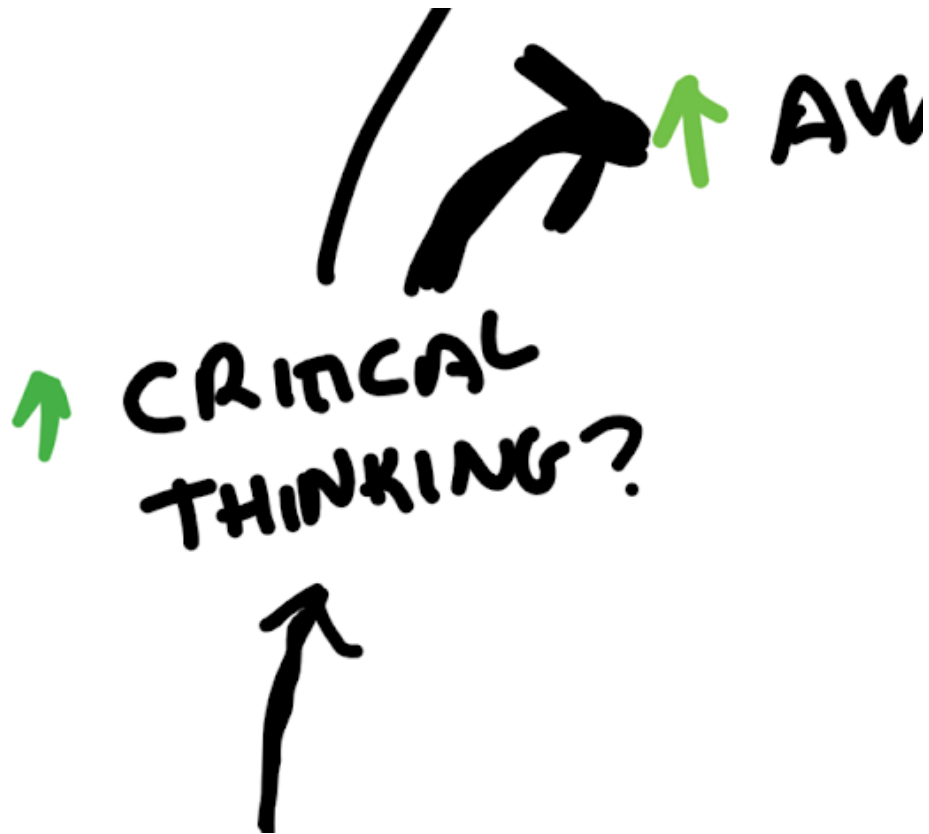


Figure 22: The image shows a detail “Critical Thinking,” representing the moment when we focus on just one detail.

- **Zooming** out means looking at the mind map as a whole: this is when we check how the detail we have added fits into the branch, into the overall topic, and what connections it has with other parts of the map.

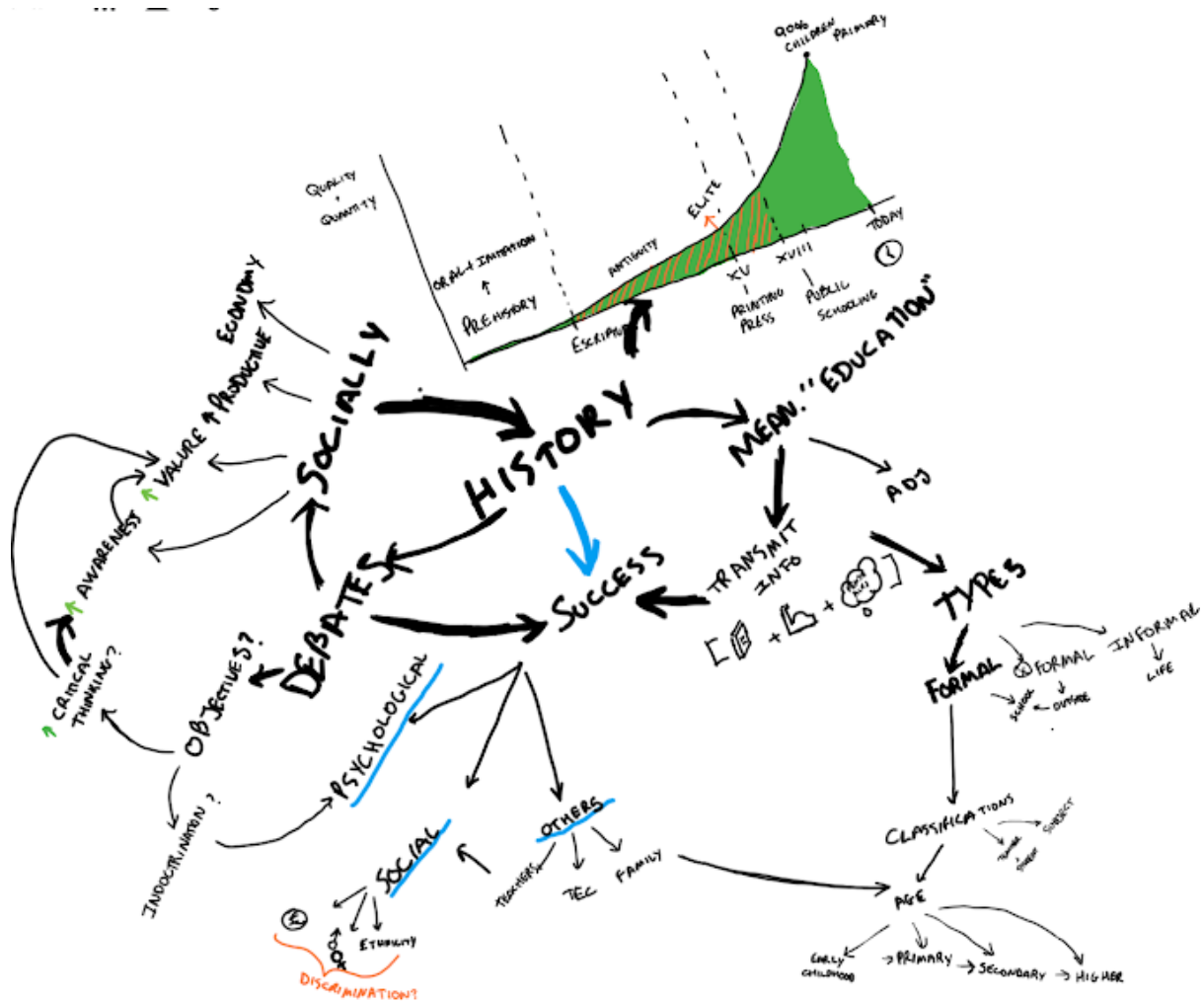


Figure 23: The image shows a complete mind map about Education. It illustrates how the concept of “Critical Thinking” contributes to the overall structure.

We could say that:

- **Zooming in** gives us depth.
- **Zooming out** gives us context.

If we only zoom in, we will end up losing the big picture and the detail will be disconnected. But if we only look at the big picture, we run the risk of not understanding the importance of the details. Only by combining both perspectives—deepening and contextualizing—can we build a clear and complete outline of what we are studying.

And... what does that mean in practice?

When we make a mind map, we have two options:

1. **Work linearly:** develop a specific branch without looking up, adding only concepts that are connected to each other, as if it were a list that moves in a single direction.

The risk is that we get stuck on one part of the topic and forget how this detail relates to the rest. Then, instead of a mind map with many connections, we end up with isolated branches that are not connected, like linear tree diagrams.

2. **Work with the zoom in and zoom out method:** every time we add new information, we do two things:
 - **We zoom in** → we place the concept in the exact location on the branch, within the corresponding layers.
 - **We zoom out** → we check how it fits with the rest of the concepts in the same layer and with the previous layers. We look for connections and similarities, we contrast and make sure that it is not isolated.

For example: **In energy.**

Let's imagine we are creating a map of **energy sources**.

- We add *geothermal energy*.
 - **Zoom out:** we detail what it is, how it works, and place it within the renewable energy branch.
 - **Zoom out:**
 - We compare it with *solar* and *wind energy* (other renewables → same layer).
 - We relate it to the more general classification of renewable versus non-renewable energy (previous layer → broader context).
 - We can even establish connections with practical applications: district heating, electricity generation, etc.

Thus, we not only understand what geothermal energy is, but also how it fits into the global energy landscape.

Example 2: **History**

We are studying the **French Revolution**.

- We add the concept of *the Storming of the Bastille (1789)*.
 - **Zoom out:** we detail what happened that day and its immediate significance.
 - **Zoom out:**

- We compare it with other events of the same revolution (*Declaration of the Rights of Man, Execution of Louis XVI*) → same layers.
- We relate it to previous causes (economic crisis, social inequalities) → previous layer.
- We also look at the subsequent consequences (birth of the Republic, revolutionary wars) → connection with other parts of the map.

In this way, it does not remain an isolated historical fact, but we understand its function within the overall process.

Example 3: In biology

We are studying the topic of **cells**.

- We add the concept of *mitochondria*.
 - **Zoom out:** we describe its function (ATP production, cellular respiration).
 - **Zoom out:**
 - We compare it with other organelles in the same layers (chloroplast, nucleus, ribosomes).
 - We relate it to the general function of the cell as a unit of life (previous layer).
 - We look for connections with broader topics such as metabolism, genetics, or tissues (other branches of the map).

Here, mitochondria cease to be just a name to memorize and become a key piece in the entire cellular ecosystem.

Practical summary:

Every time you add a piece of information to the mind map:

1. Zoom in → Place it in the right spot and add details.
2. Zoom out → Observe it within the whole, compare it with the same layer, and relate it to the previous layers.

This double movement ensures that there will be no isolated concepts and that new information is always integrated into the overall structure of knowledge you are building, interconnecting each piece of information as much as possible and increasing its relevance.

BENEFITS OF "ZOOMING OUT" AND "ZOOMING IN."

Applying this technique is not just a matter of visual order or structural simplicity. It is a powerful strategy that helps us learn better, retain more information, and master topics with greater depth and clarity. Below, we detail **four major benefits** we obtain:

1. Improved retention of the most important parts.

When we build a mind map using the "zoom in and zoom out" technique, every time we add new information, we force ourselves to look back and compare it with concepts from previous layers.

This means that the **most general and fundamental concepts** (usually located in **layer 1 or 2**) are reviewed many more times than the specific details of deeper layers (such as layer 3).

This **natural and constant repetition** reinforces our memory: every time we look for a connection with new information, we remember and reprocess the key concepts.

For example:

We are making a map about **metacognition**.

- In **layer 1**, we have concepts such as: *teaching*, *solid foundations*, *layered study*.
- When we add a new detail such as "Mind Map," before placing it, we ask ourselves:
 - Is it related to *teaching*?
 - Is it related to *solid foundations*?
 - Is it linked to the idea of *learning layers*?

Every time we do this, we review layer 1 and the upper layers. In this way, we reinforce its mental presence.

2. Maximum interconnectivity and mastery.

When we add a new element to the map and zoom out to look for relationships with **all the existing concepts** (both in the same layer and in the upper layers), we are performing an intense exercise in **deep understanding**.

Not only do we memorize the new concept, but we also:

- **We place it correctly** within the overall structure.

- **We compare and contrast** it with other similar or complementary concepts.
- **We connect** it with everything we already know.

3. Total mastery of the subject.

When we apply this technique systematically, we leave no detail unanalyzed. Even the **smallest and most specific** concepts (those we place in **layer 3**) go through a process of comparison and connection with the rest of the outline.

This means that, instead of having a fragmented memory, we have a **solid, integrated, and in-depth** knowledge of the entire subject.

So, instead of studying some parts of the subject more than others, we study all of them equally and with the best possible quality.

And... what happens if we **don't** zoom out your studying enough?

It is also essential to understand **the risks** of not applying this technique correctly:

1. We miss opportunities to make valuable connections

If we only focus on expanding and developing one branch of the map without looking up, **we fail to see possible relationships** between concepts that could help us better understand the subject, which affects our overall mastery of what we are studying.

2. We end up with a chaotic and unclear map

When we develop a branch too quickly, without seeing how it fits with the rest, we may later **discover many connections that we had not seen before**.

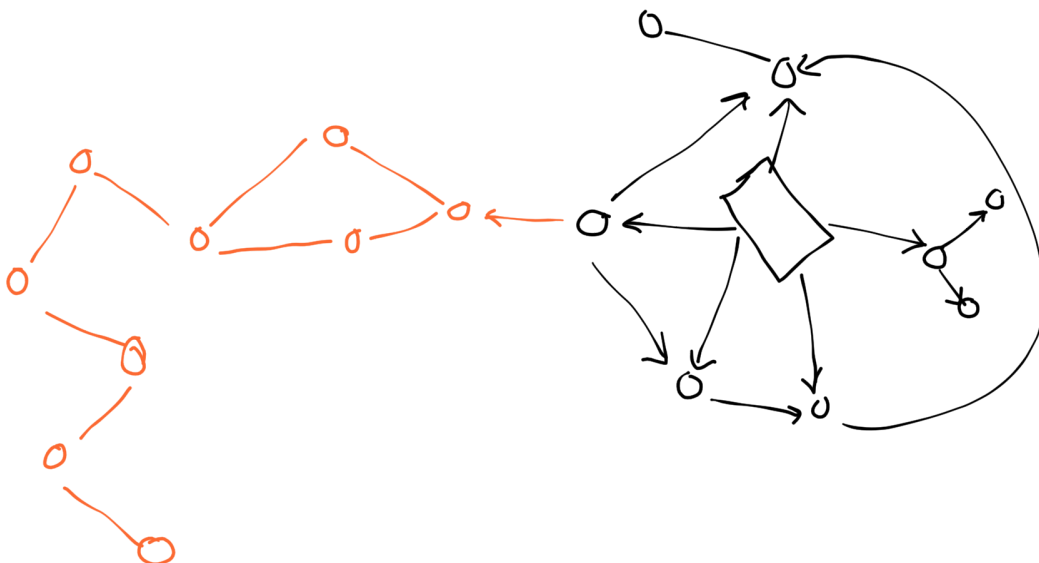


Figure 24: Illustration seeking to represent an excessively long and linear branch of a mind map, which would serve as an example of a lack of interconnectivity.

The problem is that:

- We will have to represent them with numerous crossed arrows.
- The map will become confusing and messy.
- We may have to **restructure the entire branch and place it elsewhere**. If we notice that there are too many connections to a concept, which implies a waste of time and effort, we may stop making these connections due to lack of time and practicality.

For example, imagine you are making a mind map about **your daily diet**. If you only "zoom in" and start adding details about what you eat for breakfast (coffee, cereal, fruit, milk, toast...), but you don't "zoom out" to see how this relates to lunch, dinner, or the general idea of "healthy eating," the map will be incomplete. The longer you wait to add these connections, the more details you will have written down and the harder it will be to reorganize them. On the other hand, if every time you add a food item you "zoom out" to see how it fits into a balanced diet or with other meals, the map will be constructed in a clear and orderly manner, and you will have a better understanding of the whole.

In short, studying in layers allows us to organize content in a more natural and efficient way. This way, we make better use of our mental capacity, avoid falling into linear study, and ensure that we will master the entire subject step by step. This way, we not only integrate the main concepts, but also the smallest details, ensuring maximum mastery and complete understanding.

METHODS DERIVED FROM LAYERING

There are other well-known methods that use layering as a basis for obtaining specific results.

1. Comprehensive Input

Comprehensive input (or *comprehensible input*) is based on a very simple idea: **you learn a language better when you receive information that you largely understand, but which presents you with a small additional challenge**.

Stephen Krashen, its main proponent, sums it up in the $i+1$ formula:

- i = your current level.
- $+1$ = a new or slightly more complex element that you do not yet know.

This works because:

- **It maintains motivation:** you understand enough to follow the conversation or text, but you have new stimuli that increase your knowledge. This way, if the content is too easy, we won't learn anything, and if it's too difficult, learning would require excessive cognitive effort, which would cause frustration and discourage us from continuing to study a language.
- **It promotes natural learning:** just as a young child learns their mother tongue by constantly hearing it in understandable contexts.
- **It creates layers of understanding:** every time you consume slightly more advanced content, you add a new layer to your knowledge, reinforcing the foundation.

How to apply this to language learning:

- Look for real materials, but adapted to your level (graded books, podcasts with transcripts, series with subtitles in the language).
- Accept that you won't understand everything. Context, gestures, images, and repetition will allow you to deduce meanings.
- Gradually increase the difficulty: when a material becomes too easy for you, move on to one that is slightly more complex.

2. 20/80 technique – Pareto principle

The Pareto principle states that **20% of effort produces 80% of results**. Many people use it to prioritize what is really essential and leave for later (or ignore altogether) what brings little immediate value.

In any area of knowledge, you can look for:

- What are the key concepts (that 20%) that, once mastered, allow you to understand or solve most situations (the other 80%).
- For example: in basic mathematics, understanding addition, subtraction, multiplication, and division already allows you to solve most problems; in history, knowing the broad outlines of a period helps you understand details and secondary events. Or in language learning, study the most frequent words and structures first. With just 1,000 words, you can understand most texts and conversations.

Both *Comprehensive Input* and the 20/80 rule **work because they build knowledge in layers**:

- *Comprehensive Input* starts with a foundation you understand (first layer) and adds small doses of new information (next layer).

- The 20/80 method ensures that the first layers contain the most profitable elements: the core that supports the rest of the learning.

In addition, there is another method that is fundamentally based on Layering: **Priming**

ANSWER TO THE ACTIVITY 7

SUMMARY

Layering

Definition

- Layering is a way of organizing study by dividing information into levels of importance.
- It starts with the general and essential pieces and gradually adds layers of detail.
- Comparison: putting together a puzzle by first looking at the overall picture and then fitting the pieces together, not at random.

Why it is better than linear study

- Linear study accumulates unconnected data: page after page, isolated definitions.
- Stratification allows each piece of data to fit into a pre-existing framework.
- The balance between a solid foundation and new details facilitates learning and understanding.

Visual examples

- Building a house: first walls and roof, then furniture.
- Drawing a face: first a rough sketch, then eyes, nose, mouth, and details.

HOW TO DISTRIBUTE INFORMATION IN LAYERS

1. First skim reading

- Scan the topic: titles, subtitles, keywords, bold concepts, indexes, repetitions.
- Objective: to create an initial compass of what is central.

2. Types of layers

Layer 1 – The logical layer

- Function: general map of the topic, major blocks or sections.
- Example: History of the French Revolution → Causes, Events, Consequences.

Layer 2 – The conceptual layer

- Function: knowledge of the main concepts and classifications.
- Example: Biology → cell, types and function of organelles.
- Sublayers: 2.1 very general, 2.2 more specific, 2.3 central detail.

Layer 3 – Significant details

- Function: examples and information that enrich understanding.
- Example: Mitochondria = cell's powerhouse; pamphlet "What is the Third Estate?"

Layer 4 – Insignificant details

- Function: information that must be memorized out of obligation, without conceptual impact.
- Example: specific dates, absolute zero (-273.15 °C), birth of a minor king.

Risks of not following the order

- Without layer 1 → layer 2 has no order.
- No layer 2 → we cannot distinguish significant details from insignificant ones.
- Starting with layers 3 or 4 → confusion and information overload.

CONSUME AND DIGEST

- Learning is not just about consuming information, but digesting it.
- Reflect, connect with prior knowledge, ask questions, and consolidate each layer before moving on to the next.

SNOWBALL EFFECT

- Each layer that is well assimilated facilitates the learning of the next one.
- Example: 1st layer → 5 concepts, 2nd layer → 10 concepts, 3rd layer → 15 concepts with the same effort.

HOW TO PROCESS THE LAYERS

- **Surface layers (1 and 2)**
 1. Form hypotheses: create provisional theories about new concepts.
 2. Use external resources: dictionaries, introductory videos, AI.
 3. Ask simple questions: what is it, what is it like, where does it fit in?
 4. Build the first general image: initial map, even if incomplete.
- **Deeper layers (3 and 4)**

- Layer 3: applicable details → relate to previous layers, use mind maps and flashcards.
- Layer 4: pure memorization → dates, formulas, vocabulary, with visual tricks and space repetition.

INFLUENCE ON MIND MAPS

Benefits of layering

- More thoughtful and personal maps: break linearity, personal translation of knowledge.
Hierarchical organization and visual emphasis: center = layers 1 and 2, periphery = layers 3 and 4.
- Grouping and non-linear relationships: similar concepts grouped together, colors and symbols to visualize connections.
- Directionality and fluidity: from the center (general) to the margins (details).
Constant interconnectivity: each new idea connects with the previous ones.

ZOOM IN AND OUT

- Zoom in: observe and develop the details of a branch.
- Zoom out: observe how the detail fits within the branch, layers, and overall context.
- Example: Geothermal energy → zoom in (function and detail), zoom out (compare with other renewables and the global context).
- Other examples: History (Storming of the Bastille), Biology (Mitochondria).

BENEFITS OF ZOOMING IN AND ZOOMING OUT

1. Improved retention: review general concepts each time details are added.
2. Maximum interconnectivity and mastery: situate, compare, and connect new concepts.
3. Total mastery of the subject: solid and integrated knowledge.

Risks of not applying it correctly

- Expanding only → loss of valuable connections.
- Chaotic maps → more crossed arrows and need for restructuring.
- Example: food maps without seeing connections between meals.

CONCLUSION

- Studying in layers better organizes content, avoids linear study, and ensures maximum mastery.
 - It integrates main concepts and details, generating deep, orderly, and interconnected knowledge.
-

PRIMING

When we think about how to study better, we often imagine strategies applied directly when we sit down with a book or when the teacher explains the subject in class. In other words, we focus on what to do **while studying**. But there is a preliminary step, often overlooked, that can make a big difference in our learning: mental preparation, known in cognitive psychology as *priming*.

Priming or **Mental Preparation** consists of any action we take **prior** to studying, with the aim of preparing our mind to better assimilate information. When we do this preparation, our attention, motivation, and ability to understand new concepts improve significantly. This means that we learn with **less effort** and with **greater ease in remembering** what we have learned.

A good way to understand this is through a sports metaphor. Imagine an athlete before training or competing: they would rarely start running or lifting weights without warming up first. Warming up prepares the muscles, activates circulation, and reduces the risk of injury. Well, *priming* is exactly the same, but applied to learning. It is not a "physical warm-up," but a **mental warm-up**. With this preparation, our brain is more "ready" to absorb knowledge, as we have activated the circuits that we will use while studying.

Another image that can help us understand this is gardening. If you want to plant a seed, the most logical thing to do is to prepare the soil first: loosen it, add nutrients, and water it a little. Only then can the seed grow strong. *Priming* does exactly that with our brains: **it prepares the ground so that information takes root better**.

HOW TO PRIM YOUR MIND FOR LEARNING?

Priming for better learning is not a single, rigid technique, but a set of small actions we can take before studying or attending class to prepare our brains.

ACTIVATING PRIOR KNOWLEDGE

The first and most essential way to prepare is **to activate prior knowledge**. Our brain does not learn in a vacuum. Every time we incorporate new information, it **connects it with things we already know**.

Therefore, before starting a new topic, it is essential **to remember, review, and put into play what we already know**. This activation is like turning on the spotlights on a stage: the previous information becomes visible and available, and when the teacher explains or when we read, it will be much easier to link the new information.

A very clear example: imagine that you have just studied the French Revolution. For a few days, when you hear words such as "revolt," "social change," or "equality," ideas, characters, and events related to that historical period will immediately come to mind. This happens because the topic is **recent and fresh** in your mind. Your brain has these "memory pathways" open, and it is easier to make connections.

If, on the other hand, we let too much time pass without reviewing and that knowledge becomes dormant, connecting new concepts to it becomes much more difficult. That's why **actively remembering before** studying—even if it's just reviewing general ideas or thinking of examples—helps keep that knowledge "at the forefront" and makes it easier for the brain to use it to understand what comes next.

This is the logic of activation: **keeping information fresh so that it can serve as a foundation on which to build new learning.**

Now, how is this activation carried out in practice? There are some simple and very effective ways:

1. TRY TO PREDICT THE FUTURE

At first glance, it may seem strange: "How can I predict the future if it is unpredictable?" But when we try to guess something that will happen in the future, such as what will be explained to us on a topic, **we don't invent it from scratch**, but use what we already know as a starting point.

For example, if we are going to study a topic on energy, we can formulate hypotheses such as:

- Perhaps they will talk about how electrical energy is produced.
- Perhaps they will explain ways to use less energy.
- Perhaps they will address the history of energy production.

The same would apply to a psychology topic, such as metacognition: we can expect them to explain **how we actually learn information**, what techniques help us do it better, or interesting facts about how our minds work.

This exercise has two major advantages:

1. **It activates prior knowledge** (because we use the information we already have to create hypotheses).
2. **It increases attention** during study or class, as we will be watching to see whether our predictions are correct or not.

In this sense, thinking "what do I think the teacher will explain?" turns the class into a game of constant checking, which keeps us more alert and focused.

2. BRAINSTORMING

Another very powerful way to activate prior knowledge is to **brainstorm**. The process is simple: before studying, we spend a few minutes writing down everything we can think of

about the topic. It doesn't need to be organized or complete; the goal is **to get our memory going** and bring to the surface what we already know.

This brainstorming can be complemented with a **simple mind map**. Just put the topic in the center and add related concepts, examples, or ideas. This gives us a clear picture of the starting point, and when we study later, it will be easier to connect the new knowledge with what we already knew.

(A more detailed explanation can be found in the "Brainstorming" section.)

STUDY THE MOST GENERAL PART OF THE TOPIC

Another very effective way to prepare your mind is to use the **information layers** technique, which we have already explained in detail in the previous section. Here, however, it is not a question of applying it completely, but of using it strategically as **a warm-up** before learning a new topic.

The idea is simple: **start with the most superficial and general aspects**. It is not necessary to understand everything or memorize complex data. What we are looking for is to get an initial overview of the topic, a kind of "panoramic map" to guide us. When we do this, our brain has a preliminary structure on which to anchor the more in-depth details that will come later.

To give an example: imagine you have to start studying the French Revolution. Before going into detail about the storming of the Bastille or the subsequent political stages, you can spend a few minutes reading a brief summary of what it was, when it took place, and what the general ideas behind it were (liberty, equality, fraternity). With this alone, when the teacher later explains specific details or when you read the textbook, you will find it much easier to understand and remember.

This first superficial level is sufficient as priming: don't try to master the subject, but rather **create a foundation on which you can build**.

STIMULATE CURIOSITY

When we talk about learning, we often focus on memory and effort, but there is an equally or even more powerful ingredient: **curiosity**. When a topic sparks our interest, the brain activates "explorer mode": motivation increases, we retain what we read or hear better, and, in addition, the feeling of studying becomes much more enjoyable.

That's why a key part of priming is **finding ways to pique our curiosity before delving into a topic**. It's not about becoming passionate about everything we study—we know that we don't always have a natural interest in the subject—but rather about activating questions, doubts, and connections that make us want to understand a little more.

There are several simple strategies for achieving this:

1. INQUIRY BASED LEARNING

Once we have activated our prior knowledge, the next step is to ask ourselves questions about what we do not yet **know** or understand. This process turns studying into a personal quest: it is no longer just about memorizing, but about finding answers.

In addition to the general questions you can ask yourself, there are others we can use to stimulate our curiosity, such as: *"How does this relate to my life or to today's society?" "What unexpected consequences did it have?"*

You can also look for ways to relate the topics you like to what you are going to study.

For example, if you have to study the French Revolution and you are passionate about soccer, you can investigate whether this historical event had any influence on its current popularity. You may discover that the spread of certain ideas of freedom and community also transformed collective leisure.

The great advantage of this approach is that **each answer makes the information more relevant**: not only do you learn it, but you connect it to what you are already interested in, which makes it much more memorable.

What's more, today we have extraordinary tools to help us in this process. Thanks to the internet and conversations with artificial intelligence, we can ask all kinds of questions and get answers quickly, which makes research much easier.

2. Watch explanatory videos

Another very effective way to spark curiosity is to start with **short, visual videos** that provide an overview of the topic. When presented with images and concrete examples, the brain connects more easily and begins to generate questions.

For example, a five-minute video on solar energy can visually show how panels work, what advantages they offer, and what challenges still exist. Then, when you read the textbook, you will already have a clear idea and your mind will want to know more.

3. Read summaries and outlines

Although it may seem very basic, **reading a summary before studying in depth** is one of the most powerful techniques for stimulating curiosity.

When you see the topic "at a glance," even if you don't understand all the details, you become familiar with the terminology and begin to identify concepts that are familiar to you or that you don't understand. This simple step already raises questions such as: *What exactly does this concept mean? Why is this character important?*

For example, if the teacher is going to talk about "thermodynamics" and you have never heard that term before, your brain will get stuck just trying to understand it. But if you have already seen it in a summary and have a general idea, when you hear it again you will be better prepared to delve deeper.

In this sense, summaries and outlines are not only a review tool, but also an excellent way to **prepare your mind and open the door to curiosity**.

PRIMING ACCORDING TO THE OBJECTIVE

Depending on our objective, our mental priming may vary. Preparing for **a study session at home** is not the same as preparing for **a class at school** or **analyzing a literary book**. Although the basis of priming (activating prior knowledge, stimulating curiosity, and starting with the surface layer of information) is common, we can adapt these principles to each context.

STUDYING AT HOME

When preparing to study a topic on our own, we can follow the general steps we have already explained:

1. **Activate prior knowledge** so that it is present and available.
2. **Look for introductory materials** (videos, summaries, outlines) to get a first approximation.
3. **Study only the most superficial layer** of the content (keywords, basic concepts) before delving into details.

APPLICATION TO BOOKS

When the goal is not to study a topic from a textbook, but **to work with a literary book, an essay, or a more complex work**, prior preparation becomes even more important. Reading a book with the goal of taking an exam or preparing a critical analysis is not the same as reading it simply for pleasure. Here, we not only want to enjoy the reading, but also **remember it, understand it, and be able to discuss it in depth**.

Most students follow a very common pattern:

1. They start reading the book right away, often without knowing exactly what they will find.
2. They try to understand the story or ideas as they read, but often get lost in details or confusing timelines.
3. They take notes while reading to remember names, dates, characters, or themes.
4. And finally, when the exam zooms in, they look for a **summary or outline** to organize what they have understood.

This method works, but it has a clear problem: **the first reading is very time-consuming**. You're blind, without a compass, and that makes every page require extra effort. When you don't yet understand the story or the main thesis of the essay, it's easy to get lost in the details and feel like you're not making progress.

Now imagine another scenario: before opening the book, **you read a good summary, study it, and analyze it to create a solid foundation.** This is not about cheating or replacing reading, but about getting an **overview** of what will happen: who the main characters are, what events will mark the story, and what key themes are developed. It's as if, before going to the mountains, you were given a map with the main trails: you haven't set foot on the ground yet, but you already have a clear idea of where you're going and what you'll find.

With this preparation, when you start the book you are no longer lost. You can immediately recognize when an important character appears, you can understand how the chapters fit into the chronology, and, above all, you can devote your attention to **deeper** aspects: the language, metaphors, symbols, and narrative style of the author.

For example, imagine you have to read **Shakespeare's Romeo and Juliet**. If you start reading without knowing anything, you may feel lost at first: who are the two families, why are they fighting, what role do the secondary characters play? The first reading can become an exercise in pure survival, simply trying to understand what is happening.

However, if you have read a summary of the play before you start, you already know that it revolves around two young lovers who belong to enemy families and that their story will end tragically. With this clear foundation, when you read the play, you won't have to constantly ask yourself, "Who is this? What is happening?" Instead, you can pay attention to the most interesting details: Shakespeare's poetic language, the metaphors about love and death, and the way fate and personal decisions clash in the plot.

Thus, the summary has not spoiled the play for you, but rather provided you with a **map** so that you can enjoy reading it in a much deeper and more enriching way.

The same is true of an essay: if you have to read a philosophical text, such as excerpts from Rousseau's *The Social Contract*, it can be difficult to tackle it directly. However, if you have first read a summary of its main ideas, critiques, and general analysis, each page will be much clearer to you, and you will be able to devote yourself to reflection and comparison, rather than just trying to understand what each paragraph means. You can relate the abstract ideas discussed in the text to the overview you have understood. In this way, you link specific details to your prior knowledge, which is the basic requirement for increasing the relevance of information.

In addition, here are some **specific strategies** to **prepare** for **studying a book**:

- **Read summaries beforehand:** a summary acts as a 'surface layer' that provides you with a mental map before you begin.
- **Read reviews or comments:** they offer clues about central themes and symbols, allowing you to read with a purpose.
- **Ask yourself questions before reading:** for example, "How is the historical context reflected in the novel?" or "What techniques does the author use to convey emotions?"

- **Read with an analytical eye:** once you have a clear overview, you can pay attention to details that often go unnoticed (style, metaphors, rhetorical devices).

This way of preparing for reading is like **cheating in a smart way**: it doesn't take away the work of reading or the mastery you need to have, but it allows you to take advantage of reading to get the most out of it with less time and effort.

IN CLASS

Preparing for class does not mean "studying before the teacher explains," but rather **conditioning our minds to make the most of that hour**.

In fact, there are two ways to prepare: overall preparation (having a general overview of the entire topic) and specific preparation (20 minutes before a particular class). The latter is especially useful for those who don't have much time or want to perform better without having to invest hours and hours beforehand.

Why shouldn't we study "everything" before class?

If we spent almost an hour before each class studying the content in detail, we would end up investing dozens of hours that, in the end, could prove to be inefficient. The idea is not to replace what the teacher will explain, but **to make a small mental investment beforehand** that will help us get the most out of each explanation.

With just **15 or 20 minutes of preparation beforehand**, we can save ourselves many hours of review later, because the information will no longer be completely new, but will have a place to "fit" in our minds.

How can we prepare in these 20 minutes?

1. **Activate our prior knowledge**
2. **Get a quick overview of the topic**

If we know what will be explained, we read a brief summary or look for an introductory video. It is not necessary to understand everything or study the details; the goal is to get a general idea.

3. **Formulate hypotheses and questions**

This is where curiosity comes in. When we read or see something we don't understand, instead of getting frustrated, we write down the question: *"What does this term mean?" "Why does this happen and not something else?"*

- For example: *"Why do plants need water to photosynthesize?"*

"If there is no light, how can they survive?"

- You can also come up with a possible answer, even if it's wrong. You might think, *"Surely plants use water as food."* Then, in class, when you discover that this is not exactly the case, your brain will remember the information better because you will be "correcting" a previous hypothesis.

In addition to formulating hypotheses about possible answers to the questions we ask, we can hypothesize about ways to structure the information and how the surface information you have studied can be related, "trying to predict the future" and thinking about what exactly the teacher will explain based on what we have read.

Then, in class, our minds will be more attentive to finding answers. It doesn't matter whether our hypotheses are correct or not: the simple act of testing or discarding them helps us to remember the information better.

4. Preliminary mind map

We can make a quick outline of our prior knowledge, activating it, of the superficial content we have seen on the topic or what we think we will see. It doesn't have to be perfect; the goal is to have a "skeleton" that we will then complete in class with what the teacher explains. This allows us to take more active and less linear notes: instead of writing down everything the teacher says, **we can continue adding new information to an existing outline**, relating it directly to what we knew before and being able to reflect more deeply on the explanation we are given. Instead of just listening to the content, you actively analyze and contrast it with the hypotheses you had formulated and what you had noted in your mind map.

By doing these small things, we obtain three main benefits:

- We are **more attentive** because we want to see if our questions and hypotheses are answered.
- We learn **more deeply** because each new concept connects with a previous mental framework.
- We need **to take fewer notes** mechanically, as our mental map helps us focus on important ideas and the relationships between concepts.

And... after class?

Once we get home, we only need to spend a few minutes **organizing our mind map**: reorganizing it, clarifying concepts, and highlighting the main ideas. This is a form of immediate review that consolidates what we have learned and saves us hours of study later on.

Here's an example: imagine that tomorrow you have a history class on **World War II**.

Instead of waiting for the teacher to start from scratch, spend **15 minutes beforehand** watching a short video that summarizes the main events: which countries were involved, how the war started, and how it ended.

While watching the video, questions may arise such as:

- *"Why did Hitler manage to convince so many people?"*
- *"What role did the United States play exactly, if they didn't want to get involved at first?"*

You jot down these questions in your quick mind map.

The next day, when the teacher explains Nazi expansion policy or the United States' entry into the war after Pearl Harbor, **your attention skyrockets**: you're listening actively because you want to see if they answer the questions you already have.

When the teacher says, *"The US did not intervene at first, but after the attack on Pearl Harbor, they entered the war fully,"* your brain clicks: *"Ah! That was one of my questions!"* This connection allows you to retain the information much better.

By the end of the class, you have a mind map with a clear structure: the countries involved, the phases of the war, and the answers to your questions. At home, you'll just need to organize this map a little, and you'll have a very powerful summary without having to write pages and pages of notes.

BENEFITS OF MENTAL PRIMING

Priming is like warming up before playing sports: it doesn't win you the race on its own, but it allows you to run better, with less risk of fatigue and greater confidence in your movements. The same is true for learning. Taking a few minutes to prime your mind before studying or attending class has surprising benefits, many of which are immediately apparent.

1. Increased attention

When you arrive in class without having thought about the subject beforehand, it's easy to find the teacher's words distant and boring. On the other hand, if you've taken a few minutes to come up with questions or hypotheses, your mind is **alert**: you're looking for answers, confirmations, and corrections. It's like watching a movie when you've already seen the trailer: you know what to expect and you're attentive to the details.

2. Verify hypotheses and answer questions

The brain remembers information much better when it serves to **correct a previous idea**. Even if your hypotheses are wrong, the fact that they are confirmed or rejected makes learning an active process. You are constantly comparing, and that consolidates your memory much more than simply listening passively.

3. Know what to focus on

When you have an overview of the topic before you start, it's like having a map in your hands. You can identify which parts are really important and which are secondary details.

This allows you **to better manage your attention and energy**, and not get lost in information that you would forget anyway.

4. More motivation and less frustration

One of the main causes of discouragement in class is not understanding anything that is being explained. This leads to frustration and a desire to tune out. But if you already have a basic foundation, even if it is superficial, it is much easier to follow along. In addition, if you have already watched a video with interesting facts or a short summary, the class becomes an opportunity to discover "the why" of things, and that keeps you interested.

5. Reduced cognitive load

When we hear new information without any prior knowledge, our brains crash trying to process it. It's like trying to hang pictures on a completely smooth wall: there are no hooks. On the other hand, when you are primed, it's as if you have already put in nails and brackets. Every detail the teacher explains has a place to hook onto, and that **makes learning much easier**.

6. Time savings

It may seem like spending 10 or 20 minutes before a class is a waste of time, but in reality, it's quite the opposite: it's an investment. Those minutes you invest beforehand can save you **hours of review later**, because you will have already assimilated a lot during the class itself. It's the difference between spending two hours at home trying to understand a topic from scratch or just half an hour reviewing because you already understand it.

In short, this technique is one of the most efficient and quickest to apply among all those presented in this manual. Unlike other strategies, such as learning to make advanced mind maps—which require a lot of practice, theoretical knowledge, and cognitive effort—priming is simple and practical. Even if we do it in a very basic way, spending only 10 minutes before each class, it can still bring us great results and save us many hours of review later.

Therefore, if I had to recommend a single technique to start with before any other, it would undoubtedly be **Priming**. Its simplicity and effectiveness make it the most powerful tool for improving our learning.

So, what we all want—to be able to remember most of the details and explanations given by the teacher without having to review them over and over again—is actually possible, as long as we have prepared ourselves properly to get the most out of the class.

ANSWER TO THE ACTIVITY 8

SUMMARY

PRIMING

- **Definition:** Actions taken before studying or a class that prepare the mind to better absorb information.
- **Function:** Improve attention, motivation, and understanding; facilitate memory.
- **Key feature:** It is a “mental warm-up,” like physical warm-up in sports.

How to do quality mental preparation:

It is not a single technique, but a set of simple actions before learning.

1. Activation of prior knowledge

- **Definition:** Recall and bring into play what we already know before a new topic.
- **Function:** Connect new information with prior knowledge, ease comprehension and memory.
- **Ways to do it:**
 - *Predict the future:* formulate hypotheses about what will be explained → activates prior knowledge and increases attention.
 - *Brainstorming:* write or draw concepts we remember about the topic; can be complemented with mind maps.

2. Study the most general part of the topic

- **Definition:** Do a first reading or get a superficial overview of the topic.
- **Function:** Build a panoramic map so that details can later attach to it.
- **Example:** Read a brief summary of the French Revolution before going into details.

3. Stimulate curiosity

- **Definition:** Spark interest in a topic before studying it.
- **Function:** Increase motivation, retention, and enjoyment of learning.
- **Strategies:**
 - Inquiry-based learning: ask questions, seek answers, connect with personal interests.
 - Watch explanatory videos: a visual and general overview that triggers questions.
 - Read summaries and outlines: give a prior idea and generate doubts.

MENTAL PREPARATION ACCORDING TO THE OBJECTIVE

Adaptation of general principles (activating knowledge, curiosity, superficial overview) to different contexts.

STUDYING AT HOME

- Steps: activate knowledge, look for introductory materials (videos, summaries), study only the superficial layer.

Application to books

- **Problem:** reading without preparation makes the first read very difficult and inefficient.
- **Solution:** read summaries and reviews beforehand, ask questions, have a mind map of the content.
- **Function:** recognize characters and ideas from the start, focus on deeper aspects (style, symbols, arguments).

IN CLASS

- **Global preparation:** general overview of the topic before starting a unit.
- **Punctual preparation:** 15–20 minutes before class.
- **Steps:**
 - Activate prior knowledge.
 - Do a superficial overview (summary, video).
 - Formulate hypotheses and questions.
 - Make a preliminary mind map.
- **Benefits:** more attention, deeper learning, more active note-taking.
- **Post-class review:** organize the mind map to consolidate what has been learned.

Benefits of mental preparation

1. Increased attention → we search for answers to questions and hypotheses.
2. Hypothesis verification → the brain remembers better when it corrects prior ideas.
3. Knowing what to focus on → having a map of the topic helps distinguish the essential.
4. More motivation and less frustration → prior foundation makes comprehension and following easier.
5. Reduced cognitive load → new knowledge attaches more easily.
6. Time saving → a short prior preparation prevents many hours of later review.

REVIEW

Reviewing information is one of the most important phases of the learning process. It is not enough to understand content at the outset: if we do not review it, it is easy to forget it over time. Reviewing allows us to consolidate what we have learned, reinforce connections with our prior knowledge, and ensure that the information remains active in our memory. However, not all review methods are equally effective. Therefore, in this section, we will explore various ways to review correctly and strategically in order to get the most out of our efforts.

SPACE REPETITION

Imagine you've started a new job and on your first day they explain the procedure for opening and closing the cash register. You repeat it with your colleague several times during

the morning, one after another, until you seem to have mastered it. That same afternoon, you could do it with your eyes closed. But a month goes by without you opening the store, and on the day you have to do it alone... you freeze up. Vague images come to mind, you have to stop and think, and you even feel unsure if you're doing it right.

Now contrast that with another situation. On the first day, you learn the procedure, and you repeat it that same night at home, mentally. Two days later, you rehearse it again at work. The following week you do it again, and after three weeks you do it again. After a few months, even though time has passed, the process comes almost automatically.

The difference is that, in the first case, **the repetition was intense but concentrated in a very short period of time**; in the second, **the repetitions were spaced out over time**, which allowed your brain to consolidate and reinforce the information in the long term.

We have all experienced this same mechanism with things as simple as a password. If we use it every day for a week, it seems impossible to forget it... but if months go by without using it, it disappears from our memory. On the other hand, if we have entered it at specific times over weeks or months, we are much more likely to remember it even long after.

The lesson is clear: **it's not just how many times we repeat information, but how we distribute those repetitions over time.**

Space repetition is a learning technique based on a simple but powerful principle: **to remember better, we must review information several times, leaving increasing intervals of time between each repetition.**

Unlike studying over and over again in a single session (commonly known as "*cramming*"), space repetition takes advantage of the natural way our brains forget and remember.

This technique is based on the **forgetting curve**, formulated by Hermann Ebbinghaus in the 19th century. When we learn something new, our memory is very high immediately after learning. But if we don't review it, retention drops rapidly in a matter of hours or days.

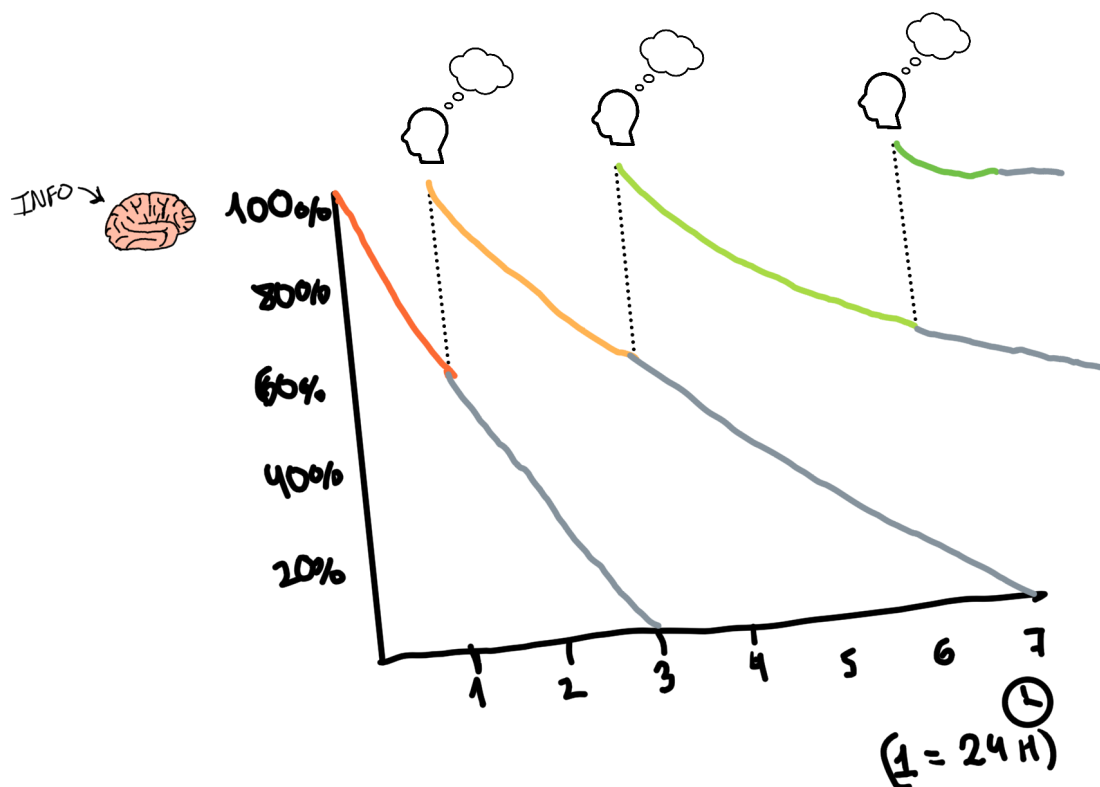


Figure 25: Graph representing the percentage of retention we obtain from repeating the same content over a period of time (days). We can see that each time we review, it takes longer to forget a topic.

The typical graph accompanying this theory shows a curve that drops sharply shortly after learning, and then more gradually as the days go by. However, when we actively review, the curve rises again—not to 100% of the original memory, but very high—and the subsequent decline is much slower than the initial one. If we review again after a longer period of time, the curve decreases even more slowly, and so on.

In other words, each review is like reinforcing a path in a forest: on the first day, the path is narrow and full of obstacles; if we walk it again too soon and too many times in a row, we don't add much solidity: it's like stepping on the same footprint before it has begun to fade. But if we return just before the vegetation begins to cover it again, each step makes it clearer, wider, and more durable.

This explains why repeating something a lot in a short period of time creates a false sense of mastery: the memory is fresh, but not consolidated. On the other hand, when we space out our reviews, **we force the brain to retrieve the information just as it begins to fade**, and that retrieval effort is precisely what strengthens memory.

THE IMPORTANCE OF REPETITION

Knowing something today does not guarantee that you will remember it tomorrow. Even if the initial learning is of high quality, memory is like a muscle: if it is not used, it weakens. Therefore, if we want information to really stick, we must schedule reviews over time. Not just any old way, but with a clear strategy.

Scheduling review sessions

A simple example of a sequence could be:

1. **The same day:** once you get home, review and complete what you learned in class. This could be by structuring the mind map you developed in class or explaining the concept in your own words. Then, **a few days or a week later**, relate it to new knowledge you have learned, **months later**, and then do **annual reviews** of key content that you want to retain in the long term.

This cadence may vary, but the important thing is that the intervals are increasing. It is precisely the fact of "almost forgetting" and having to make an effort to remember that strengthens the memory.

And... why don't many people do this?

It seems simple, but the reality is that most people do not apply this principle systematically. The reasons are clear:

- **Organization:** if we are going to be tested, we need to plan and mark the review dates.
- **Dedication:** it is not enough to reread; it is necessary to activate the memory and reflect on it.
- **Discipline:** maintaining commitment amid other tasks and responsibilities.

In addition, many people rely too heavily on the feeling of "I already know this" that comes after intensive study. This is a dangerous mistake: it is a fragile memory that fades quickly.

This is where **metacognition** and what we have seen in **previous chapters** come in: the **quality of the first learning** determines the **number of repetitions necessary**.

- If the first contact is superficial, you have not understood what has been explained well and you will need many repetitions to retain the information, since it is not very relevant to you. You will be fighting brute force against forgetting.
- If the first contact is deep—making connections, asking questions, mind mapping—each review will be more efficient and less frequent because you have the information well integrated; you just need to refresh it.

This is like building a house: if the foundations are solid, only minor repairs will be needed; if they are weak, you will have to constantly repair it.

Space repetition is a powerful tool, but if all we do is **repeat mechanically**, the results will be poor.

Many students confuse **quantity of repetition** with **quality of learning**. It's like trying to learn an entire text in an unfamiliar language just by repeating the sounds, without

understanding the meaning. You may be able to reproduce it from memory in the short term, but there will be no real integration.

SUMMARY

SPACE REPETITION

What is it?

- Repeating information several times, leaving increasing intervals between each repetition.
- It prevents the rapid forgetting that occurs with intensive *cramming*.
- Example: learning a procedure at work and repeating it on different days, instead of doing it all in one morning.
- Benefit: It consolidates long-term memory.

How does it work?

- Based on Ebbinghaus's **forgetting curve**: retention drops rapidly if we do not review.
- Each active review reinforces the memory and slows down the subsequent decline.
- Metaphor: walking along a path in a forest; if you repeat it too often, it doesn't stick; if you repeat it just before you forget, the path becomes clearer and more permanent.

Importance of repetition

- Knowing something today does not guarantee that you will remember it tomorrow.
- Memory is like a muscle: without use, it weakens.
- The quality of initial learning influences the need for repetition:
 - Superficial learning → more repetition needed.
 - Deep learning (connections, questions, mind maps) → fewer repetitions, but more effective.

Schedule review sessions

- Example sequence:
 - Same day: immediate review after class.
 - Following days: review and relate to new knowledge.
 - Next week, months later, and annual reviews for key content.
- Strategy: increasing intervals, almost forgetting before reviewing, to reinforce memory.

Why don't many people do this?

- It requires organization: planning review dates.
- It requires dedication: activate memory, don't just reread.
- It requires discipline: maintaining commitment among other tasks.
- Common mistake: relying on the feeling of "I already know this" after intensive study.

Effectiveness

- Mechanical repetition without understanding has little effect.
- Repeating with understanding and connections (mind maps, questions) truly integrates the information.

Conclusion

- Space repetition is a powerful and practical tool for consolidating long-term memory.
 - It's not just how many times you review, but **how and when** you do it.
 - Combined with quality learning, it reduces study time and improves retention.
-

The science is clear: **every review should be active**. This means trying to recall the information without looking at it, explaining it in your own words, solving problems, or connecting it to other ideas. It is this active process that turns information into consolidated knowledge.

Now, in order to do this consciously, we need to understand the **different ways we can remember information** and see which ones are effective and which ones are not.

WAYS TO REMEMBER INFORMATION:

1. RECOGNITION

Imagine you are taking a multiple-choice test. You have the question "What is the capital of Japan?" and four options: *Tokyo*, *Beijing*, *Seoul*, *Bangkok*. You may not have remembered the exact answer before seeing the options, but when you read them, the word *Tokyo* sounds familiar and you choose it.

This is what is called **recognition**: a type of memory retrieval in which you identify the correct information from among different alternatives. It is the simplest type of memory, because the answer is already in front of you and you only have to recognize it, not generate it from scratch.

For example, when we are reviewing for an exam with a book or notes, we often reread them and, as we read, we see that all that information is familiar to us and therefore we consider that we know everything, but this is not true. You would not be able to remember that information if you had not read it again. It is like when someone tells us about a relative we have not seen in a long time. If they only told us their name, we might know of their existence, but no face would come to mind. Only when you see them again do you realize that you knew what they looked like, but you did not remember.

In this way, we must avoid falling into this illusion of learning and know how to differentiate between when we only recognize information and when we really know it and can remember it.

2. CUED RECALL

Think of a day when you couldn't quite remember what you did. Someone asks you, "What happened last Christmas when we were all at Grandma and Grandpa's house?" Suddenly, the question brings back images of dinner, laughter, and that unexpected gift. The cue has triggered memories that would not have surfaced on their own.

This is called *cued* recall: a type of retrieval in which a question, partial information, or specific detail serves as a signal to activate your memory. Instead of having the answer in front of you (as in recognition), here a cue guides you to the information you have stored, making it easier to retrieve even if you hadn't remembered it spontaneously.

This usually happens when we answer general questions. Questions direct your attention to a specific area of memory, as if they were shining a beam of light on a dark area of a warehouse full of boxes.

In psychology and therapy, this type of cued recall is widely used in treatment. Precise questions, asked with sensitivity, can unlock hidden or vague memories, especially those linked to intense emotions. In education, it is also a very powerful tool: a teacher who knows how to ask questions well can help a student retrieve information they thought they had forgotten.

The key lies in **the quality of the question**. A question that is too general can leave you going around in circles without finding anything concrete; on the other hand, a well-focused question—with details that act as clues—can open the way to very specific and clear memories.

Below, we will look at ways to use questions and clues to review content more effectively, making good use of **flashcards** and **quizzes to help you study**.

FLASHCARDS

Imagine you are preparing for an exam in which you must memorize many definitions of different concepts. Perhaps you have already used a simple technique: you take a concept from a book or your notes, cover its definition with your hand, and try to say it from memory. When you succeed, you feel that the knowledge is "yours"; and when you don't, you look at the answer again and try again.

What you are doing, even if you don't know it, is **actively retrieving information** from a clue: the word or concept that serves as your question.

Now, imagine if we could combine two of the most powerful methods for consolidating memories:

1. **Active recall** – forcing your memory to produce the answer without seeing it.
2. **Space** repetition—reviewing the information at increasingly longer intervals, just before you are about to forget it.

This combination is essentially what *flashcards* offer us.

Definition:

A **flashcard** is a physical or digital card with a question (or clue) on one side and the answer on the other. The goal is to practice retrieving information, and when used with a space repetition system, it helps consolidate it in the long term much more efficiently than simply rereading. *Flashcards* can be as simple as a piece of paper with two sides or as sophisticated as applications that automatically calculate the optimal review intervals based on your performance.

When we use *flashcards* in the traditional way (on paper), the process is simple:

- Each card has **two sides**:
 - **Front**: you place the **question**, keyword, or clue that will help you activate your active recall.
 - **Back**: you write the **answer** or the information you want to remember.
- You review the card, look at the front, and try to remember the answer without looking at it.
 - If you know it, you can set it aside to review later.
 - If you **don't** know it, put it back in the pile to review it soon.

What is a *flashcard*?

Show answer

Figure 26a: The image shows the front of the flashcard in the application where it says "What is a flashcard?"

A flashcard, or memory card, is a card, physical or digital, with a question (or clue) on one side and the answer on the other.



Figure 26b: The image shows the back of a flashcard, with the answer to the question "What is a flashcard?", which is: "A flashcard, or memory card, is a physical or digital card with a question (or clue) on one side and the answer on the other."

The problem with this manual method is that **it is easy to make mistakes with the review intervals**: you may review cards you have already mastered too soon (wasting time) or difficult cards too late (forgetting them completely).

This is where **space repetition algorithms** (SRS) come into play.

These digital systems automatically decide **when to show you each card again** to maximize retention and minimize study time. The idea is simple but powerful:

- When **you remember** the answer **well**, the interval until the next review is lengthened.
- When **you struggle** or **fail**, the interval remains short or is reduced.
- The goal is to present each card **just** before you are about to forget it, taking advantage of the "forgetting curve" of human memory.

Practical example of how it works:

Let's say you use a *flashcard* app with a Space Repetition System and you get the question "What is the capital of Mongolia?"

- If you answer quickly and correctly ("Ulaanbaatar") and mark it as **"Very good,"** you may see it again in 10 days.

- If you mark **Good** (you remembered it, but with a slight doubt), you may see it again in 3 days.
- If you mark **Almost no** (you partially remembered it), the review may be tomorrow.
- If you mark **No** (wrong answer or no memory), the system may show it to you again after a few minutes or hours.

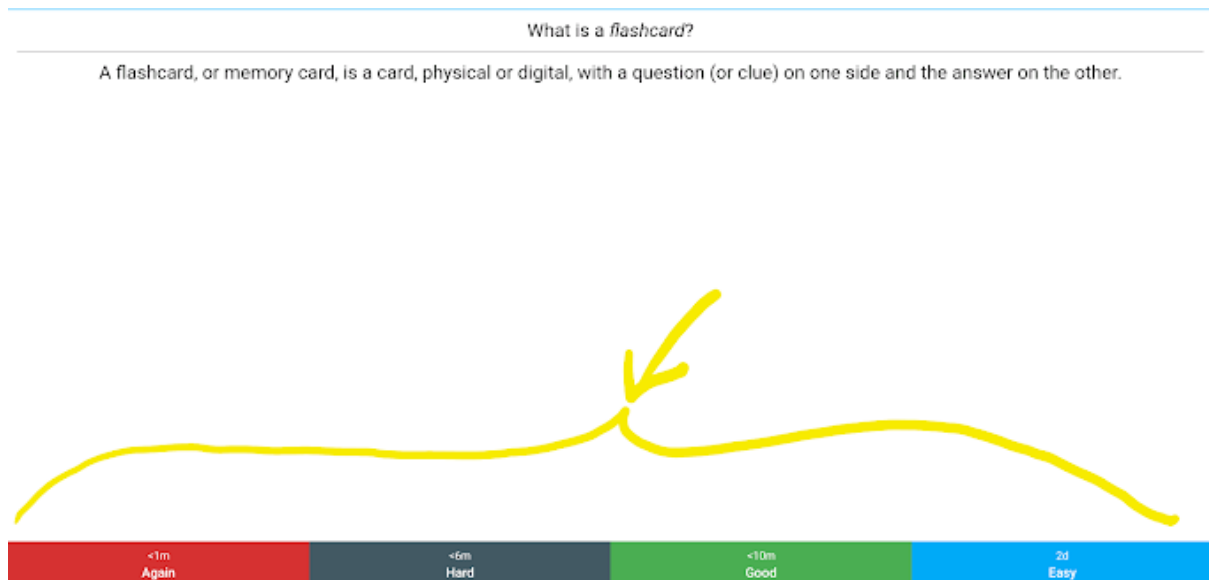


Figure 27: *The image highlights the types of responses we usually have in flashcard applications that use spaced repetition.*

Over time, the cards you have mastered may only appear every few weeks or months, while the difficult ones continue to appear frequently until you consolidate them as well.

Well-known applications that use this system:

- **Anki** – free and highly customizable; very popular among medical students, language learners, and exam takers.
- **Quizlet** – easy to use and with numerous collections created by other users; combines SRS with other study modes.
- **Memrise** – mainly focused on languages; adds videos of native speakers and uses mnemonic techniques.

DISADVANTAGES OF FLASHCARDS

1. Isolated information

When we use *flashcards*, especially intensively and as our main strategy, we can run into several significant problems. One of the most notable is an **overly fragmented approach**. This means that we study concepts in **isolation**, without connecting them to other ideas. It is

a type of superficial thinking, focused only on memorizing definitions or understanding each concept separately, rather than seeing it as part of a network of knowledge.

For example: imagine you want to learn how to make the perfect latte. With *flashcards*, you might have one card that says "Boiling water: 100°C," another that says "Amount of coffee per cup: 7 g," and another that says "Heat the milk to 65°C." These are useful pieces of information, but studying them in isolation does not guarantee that you will actually be able to make a latte.

Because, in reality, the sequence, rhythm, and combination of steps are essential: first, you must prepare the coffee, heat the milk without burning it, and then mix it in the right proportions. If you only know each step as isolated pieces of information, it's easy to forget how they connect to each other. The result? You might end up preparing the milk first, then forget to make the coffee, or not respect the temperatures and end up with watered-down coffee.

This is the problem with overly fragmented learning: as with coffee with milk, having small pieces of information does not mean you know how to apply them together to achieve the final result.

In this way, a fragmented approach can lead to **superficial learning**: you memorize information without really understanding it, or you only understand it individually and in isolation. This also causes the **loss of connections between ideas**, weakening the ability to transfer knowledge to new situations.

2. Learning debt

Added to these problems is a particularly important phenomenon: **learning debt**. The metaphor of "debt" comes from the fact that when we create a *flashcard*, we are often not delving deeply into or reflecting on the content at that moment. Instead, we hand over the task of understanding and consolidating this information to a future version of ourselves. It's as if we were saying, "I'm not putting in much effort now, but my future self will take care of reviewing and learning it well."

The problem is that the future version of ourselves may find themselves in less than ideal conditions: they may not have time, they may be tired, or they may have other priorities. And when that happens, the debt accumulates.

For example: today you create 30 *flashcards*. Tomorrow you will have to review the ones that correspond to the repetition system plus the 30 new ones you create. If you repeat this every day for weeks, you can end up with hundreds or thousands of pending cards. If one day you can't review them (for example, because you are sick or have exams in other subjects), the mountain of pending cards can grow until it becomes unmanageable.

When this happens, it is easy to experience **work exhaustion** or mental exhaustion. This situation can lead to demotivation—every day the challenge of reviewing seems greater—and **excessive dependence** on flashcards: even if you want to try other study methods, you feel "trapped" by the obligation to keep up with the pace of repetitions.

3. Illusion of knowledge

Another risk is the **illusion of knowledge**. With continued use, it is common to begin to recognize patterns and, before finishing reading the question, anticipate the answer. For example, just by reading "Who is the second level of..." you remember that the end of that sentence was "What is the second lowest level of teaching?" and, therefore, the answer was "Understanding." You have recognized the pattern of the sentence; you have not necessarily thought about what the answer to that question was, but rather memorized it as a pure phrase. This can create a false sense of mastery, especially if the cards are written in a very similar way or if the brain simply remembers the visual form of the text.

Another example of illusion could be if we ever turn over a card and, even though we haven't been able to answer it, **we recognize the answer**; if we are tired or no longer want to see that card, we can mark "I know it" instead of "I got it wrong," because "I did know it," when in reality we have only identified it by familiarity, not by active memory.

For all these reasons, it is essential to consider flashcards as a **complement** to a broader learning strategy, and not as the sole pillar on which all study is built.

And... how can we use them effectively when learning?

HOW TO USE MEMORY CARDS CORRECTLY?

The key to avoiding *learning debt* and really taking advantage of flashcards is to design them to **work on connections** and not just isolated facts.

1. Memorizing insignificant details

If you remember what we saw in the section on *Layers*, there was a **fourth layer** that corresponds to specific pieces of information that are difficult to connect logically with other knowledge.

Flashcards are especially useful here:

- If you have an isolated detail (such as a proper name, a specific date, or a formula with no apparent connection), space repetition can help you retain it.
- However, even here you can try **to increase the relevance** of that detail by looking for an association or story that makes it more memorable.

Example: If you need to remember that the "Battle of Waterloo" was in 1815, you can imagine Napoleon writing the number "1815" on a uniform before the battle. That way, it's not just a cold number.

2. Design flashcards that relate concepts

Instead of making cards with simple questions like "*What is the capital of France?*", look for questions that connect two or more ideas, for example:

- *"What is the difference between the political capital and the economic capital of a country?"*
- *"How are Paris and Brussels historically related?"*

This approach forces the brain to make connections between pieces of knowledge, preventing information from becoming fragmented and lacking context.

In addition, when you notice that you remember many cards with isolated facts (e.g., simple definitions), you can replace them with cards that compare concepts. This **reduces the total number of cards** and repetitions needed, while increasing the relevance of the information and your mastery of the subject.

For example: You are studying anatomy and have flashcards about the heart and lungs; instead of just having "Function of the heart" and "Function of the lungs," you can have a card that says: *"How do the heart and lungs interact during blood circulation?"*

3. Use in language learning

Flashcards are very popular for learning vocabulary, but it is easy to fall into the trap of learning words in too much isolation.

3.1. Learning in context

A **better way** to learn is to learn the word **together with a sentence**, within a **context**. For example, instead of just writing:

1. **Front:** "water"
2. **Behind:** "water"

You can write:

1. **In front:** "I'm thirsty, I want to drink water."
2. **Behind:** "I'm thirsty, I want to drink water."

This way, you not only learn the meaning of the word, but also how it is used and what words it usually appears with. Furthermore, if we understand the whole sentence except for the new word we want to learn, we can deduce its meaning from the context, just as we do in conversation or when reading a text. This follows the strategy of comprehensible *input*, which argues that we learn vocabulary more effectively when the new term appears in a context that we already understand almost entirely and only need one small piece to understand the full meaning. This small difficulty helps us connect the new word with prior knowledge and better fix it in our memory.

3.2. Increase the relevance of its meaning on first contact

When you encounter a new word, before putting it directly on a flashcard:

- Look up its **etymological origin**.
- Analyze whether its root is related to other words you already know.
- Connect it with a mental image or a personal situation.

Example:

If you learn the word "purpose":

- **pro** → "towards the future"
- **pósito** → "to put"
That is, "to put toward the future." This connection makes it easier to remember and gives it a meaning beyond the literal translation.

On the **back** of your flashcard, you can write this explanation or personal connection. That way, when you review, you don't just think, "What does this word mean?" but also, "What connection did I create to increase its meaning for me?" or "What was its etymological origin?"

4. Put little information on a single card

A common mistake is to create cards with very long answers or with several concepts at once. This hinders active memory because, when we don't remember one of the elements, we may mark the entire card as "not remembered" even though we know part of it.

In addition, since the information is all together, the brain cannot practice retrieving each idea separately, which reduces the effectiveness of the space repetition system.

For example, if you create a card that says:

- **Front:** "Explain all the causes and consequences of World War I."
- **Back:** a five-line text with multiple ideas.

The problem is that when you review it, you don't know if you've missed one part, two parts, or all of it, and the review becomes less accurate. It's better **to divide it into several more specific cards**, each with a single clear question, such as:

- "What was the immediate cause of World War I?"
- "Which alliance was known as the Triple Entente?"
- "What was a major economic consequence of the conflict?"

In conclusion, these strategies transform flashcards into a tool **for deep learning**, not just mechanical and superficial memorization. Space repetition ensures that you don't forget the information, but **increased relevance** and connections reduce the number of repetitions needed and improve understanding.

SUMMARY

FLASHCARDS

What are they and how do they work?

- Flashcards are cards with a question or clue on one side and the answer on the other.
- They practice **active retrieval**: they force your memory to generate the answer without seeing it.
- When used with **space repetition**, they consolidate information in the long term better than rereading.
- They can be paper or digital (Anki, Quizlet, Memrise).

Traditional use (paper)

- Front: question, keyword, or clue.
- Back: answer.
- Review, try to remember, and decide:
 - If you know it → leave it for later.
 - If you don't know it → review it again soon.
- Problem: it is easy to make mistakes with intervals when doing this manually.

Digital space repetition (SRS)

- Algorithms automatically decide when to show the card based on performance.
- When you remember well → longer interval.
- When you fail → shorter interval.
- Goal: show the card just before you forget.
- Practical example: capital of Mongolia
 - **Very good** → review in 10 days
 - **Good** → review in 3 days
 - **Almost no** → review tomorrow
 - **No** → review minutes or hours later

Disadvantages of flashcards

1. Isolated information

- Risk: fragmented learning, without connections.

- Example: learning the steps of a recipe separately → you don't know how to apply them together.

2. Learning debt

- Creating lots of cards without thinking → work that your "future self" must complete.
- Accumulation of pending cards → work exhaustion and demotivation.

3. Illusion of knowledge

- Recognizing patterns or visual forms → false sense of mastery.
- Example: anticipating the answer based solely on the pattern of the sentence.

How to use them correctly:

1. Memorize isolated details.

- Useful for names, dates, and formulas.
- You can increase relevance with visual associations or stories.
- Example: "Battle of Waterloo" → 1815 → imagine Napoleon writing the year on his uniform.

2. Relate concepts.

- Questions that connect two or more ideas → avoids fragmentation.
- Example: "How do the heart and lungs interact during blood circulation?"

3. Language learning

- Learn in context, not just isolated words.
- Example: Front: "I'm thirsty, I want to drink water." Back: "I'm thirsty, I want to drink water."
- Increase relevance with etymology or personal connections.

4. Put little information on each card.

- Avoid long answers with multiple concepts.
- It is better to divide them into specific, separate questions.
- Example: instead of "Causes and consequences of World War I," make flashcards such as:
 - "What was the immediate cause of World War I?"
 - "Which alliance was known as the Triple Entente?"
 - "What was a major economic consequence of the conflict?"

Conclusion

- Flashcards + space repetition → memory consolidation.

- Add relevance and connections → fewer repetitions, better understanding.
 - They are a powerful tool when integrated into a broader learning strategy.
-

REVIEW WITH QUESTIONS

Before continuing with this part, answer the following questions as if it were a mini exam:

1. According to **schema theory**, what happens if new information does not fit into any existing mental schema?
 - a) It is automatically stored in long-term memory
 - b) The brain creates a new schema or forgets it if it has no connections
 - c) It is always remembered because it is new and attracts attention
 - d) It is only stored if we write it down literally
2. Explain in your own words the difference between **mass repetition (cramming)** and **space repetition**. What effect does each have on short-term and long-term memory?
3. Which of the following is **not** one of the three requirements for achieving **mastery**?
 - a) Number of connections
 - b) Quality of connections
 - c) Clarity of structure
 - d) Speed of study
4. The manual explains that **linear note-taking** can even be "inferior to superficial thinking." It explains why and proposes an alternative strategy for transforming notes into a tool for deep learning.
5. It describes how **curiosity and quality questions** can act as a driver of learning, even when a topic is not initially interesting.
6. **Working memory** has a limited capacity (4-7 items). Which of the following strategies **does not** help to alleviate its load?
 - a) Grouping information into chunks
 - b) Visualizing or writing down items to unload the mind
 - c) Mentally repeating information without any support
 - d) Using diagrams and graphic representations
7. The manual argues that **deep thinking (higher level)** should not wait until the last stage of learning. It explains why starting by analyzing, applying, or evaluating can be more effective than memorizing at the beginning.

Now I will provide you with the answers so you can check what you have written.

Question 1: b) The brain creates a new outline or forgets it if it has no connections.

Question 2:

- **Massive (cramming):** Studying for many hours at a time → may help you pass upcoming exams, but the information is quickly forgotten.
- **Spaced:** Spread the review over days/weeks → facilitates long-term consolidation, as the brain reinforces connections each time it is reactivated.

Question 3: d) Speed of study.

Question 4:

- Linear notes only copy information and do not represent connections → they overload working memory and do not allow for deep thinking.
- Alternative strategies: concept maps, visual diagrams, writing down your own examples, formulating questions and answers, hierarchical diagrams.

Question 5:

- Questions spark interest and attention, even artificially.
- Curiosity makes information relevant because it responds to one's own doubts → this leads to better learning and longer retention.

Question 6: c) Mentally repeating the information without any support.

Question 7:

- When we analyze, apply, or evaluate, we are forced to understand and manipulate information, which reinforces memory and comprehension.
- This process accelerates deep learning and develops critical thinking.

AFTER THE QUIZ

You have just taken the test and now you have the corrected answers in front of you. You may feel relieved to see that some questions went better than you expected. You may also have found a mistake that you didn't think you would make. But the question I want to ask you is: **how did you really feel while you were answering?**

Did you hesitate over any of the answers? Did you find that, while you were writing, you weren't sure, but in the end it turned out to be correct? Or, on the contrary, were you convinced and then realized you were wrong? What if I told you that, deep down, the result—whether you got it right or **wrong—isn't the most important** thing? Would you believe me?

The real value of this little test is not just to check whether you got it right or wrong, but to offer you a mirror of your thought process: to see where you felt confident, where you

hesitated, and where you failed unexpectedly. This is the information that really helps us learn.

Think of it this way: when you have doubted an answer and it turned out to be correct, that indicates that there is still uncertainty. Perhaps if the question had been phrased differently, you would not have known how to answer it. These types of situations are very valuable clues as to where you still do not have complete mastery of the subject.

What we usually do, however, is look for more and more questions: exams from previous years, quizzes created by other people, and even questions generated by artificial intelligence. This makes us feel like we are reviewing well because we are exposing ourselves to many different situations. And it's true that variety helps: the more points of view we see, the more opportunities we have to better understand the subject matter. But there is a danger when we base all our preparation solely on quantity.

It's like making a statistical bet: the more exercises we practice, the greater the probability that a similar one will appear on the actual exam. This strategy may yield results in the short term, but it does not guarantee that we have truly understood the subject. The risk is that we learn specific questions instead of understanding the underlying idea. And then, if the question is slightly modified, we find ourselves lost.

That's why what you've experienced with this exam is so valuable. It's not just about seeing how many you got right or how many you got wrong, but about noticing the moments of certainty and the moments of doubt. What interests us is not the number of questions we ask, but **how we use them** to better understand.

THE POWER OF CONFIDENCE

When we finish an exam or a quiz, we often look only at the result: how many answers we got right and how many we got wrong. But there is something much more revealing than the scores: **the confidence with which we answered.**

Think about these cases: there are questions that you answered with **confidence** and then saw that they were **correct**. Perfect. But there are also others that you **answered** with **doubts** and, by **chance**, ended up being **correct**. In this second case, although the result seems good, it doesn't really tell us much. Why? Because it wasn't a success of our knowledge, **but of luck. You followed your intuition in a moment of doubt, and that is not a solid basis for learning.**

Think of a simple example: if you are asked, "What is the capital of France?", you probably know immediately that it is Paris. You don't hesitate. The information is consolidated in your mind. It is clear, stable, and automatic.

Now imagine you are asked something less familiar or a variation on the question you have seen before. You begin to doubt: "Are you sure that's right? What if it's not?" This doubt is not just a feeling: it is an indicator that **this information has not yet been fully assimilated**. You cannot rely on luck to get it right, because getting it right by chance does not mean you truly understand it. Doubt alerts you to a weak spot in your understanding, a part of the subject that you have not yet mastered and need to reinforce.

When you also receive **immediate** feedback—for example, after correcting an exam—doubt becomes a compass. If your answer was correct, but you had doubts, you see that your knowledge is not yet solid and that you need to work on it to consolidate it. Perhaps if the question had been phrased differently, you would not have been able to answer it. If your **answer** was **incorrect**, but you were sure, this is an even clearer sign: there was a **false sense of mastery**. This is the most delicate case, because we were not even aware that we were missing information. It's like a blind spot: if we don't know that we don't know, we can't improve. So, because you are just reviewing, you now have the **opportunity** to discover what confused you and why you thought you knew it.

So doubt is not just a potential mistake: **it is a way to gauge your confidence and measure the real state of your learning**. It indicates the parts of your knowledge that are fragile, poorly consolidated, or not fully understood, and therefore require more attention.

We can see this through a comparison. Imagine a doctor performing a complicated operation: if he hesitates before making an incision, he may get lucky and get it right, but he could also make a serious mistake. His work cannot depend on chance, but on complete mastery of what he does. Therefore, our learning should follow the same logic. We don't want to get it right by chance, but to understand why we got it right.

In this way, we can establish some simple rules:

- **If you know you don't know** and you fail: perfect, you've identified a weak point that needs to be reviewed.
- **If you hesitate and get it wrong**: this is also a clear clue that you should take advantage of.
- **If you hesitate and get it right**: don't be overconfident, you also need to review, because your knowledge is not yet stable.
- **If you were sure and you got it wrong**: this is the worst case and the most important one to work on, because it creates a false sense of mastery. Here you need to investigate why you thought you knew it and what went wrong in your reasoning.

In this way, reviewing questions is not a game of "right or wrong," but a tool for **mapping the weak points in our understanding**. Confidence becomes the true indicator of what we know and what we do not yet know.

Another **important detail**: when reviewing, don't just read the answers and think, "Oh, yes, this sounds familiar." This is a very common mistake, which in psychology is called the "illusion of knowledge." It may seem like you already know it, but if you can't write it down in your own words or at least outline it, you don't really know it. In the exam, you won't have this feeling of recognition: you'll have to remember and produce the answer yourself.

That's why it's so important to be honest with ourselves. Writing, even if it's just short sentences or keywords, forces us to check whether we really understand what we think we

know. It's not about writing a book every time, but about clearly recording what we really know.

In summary: **the confidence with which we answer questions is more valuable than the right or wrong answer itself**. It helps us identify where we need to reinforce our learning and better prepares us to take exams and, more importantly, to truly understand.

TYPES OF CONTENT

When we talk about how we learn and review, not all knowledge works the same way. So far, we have talked a lot about confidence: how doubting or feeling confident can give us clues as to whether we have truly mastered a topic. But this is especially useful when it comes to **theoretical content**. When we enter the realm of **procedures**, confidence alone is no longer enough.

To understand this well, we can differentiate between two main types of knowledge: **declarative** and **procedural**.

1. DECLARATIVE KNOWLEDGE

This is **theoretical** knowledge, which we can express in words and which answers the question "what do I know?" For example:

- Knowing that the capital of France is Paris.
- Knowing the rules of soccer or volleyball.
- Knowing the formula for the area of a triangle.

This knowledge is fundamental because it provides us with a **frame of reference**. Without it, it would be impossible to engage in any practical activity. If you don't know the rules of soccer, you won't be able to play properly. If you don't understand Newton's basic laws, you will find it difficult to solve a physics problem.

2. PROCEDURAL KNOWLEDGE

Here it is no longer a question of "knowing what," but of "knowing how." These are the skills that allow us **to actually perform** an action, to put declarative knowledge into practice. For example:

- Not just knowing the rules of volleyball, but being able to make a good pass or serve.
- Not just remembering the formula for a triangle, but knowing how to apply it correctly in an exercise with real data.
- Not just knowing the rules of driving, but being able to drive a car well in traffic.

Procedural knowledge involves **practice, experience, and often automation**. When a person solves equations quickly, they are not thinking about each step as if it were new; they have already integrated it and can do it fluently. When you play a sport, many movements come naturally without having to think about them step by step.

One very important thing is to understand that **we need declarative knowledge in order to arrive at procedural knowledge**. First, we have to learn the theory, the basic concepts, the rules, and the steps. This is like having a map. But just having the map is not enough: you have to go out on the street and walk.

And here's something curious: **when we practice procedural knowledge, we understand declarative knowledge better**. It's a self-reinforcing cycle. For example, you can read a description of a meal, but only when you taste it do you really understand what that flavor means. Or you may have read many times what it means to "have butterflies in your stomach," but only when you experience it do you truly understand it.

The same is true of studying: you can understand the theory of how to solve a type of math problem, but only when you do several, when you make mistakes and try again, do you truly consolidate that learning. And that is why it is very important that whenever we learn a new concept that we should know how to apply, we do so immediately, as taught in this manual.

Therefore, declarative and procedural knowledge are not separate worlds, but two sides of the same coin:

- **Declarative** knowledge provides you with the language and rules.
- **Procedural** knowledge provides you with skill and fluency.
Together, they allow you to truly master a subject and not just have a superficial understanding of it.

So, once we understand this difference, it is natural to ask: how can we practice in the best way? How can we use questions not only to review theory, but also to improve processes and practical skills? This is where the **ability to learn from mistakes** comes into play.

LEARNING FROM MISTAKES

When we talk about learning from mistakes, we must clearly differentiate the context. In **procedural** content, such as mathematics, physics, or engineering, every step is important. A small mistake at the beginning of a calculation, even if it seems insignificant, can carry through to the end and make the result completely incorrect. That is why we say that, in these cases, mistakes carry significant weight and represent a key opportunity to learn.

But how can we really take advantage of mistakes? Let's take a closer look:

1. When you don't even know where to start

There are situations in which the mistake is not a miscalculation, but rather not knowing how to start the problem. This is a **very powerful warning sign**: it indicates that you either have

not yet understood the theory, or you do not know how to relate the question to the knowledge you already have. In this case, the mistake tells you that you need to reinforce your basic understanding before you can practice complex procedures.

For example: you are given a physics problem about the trajectory of an object, and you don't even know which formula to start applying. This "initial block" is a mistake in itself, because it reveals a gap in the connection between theory and practice.

2. When you get stuck halfway through

Other times, you start solving correctly, but halfway through the process, you realize you don't know how to continue. Perhaps a calculation arises that you don't know or an algebraic transformation that you don't master sufficiently. This error is also very valuable because it shows you **which specific step you need to practice more**.

For example: you know how to set up a quadratic equation, but when you get to solving the square root, you get confused with the signs. Your mistake is no longer one of understanding the concept, but of mechanical practice.

3. When you reach the end but want to check if you got it right

Here, the error can be subtle: you think you've followed all the steps correctly, but the final result doesn't match what it should be. This is the perfect time to **investigate why**. It's not just a matter of correcting the figure, but of tracing the process and finding out exactly where you went wrong.

For example: in a long integral, everything may have been going well until you forgot a minus sign halfway through the calculation. If you ignore this error, it will happen again and again. But if you point it out and analyze it, you'll remember to be more careful in the future.

THE WEIGHT OF SMALL MISTAKES

One of the most important points to understand is that **we should not view mistakes as a one-off exception**, a distraction, or an oversight. On the contrary: every mistake we make, no matter how small, should be considered a pattern that, if we do not pay attention, **will repeat itself over and over again**.

Sometimes we say to ourselves, "I knew it, I just got confused." But that thought is a trap. If you've been confused once, you're very likely to do it again in the future, especially under pressure, such as in an exam. That's why we must adopt the mindset that **every mistake is a warning sign of something that will reappear if we don't train ourselves**.

MAKE A LIST OF MISTAKES

A good strategy is to keep track of mistakes, even the most insignificant ones. You can make a list by hand or in Excel where you write down:

- What mistake you made.

- In which exercise or context it appeared.
- How many times you have repeated it.

As the list grows, there will be mistakes that have only appeared once and others that will be repeated constantly. It is the latter that require more attention, because they are ingrained in our way of thinking or working.

Just seeing that **you've made the same mistake four or five times** makes you more aware and forces you to pay more attention next time.

For example

- **In mathematics:**

A very common mistake is to forget the negative sign when changing a term from one side of an equation to the other. For example: $7 - x = 37 \rightarrow 7 = 37 - x$

If you write "forgetting the sign when changing sides" on your list and notice that you have repeated it four times in different problems, this point automatically becomes a priority for attention.

- **In language learning:**

The same thing happens when learning languages or improving grammar, even in our native language. For example, in English, many students forget to add the "s" in the third person present tense:

- They write: *He play football every Sunday*
- Instead of: *He plays football every Sunday*

If this error appears several times in your records, you will know that it is a recurring pattern that requires a specific strategy to correct it (doing specific exercises, repeating phrases, underlining the "s"...).

The most interesting thing is that when you have this list and see that **you repeat the same mistake more than once**, it transforms the way you learn. Instead of seeing mistakes as accidents, you consider them a **map of your real weaknesses**. Each time you return to them, you increase the relevance of that detail in your memory and force yourself to find ways to avoid it: a mnemonic rule, a mental association, additional practice...

In practice, you turn your error system into an active learning tool that guides you exactly where you need to focus your attention.

In addition, there are other ways to learn from mistakes, such as writing a **logic sheet**.

LOGIC SHEET

Imagine you are standing on the bank of a river with a field notebook, like scientists do. You observe, compare, and look for patterns. You see that whatever you drop falls, that if you don't drink water you get dizzy, that a deep cut will bleed. From a specific case, you derive a general rule: that is **induction**. Thousands of thinkers—from Pythagoras to Aristotle—have done exactly that: observe reality, discover regularities, and turn them into laws or procedures that can be repeated.

Now take this scene to the study. Every exercise you don't know how to solve is like a field observation: it contains clues, conditions, and a logic that has escaped you. If, instead of turning the page, **you pause for a moment, figure it out, and make a note of it**, patterns begin to emerge. This is where **the logic notebook comes in**: your field notebook for problems, where you transform specific errors into reliable routes that you can reuse.

A **logic notebook** is a **personal mini-manual** where you convert the exercises that tripped you up into **clear and justified procedures**.

Normally, when we make a mistake, we just check the teacher's correction and that's it. But often we are left with the final answer without understanding **why we were wrong** or **what we should do next time**. On the other hand, when we make a logic sheet, it is not a collection of copied solutions: it is a living page where you write, in your own words:

- **When** the type of problem appears (the conditions that characterize it).
- **Why** you got stuck (the conceptual piece or logical step you were missing).
- **How** you should solve it next time, **step by step, with the reason for each step**.

Every time we get stuck on an exercise, we not only solve it, but we also write down **how we did it, what we discovered, and how we can apply it to similar cases**.

It is, in essence, an **active** way of dealing with mistakes: you analyze, evaluate, and generalize. It works like a small mental algorithm—almost like programming: "**If** the statement gives me A and asks me for B, **then** first I apply this principle, **then** this other one, because...". This "because" is key: it forces you to understand, not just repeat.

Thus, the logic sheet **replaces passive correction** ("I look at the solution and that's it") with **your own creation**: you discover the pattern and explain it as if you had to teach it to someone else. The result is a document that guides you when you encounter similar problems, reinforces the theory behind them, and trains your metacognition: you know what went wrong, what to watch out for, and which path to follow.

A simple example might be this: imagine you have a problem in which an object falls from a **height** and you are asked what **speed** it will have when it hits the ground. Suppose you are stuck because you don't know how to relate these two ideas.

On your logic **sheet**, you **would** make three notes:

1. **When it appears:** "When an object falls and I am asked for the final speed."
2. **What was the mistake:** "I forgot that the higher the height, the greater the speed when falling."
3. **How to solve it:** "I must remember that the object transforms all the height into speed. Therefore, the greater the height, the faster it will reach the ground."

The next time you encounter a similar problem, not only will you have the answer, but **you will** also **remember the logic**: that height and speed go hand in hand in these cases.

HOW DO YOU BUILD A LOGIC SHEET?

A logic sheet has different parts. Each one helps us organize our thinking and see clearly what we have learned and how to apply it in the future.

1. CONDITIONS

Here we write down **the general situation** that is repeated in several exercises.

It is not the specific statement of a problem, but the common pattern behind it.

For example:

- *An object falls from a certain height, and I need to calculate how fast it will hit the ground.*

These are the conditions: what we are given and what we are asked to do.

The value of this step is that we no longer think about the isolated exercise (the apple in the specific problem), but rather a **general situation** that could be repeated a thousand times in different contexts. In other words, it allows us to identify **when we can apply the same strategy**.

However, **if the context were to** change—for example, if wind or air resistance had to be taken into account—the same sheet would no longer be useful: in this case, it would be necessary **to make another one**, adapted to these new conditions.

2. SOLUTION

In this part, you write down **how you should act** whenever you encounter the conditions you have just described.

You should not only note the steps, but also **the reasons** for each step. This is key:

- *What should I do?*
- *Why should I do it this way and not another way?*

Example:

- **What do I do?**
 - Step 1: I look for a way to calculate height and speed
 - Step 2: I work them out until I find a result
- **Why do I do it?** Because I know that when the height decreases, the speed increases; there is a direct relationship between these two elements.

With this method, you stop **memorizing mechanically**. If you just repeated the steps, any small change in the exercise would leave you lost. On the other hand, if you understand the logic behind it, you can adapt the reasoning to other similar contexts.

3. WHY DID WE FAIL?

A logic sheet is born from mistakes. Here you write down **what you hadn't seen, what you hadn't understood, or what connection you were missing**, why exactly you couldn't solve it correctly at first.

Example:

- *"I failed because I hadn't realized that the higher the height, the faster it will fall."*

This section is important because:

1. It helps you become aware of your weaknesses.
2. It allows you to remember this in the future and avoid making the same mistake again.
3. It gives you clues about which theoretical points you need to reinforce.

It's almost like leaving a note to your future self: "Be careful with this, this is where I failed before."

4. EXERCISES THAT FOLLOW THE SAME LOGIC

Now you collect examples of exercises that share the same pattern. This is very powerful because it allows you **to see generalization in action**, basically relating many specific examples. They cease to be isolated exercises and begin to relate to each other.

Examples:

- Ex. 1: An apple falls.

- Ex. 6: A ball falls.
- Ex. 12: A cell phone falls.

All these cases share the same conditions: an object falls from a height and you need to calculate its final velocity.

Taking this step is like **looking for patterns in nature**: you observe that different situations, which at first glance seem different, actually follow the same logic.

In addition, relating several exercises to each other allows you to:

- Rethink them in a broader way.
- See connections that you didn't notice before.
- Have a much more useful worksheet when reviewing, since you will know which exercises to use to review that aspect.

BENEFITS

Making a *logic sheet* is not just a way to correct specific errors; it is a strategy that transforms the way we learn and review. In this way, there are a number of general benefits we gain from doing them:

1. Increased mastery

The first major benefit is that **it stimulates deep thinking**. When we write down the conditions, the solution, and the reasons behind each step, we are not just repeating formulas: we are analyzing, contrasting, and evaluating. In other words, we make our brains work at a higher level, as it forces us to recognize patterns and connect different exercises that follow the same procedure. This not only helps us solve practical problems, but also better understand both the theoretical and procedural aspects of the subject.

2. Greater clarity

Another advantage is **clarity when solving exercises**. Instead of viewing them in isolation, each exercise becomes part of a broader pattern. This gives us a global view: we are no longer faced with a list of disconnected problems, but with a set of strategies that we know how to apply when certain conditions are repeated. And that, in turn, has a direct impact on how we review.

3. Improves the efficiency of reviews

In fact, the *logic sheet* is a tool that **improves and simplifies review**. When it comes time to study for an exam, most students redo all the exercises from the course as a form of space repetition. But this has a disadvantage: if the exam presents questions that are slightly different from the ones practiced, that preparation may not be enough. With a logic sheet, on the other hand, we don't need to repeat each exercise as if it were a new case. We can

clearly see which problems follow the same pattern, identify the weak points that we still struggle with, and focus our practice on those, avoiding unnecessary repetition of those we have already mastered. This makes revision **faster, more efficient, and much more focused on what we really need to improve.**

There is also a practical aspect: long exercises, with numerous numbers and steps, often become confusing and difficult to review. On the other hand, when we have them summarized on a separate sheet, with the procedure and reasons clearly stated, we can consult them without getting lost in the details. This helps us identify exactly where we went wrong in our reasoning and understand the solution as a whole more easily.

Furthermore, it is important to note that **it is not necessary to make a sheet for each exercise.** If we did that, we would end up with an endless list. It makes sense to do them only for the problems that we really struggled with, those that we did not know how to solve or that generated the most doubts. In this way, each sheet becomes a kind of "treasure": a lesson learned that saves us time and helps us avoid making the same mistake in the future.

This gives us an additional benefit: over time, we can build up **a small book of logic** organized by topic. This personal collection will serve as our own manual, tailored to our needs and weaknesses. When it comes time to review, instead of getting lost among hundreds of exercises, we will have a clear and structured map to guide our thinking in each situation.

In short, doing *logic sheets* gives us three essential things: **more mastery, more clarity, and more efficiency.** It allows us to see patterns, understand the reasons behind the procedures, and review in a much more practical and focused way. In a way, it means going from simply repeating exercises to becoming thinkers capable of finding solutions with judgment and flexibility.

ANSWER TO THE ACTIVITY 9

SUMMARY

REVIEW WITH QUESTIONS

1. REVIEWING QUESTIONS IS NOT JUST ABOUT CHECKING IF YOU GOT IT RIGHT

The value of a quiz or short exam is not just to find out if you got it right or wrong. It is a mirror of your **thought process**:

- Where you feel confident.
- Where you hesitate.
- Where you think you know but fail.

These moments are key indicators for detecting **fragile knowledge** and deciding where it needs to be reinforced.

Key: confidence vs. accuracy

- **You know you don't know and you fail:** perfect, you've identified a weak point.
- **You doubt and fail:** clear sign that you need to review.
- **You hesitate and get it right:** you still need to review, your knowledge is not stable.
- **You are sure and you fail:** high alert, false sense of mastery.

Illusion of knowledge

- Just recognizing an answer does not guarantee that you have mastered it. You must be able to **produce the answer in your own words or outline it**.

2. TYPE OF CONTENT AND HOW WE LEARN

- We differentiate between **declarative** and **procedural knowledge**:

2.1. Declarative ("knowing what")

- This is theoretical knowledge: facts, definitions, rules.
- Example: knowing that Paris is the capital of France or the formula for the area of a triangle.
- Essential for starting any practical activity.

2.2. Procedural ("know-how")

- These are practical skills: applying, executing, automating.
- Example: performing a correct serve in volleyball, solving a triangle with real data.
- Developed through **practice, experience, and repetition**.

Relationship between the two: we need declarative skills to practice procedural skills, and practicing procedural skills reinforces and consolidates declarative skills.

3. LEARNING FROM MISTAKES

Mistakes are not accidents, but **indicators of incomplete knowledge**. They can be used in different contexts:

3.1. Types of mistakes

1. **Not knowing where to start:** indicates a theoretical gap or lack of knowledge of the connection with the theory.
2. **Stuck halfway through the process:** reveals specific steps that need more practice.
3. **Seemingly subtle final error:** the result does not match and shows deviations in the process.

3.2. Weight of small mistakes

- Repeated errors reveal patterns that need to be corrected.
- Math example: forgetting the sign when moving terms in an equation.
- Language example: forgetting the "s" in the third person in English.

3.3. Strategies

- Keep a **record of mistakes** (list or Excel) with:
 - What mistake you made.
 - In what context.
 - How many times it is repeated.
- Repetitive errors become a priority for attention.

4. LOGIC SHEET

- A logic **sheet** is a personal mini-manual that transforms mistakes into active learning:

4.1. Parts of the sheet

1. **Conditions:** general situation that repeats itself, not the specific exercise.
 - Example: "An object falls from a height and I need to calculate the final velocity."
2. **Solution:** detailed steps and reasons for solving the problem.
 - Step 1: Identify variables and formulas.
 - Step 2: Apply relationships between variables.
 - Reason: understand the "why" behind each step.
3. **Why we failed:** indicate what was not seen or understood.
 - Example: "I forgot that the higher the altitude, the greater the speed."
4. **Similar exercises:** collect cases that follow the same logic.

4.2. Benefits

- **Increased mastery:** forces deep thinking and connects several exercises.
- **Greater clarity:** problems are no longer isolated; patterns and connections are identified.
- **Effective review:** focus on weak points and avoid unnecessary repetition.
- Possibility of creating a **personal manual organized by topic**.

5. GENERAL SUMMARY

- Reviewing questions with an eye toward **confidence** helps map real knowledge.
 - Distinguishing between declarative and procedural ensures that theory and practice reinforce each other.
 - Mistakes, especially repetitive ones, are **maps of weak points**.
 - **Logic sheets** turn mistakes into active, structured learning that can be transferred to new problems.
-

3. FREE RECALL

Imagine you come home after a busy day and a friend says to you:

"Well, tell me how your day went, from when you woke up until now."

You don't have any specific questions like "Did you have any meetings today?" (a clue), nor a list of options such as "Were you at work, at the gym, or at the library?" (recognition). There is nothing here to help you directly: you have to draw on all your memory and start reconstructing the story.

Perhaps you start in the morning: you remember the smell of coffee, the cold outside, the sound of the bus arriving. Then you move on to arriving at work, the email that surprised you, that unexpected conversation with a colleague, the lunch you enjoyed, the intense afternoon at work... and so, step by step, you extract memories that were stored but not activated.

This process requires you to decide where to start, how to organize the facts, and what details to include. There are no external cues to help you: only your own ability to search, sort, and express what you have stored.

This is what is called **free recall** or *active recall*: retrieving information without any external cues. It is the most demanding form, because the brain must do all the work of locating and reconstructing the data. Unlike recognition (where the answer is already in front of you) and cued recall (where a specific question triggers your memory), here the retrieval is completely autonomous, which makes it especially powerful for consolidating learning.

Some ways to do this are by explaining a topic to someone or brainstorming.

BRAINSTORMING

Imagine yourself facing a blank sheet of paper. You know you have to study a subject, but you don't know where to start. Maybe you have random words, fragments of ideas, scattered memories in your head... but when you try to write something coherent, you get stuck. After a few seconds, you ask yourself, "Do I really remember anything I've learned?"

What happens at this moment is more common than it seems: we often know more than we think, but the ideas don't come because we're not activating them. And this is where a simple but powerful strategy comes in: **brainstorming**.

Brainstorming consists, literally, of jotting down on paper (or saying aloud) everything that comes to mind on a given topic. No censorship, no worrying about order or whether it's entirely correct. The key is to start pulling out any piece of information that may be hidden in our memory and let some ideas lead to others.

This technique, which may seem chaotic at first, has a very clear objective: to make visible what we already know and activate it so that we can work with it later. When ideas are on

paper, we no longer depend solely on our immediate memory. We have a basis from which we can organize, expand, and relate knowledge.

In short, brainstorming is a bridge between what we know and what we want to learn or remember. It is the transition from confusion to movement, from the uncomfortable silence of a blank page to a constant flow of ideas that open up new paths.

APPLICATIONS OF BRAINSTORMING

Now I will explain the main applications of brainstorming in learning:

1. Activation of prior knowledge

When we want to learn something new, our mind does not work in a vacuum: it always starts from what it already knows. The problem is that, often, this prior knowledge remains "dormant" in some corner of our memory and is not readily available when we study. This is where brainstorming becomes a key tool: it allows us **to reactivate what we already know and put it into play** before tackling new content.

As I explained in the section on '*Priming*', activating this knowledge has a direct effect on learning: when new information can be easily related to something we already know, it becomes more relevant and is integrated more solidly. Imagine that you have just thought about everything you know about horses: their anatomy, uses, interesting facts... If, after a few minutes, someone explains new information related to horses—for example, a fact about how they are used in a historical context—the connection is made immediately, without effort. On the other hand, if that information "about horses" had been dormant in your memory, you would have to make twice the effort to retrieve it before you could make the connection.

That's why we say that **activating prior knowledge is key**: it not only reminds you of what you already know, but also turns that knowledge into an active foundation on which new knowledge can take root.

Doing this visually, through brainstorming combined with a mind map, further multiplies this effect. When you put everything you already know down on paper, your working memory doesn't have to bear the entire burden: you have an outline in front of you that clearly and neatly shows the points you know and how they connect to each other. This frees up mental resources and allows you to focus on what really matters: **finding new connections, building bridges, and growing your knowledge map.**

2. Review, reinforce, and discover weak points

One of the most difficult moments in learning comes when you try to remember what you have already studied. If you have ever tried to explain a topic from memory so you can review it with a friend, you know the feeling: you start off confidently, but soon you pause, hesitate, jump from one concept to another, and in the end, you feel like your speech is a messy improvisation. It's not that you haven't studied enough, but rather that recalling everything we've learned accurately from memory alone is a very costly process that requires a lot of cognitive effort.

This is where brainstorming, supported by a mind map, comes into its own. When you write down what comes to mind and put it on paper, you are not only trying to retrieve information, but also **visualizing the path of your reasoning**. You are no longer relying solely on your internal memory: you have external support that shows you the steps, links, and ramifications of ideas.

For example, imagine you are reviewing the topic of memory forms. If you try to do it from memory alone, you may vaguely remember that there was something about "free recall" and "recognition," but you can't remember the entire classification. On the other hand, if you start a mind map, write "forms of memory" in the center, and let the first ideas come to mind, other related concepts will most likely appear as well: the advantages of active recall, the disadvantages of simple rereading, the relationship with working memory... And from there, the picture becomes complete.

It's like having to explain something from memory to someone else, like a teacher explaining something by drawing diagrams on a blackboard. **The mind map acts as a safety net: it helps you retrieve information that would otherwise remain hidden.**

In addition to facilitating recall, this exercise has another very powerful effect: **it reinforces knowledge**. When you actively try to recall what you know, **the mind map you have created for studying** and writing down, what you are really doing is practicing your ability to retrieve information without relying on external cues. It's as if you were explaining the topic to someone else, but with the advantage of being able to see the whole thread of your reasoning in front of you. This makes the information stick more firmly in your memory and allows you to access it more easily in the future.

Finally, there is a benefit that often goes unnoticed, but which is fundamental: **discovering your weak points**. When you build a mind map, the most complete and connected parts represent what you have assimilated well; on the other hand, the shorter, empty, or confusing branches are a reflection of your weak points. It's as if your brain is telling you, "You don't have a clear enough understanding of this yet." This information is invaluable because it tells you where you need to focus your attention again, what you need to review more, and where you can look for other strategies to increase the relevance of the content.

In fact, the very act of not remembering a concept at first is already a learning opportunity. When you encounter that gap, your attention focuses even more on it, and when you finally manage to fill it, the memory becomes much more deeply rooted.

3. Finding other unexplored connections

There is a subtle but profound benefit to brainstorming with mind maps: when you try to remember everything you know about a topic and put it on paper, you not only retrieve information, but **you also discover connections you hadn't seen before**. Suddenly, knowledge reorganizes itself before you, and new structures emerge that are clearer and more useful than you imagined.

It's like when you try to draw a map of your city from memory. You start writing down streets, squares, buildings... and suddenly you're surprised to see that there are alternative routes to get to the same place. Maybe you've always gone from home to work on the same main

street, but when you review the map, you realize that there's a shorter shortcut hidden behind a park. That path had always been there, but you hadn't recognized it as an option until you rethought how the city is structured.

The same thing happens with learning. When you review a topic by brainstorming, the simple act of **actively rethinking the connections** leads you to discover new avenues: more logical relationships, unexpected analogies, ways of explaining a concept that make more sense than the ones you had used before. These new connections not only broaden your understanding, but also increase your mastery of the subject and allow you to see it from different perspectives.

For example, imagine you are working on the topic of memory and already have a mind map that includes concepts such as "free recall," "recognition," and "active recall." Perhaps, upon further reflection, you realize that "active recall" is not only a study technique, but also has parallels with the way athletes train through deliberate repetition or musicians practice difficult pieces. This connection was not part of your initial map, but once discovered, it enriches your view of the topic and opens the door to better explain it and apply it in new contexts.

That's why, even if you already know a subject very well, returning to it with this exploratory attitude allows you **to gradually increase your mastery**. Each new connection is a path added to your mental map, and the more paths there are, the more flexible and creative you can be when solving problems with the knowledge you already possess.

(See Figure 12 for a visual example)

4. Finding the best way to explain a topic to someone

We've all been in that awkward situation of trying to explain a topic and ending up jumping haphazardly from one idea to another. You start out enthusiastically, but suddenly realize that you've forgotten an important point, mixed up concepts, or left your listener more confused than they were at the beginning. It's not that you don't know enough, but rather that **you haven't thought ahead about how to structure your knowledge so that it's clear to the other person**.

This is where brainstorming becomes a powerful tool. When you capture everything you know about a topic in a mind map, you make the skeleton of your explanation visible: the key points, the connections, and the logical order. This gives you much greater control, because you not only see what you want to explain, but also **how you want to guide your listener along the path of your reasoning**.

Imagine, for example, that you have to explain the concept of "working memory" to someone who is not a specialist. If you try to improvise, you might start by talking about the brain, then jump to examples from everyday life, and end up mentioning some experiment you vaguely remember. The result? A fragmented discourse. But if you've brainstormed beforehand, you have a clear structure in front of you: first, you can introduce the idea with a simple example (temporarily remembering a phone number), then link it to its function in learning, and finally add the implications for everyday life. **The explanation flows because you've mapped out the path.**

What's more, this process not only organizes your thinking, but also allows you **to adapt it to your audience**. If you explain the same topic to a student, a coworker, or a family member with no prior knowledge, the order and examples you use will not be the same. The mind map allows you to visualize all the pieces of the puzzle and choose the most appropriate ones for each situation.

In short, brainstorming before explaining a topic is not only technical preparation, but also an act of respect towards your listener: it ensures that your message is clear, progressive, and easy to follow. It is the difference between speaking "disjointedly" and **guiding the other person step by step so that they truly understand and integrate what you want to convey**.

OTHER APPLICATIONS:

In addition to practical applications for learning, there are some other quite useful general applications:

1. Increased creativity

One of the most powerful benefits of brainstorming is its direct impact on creativity. Normally, our **working memory** is limited: we can only keep a few items active at a time, which means we often forget ideas we had thought of a few minutes ago. The result is that when we construct an argument or look for solutions to a problem, we lose pieces along the way.

Imagine you are looking for ways to improve the performance of a bicycle. First, you think that it might be necessary to reduce the weight of the frame. Then you think about using a different type of chain. Later, you improve the lubrication with a different oil. But as you move forward, you forget that first idea about weight, and that prevents you from seeing a possible connection: that reducing the weight of the frame could be even more effective if you also use an oil that reduces friction. **The brain, on its own, does not always keep all ideas present at once.**

This is where brainstorming—especially when used with a mind map—gives us a key advantage. By putting everything we've thought of on paper, from the first idea to the last, we can see them all simultaneously. This allows us to combine them, link them, and discover unexpected connections that would have been lost if we had relied solely on our working memory.

This way of working has three essential creative applications:

1. **Solve problems more easily.** When you have all the options in front of you, it's easier to find combinations that really work. What seemed like isolated ideas become pieces of the same puzzle.
2. **Generating ideas for new projects.** Seeing a broad set of ideas helps you explore paths you might never have considered if you had followed only one line of thought.

3. **Eliminate creative block.** When your mind goes blank, the feeling is frustrating. But when you already have a handful of ideas visible, even if they are small or scattered, it is much easier to develop new ones from them.

2 Self-awareness

Another less obvious but extremely profound benefit of brainstorming is its ability to become a mirror of our own thinking. When we rely solely on our working memory, ideas come and go easily, like clouds quickly crossing the sky. However, by putting them down on paper—without filters or censorship—we suddenly have a clearer picture of what really lies within us.

This seemingly simple process of writing down the first things that come to mind about a topic allows us to observe patterns that were previously hidden. When we reread what we have written, we often discover **ideas that repeat themselves over and over again**, even though they arose at different times. These repetitions are not random: they often point to interests, concerns, or emotions that really matter to us, even if we were not fully aware of them.

It is as if, instead of listening to our thoughts in passing, we can see how they connect, which ones are similar, which ones repeat themselves, and which ones are linked to specific emotions. From this perspective, what seemed scattered is transformed into a map full of paths and relationships.

This practice has applications that go far beyond study. For example:

- **In a therapeutic context**, brainstorming can help bring order to seemingly chaotic thoughts. Writing without judging what comes to mind can allow us to identify recurring emotions or ideas that come up again and again, pointing to important areas of focus.
- **On a personal level**, it can help us better understand our tastes and priorities. If references to music, nature, or creative projects always appear in different brainstorming sessions, it is a clear clue to what really nourishes and motivates us.
- **When making decisions**, seeing our ideas laid out on a mind map makes it easier to understand what we value most and what causes us to have doubts. When we observe which thoughts are repeated or connected most strongly, we have more solid criteria for making consistent choices.

HOW TO BRAINSTORM EFFECTIVELY

Brainstorming is not just about writing down random words. It is a process with clear phases that allows us to transform what seems like a simple jumble of ideas into a map that reflects how we think and opens the door to new connections. The secret is to combine **spontaneity** and **organization** without breaking the natural flow of thought.

1. The main question

It all starts with asking a guiding question. Usually it is:

- *"What do I already know about this topic?"*
- or *"What comes to mind when I think about it?"*

This question is fundamental, because without a clear starting point it is easy to get lost or distracted.

Broad knowledge

If you have a lot of information on the subject, you can start by dividing it into large blocks or topics. For example, if the topic is **energy**, brainstorming could be developed as follows:

- **Energy**
 - *spiritual energy*
 - *energy production* (sources such as coal, solar, wind, etc.)
 - *energy in physics* (kinetic, gravitational potential, elastic potential, etc.)

This strategy allows you to distribute your knowledge and not get stuck in a single branch.

Delimited knowledge

If you already know you want to address a specific aspect, you can limit your brainstorming to that point alone. For example: *"energy production."* In this case, all the ideas that arise will be related to this subtopic (types of production, advantages and disadvantages, historical examples, etc.).

This approach is useful when you want to prepare a speech or text with a clear objective, because it prevents you from getting sidetracked.

The chain effect of questions

As you write, you can fuel the brainstorming process by asking yourself successive questions:

- *What does this remind me of?*
- *In what other situation have I seen this concept?*
- *What can it be related to?*

These questions act as extra fuel that keeps the flow of ideas going.

2. Spontaneity

A common mistake is to want ideas to emerge already organized or perfectly formulated. Brainstorming **is not a rational or linear process**, but rather intuitive and even chaotic. The key is to let thoughts flow as they come, without censorship.

Write without filters

When writing, don't worry about whether what you write makes sense or not, or if it seems too trivial. Write it down anyway. Often, ideas that seem "trivial" are the ones that later reveal unexpected connections.

For example, if the topic is "education" and the word "scooter" pops into your head because you remember how you used to ride to school, write it down. Later, you may be able to relate it to the concept of *the path to knowledge* or *alternative learning methods*.

Avoid mental barriers

When we filter too much before writing, we end up with an almost empty page. The idea is to do the opposite: quickly write down the first words that come to mind, as if they were 'sparks' of thought. There will be time to put them in order later.

Brainstorming

This phase should be similar to when you passionately explain a topic you love: one idea leads to another, and from that a third emerges, and so on. If someone interrupted you in the middle of your speech, you would probably forget your train of thought; the same thing happens here. That's why it's important **not to interrupt the process too soon**.

3. STRUCTURE

Once you have enough ideas on paper, it's time to give them structure. This is where brainstorming stops being a collection of unrelated words and becomes an organized system that you can understand, remember, and use.

Patterns and repetitions

One of the first things you should do is look at which words or ideas have been repeated. Repetitions often indicate that a concept is important in your thinking. From there, you can reorganize the material so that this central element plays a more prominent role.

Expand and zoom out

Sometimes we focus too much on one branch and get lost in the details. This can be useful, but there comes a time when you need to take a step back ("zoom out") to see the big picture again.

This constant movement of "zooming in" on the details and "zoom out" to see the whole allows you to detect unexpected patterns and relationships. It's like looking at an

impressionist painting: if you're too close, you only see dots of paint, but if you step back, you discover the whole image.

(See Figure 24 for a visual example.)

However, it is important to differentiate between brainstorming and mind mapping:

- **In a mind map**, the process of zooming in and out is constant, because the map is constructed with the intention of order and hierarchy.
- **In brainstorming**, we first let our thoughts flow without filters, and only when we have enough material do we move on to structuring it. If we tried to organize from the beginning as we do with mind maps, we would cut off the natural flow and lose many valuable associations.

ANSWER TO THE ACTIVITY 10

SUMMARY

BRAINSTORMING

1. WHAT IS BRAINSTORMING

- It is a technique for putting down on paper everything that comes to mind on a topic **without censorship or order**.
- Objective: to make visible what we already know and activate our memory for later work.
- It serves as a bridge between what we know and what we want to learn or remember.

2. MAIN APPLICATIONS IN LEARNING

2.1. Activating prior knowledge

- It allows us to retrieve information that remains "dormant" in our memory.
- It facilitates the connection of new knowledge with what is already known.
- Combined with a mind map, it clearly shows relationships and frees up mental resources.

2.2. Reviewing, reinforcing, and discovering weak points

- Writing down ideas helps visualize the thread of reasoning, without relying solely on memory.
- It reinforces active memory and better fixes information.
- Empty or short branches on the mind map indicate weak points to review.

2.3. Finding new connections

- Brainstorming helps to discover previously unobserved relationships.
- It allows you to reorganize knowledge and visualize clearer and more useful structures.
- E.g.: analogies with other fields, such as sports or music.

2.4. Prepare clear explanations for others

- It allows you to visualize the key points and logical order before speaking.
- It helps adapt the explanation to the audience.
- Facilitates coherent and understandable speech.

3. OTHER APPLICATIONS

- **Creativity:** helps combine ideas, generate projects, and eliminate mental blocks.
- **Self-awareness:** reveals patterns of thought, interests, and personal priorities.
- Also useful in a therapeutic context or for decision-making.

4. HOW TO BRAINSTORM EFFECTIVELY

4.1. Formulating the main question

- Example: "What do I already know about this topic?" or "What comes to mind when I think about it?"
- This allows you to establish a clear starting point.

4.2. Spontaneity

- Write **without filters or self-censorship**, letting ideas flow.
- Seemingly trivial ideas can generate valuable connections.
- Continuous flow: one idea leads to another without premature interruptions.

4.3. Structure of the material

- When there are enough ideas, look for **patterns and repetitions** to identify important elements.
 - Zooming out allows you to see the big picture and detect unexpected relationships.
 - Difference from mind maps: brainstorming flows freely and then organizes itself; mind maps seek order from the outset.
-

INTERLEAVING

Imagine you are learning to play basketball. Your coach makes you repeat the same shot **a thousand times** from a specific spot on the court. Once you have mastered it, you move on to practicing **a thousand times** from another spot. At that point, you are probably very good at it: you receive the ball where you have practiced and the shot comes almost automatically.

But... what happens in a real game? You don't always receive the ball in the same place. Maybe you have to shoot from the side, maybe while running, maybe while being defended. And if you've only practiced in a concentrated and repetitive way, when the situation changes, you freeze up or miss more than you expected.

The same thing happens with studying. How many times has it happened to us that in math, physics, or any other technical subject, we've spent weeks or months working intensively on a topic (for example, derivatives), doing many exercises in a row... but when, after six months or a year, we're asked for a derivative again, we don't remember it? The knowledge has faded because we worked on it in a very concentrated way at a specific time, but we didn't review it or combine it with other content.

These examples make us reflect:

- Perhaps repetitive and concentrated practice (doing the same thing many times in a row) is not the best way to learn in a lasting way.
- Perhaps we need a different way to train our minds and memories, a way that prepares us for **varied situations** and helps us **remember over time**.

This is where the technique of **interleaving** comes into play.

The interleaving technique consists of **alternating different types of problems, content, or skills within the same learning session**, rather than practicing a single type repeatedly and continuously.

- If you practice **in a blocked manner**, you always do the same type of exercise in a row (for example, 20 derivative problems).
- If you practice **in an interleaving manner**, you mix different exercises (for example, one on derivatives, then one on limits, then one on probability, and then back to derivatives...).

This technique **forces the brain to think each time**: first it must identify what type of problem it is facing and only then apply the appropriate strategy. This makes learning deeper and more lasting.

For example: imagine you have a sheet of math exercises. If they are all the same type (for example, all derivatives), there comes a point where you no longer need to think too much:

you just repeat the procedure from memory. On the other hand, if you have a derivative problem, a limit problem, and a probability problem on the same sheet, your brain has to **stop** each time, **recognize what type it is**, and choose the appropriate strategy. This really reinforces learning.

Another example could be in basketball: if you only shoot 100 times in a row from the same spot, your body and mind do it almost on autopilot. But if you constantly change the point from which you shoot during training—now from the side, now running, now defended—each time your brain must **recognize the situation and adjust your technique**. Over time, this makes the movement flexible and automatic, allowing you to make shots in any situation during the game.

Therefore, the key difference is:

- **Blocked:** you repeat until you get it right, but the next day it's hard to remember.
- **interleaving:** you practice in a more demanding way, but that consolidates your knowledge and makes it more useful in the long term.

HOW CAN WE APPLY IT EFFECTIVELY?

When discussing the interleaving technique, we must remember that **it makes no sense to start here**. Before applying it, the person must **understand and have a basic grasp of the fundamental procedure** of what they are learning.

1. The importance of blocked practice

Imagine you are learning to use a new type of hammer. On the first day, logically, you cannot alternate with other tools if you do not yet know how to hold it correctly. First, you must learn **the correct movement, understand the technique, and practice it repeatedly** until you acquire a minimum level of confidence.

In learning, this is what we call **blocked practice**: repeating the same type of exercise or problem many times in a row, with the aim of **establishing the basic procedure**, that is, learning a technique.

- In mathematics, this means doing only derivatives until you understand the steps and know how to solve them without hesitation.
- In sports, it would be repeating a technical movement, such as shooting a basket, hundreds of times.

This phase is essential because it is when **we build the foundations**. If we don't know how to perform the movement or procedure correctly, there is no point in trying to mix it with other techniques.

Therefore, interleaving **does not** replace blocked practice, but comes **after it**, as a way to **reinforce, review, and take learning to a deeper level**.

2. interleaving

Once we know how to apply the technique, that's when Intercalació comes into play. This consists of **mixing different content or similar problems in the same session**. For example:

- In mathematics, one problem involving derivatives, another involving limits, and another involving integrals.
- In sports, alternating free throws, moving shots, and layups within the same training session.

The added value is that each time, the brain must **stop, recognize what type of problem it is, and retrieve the appropriate technique from memory**. This prevents it from acting mechanically and makes learning more flexible and useful in real-life situations.

When we apply the interleaving technique, it is not a matter of mixing anything at random. If we were to conduct a session with **topics that are too different** (for example: a math problem, then a literary text commentary, and later an English exercise), the brain would change contexts so much that it would not take advantage of the real potential of interleaving.

What we are looking for is content that has points in common, but also clear differences.

- **Common points:** so that the brain can confuse them and therefore has to **pay attention to distinguish them**.
- **Clear differences:** so that it can **choose the right strategy** and not fall into mechanical repetition.

For example:

- **In mathematics:** mix problems involving derivatives, integrals, and limits. They are all calculus, but each type requires different strategies.
- **In sports:** mix movements that may appear together in a game (e.g., short shots, long shots, and layups in basketball), but it is not necessary to combine this with physical endurance training on the same day.

3. The importance of space repetition

However, there is a danger: even if we mix different types of problems in the same month of intensive study, this is still **concentrated practice**. In other words, it is a great effort at a specific moment, but after a few months it may disappear from our memory.

What really makes interleaving powerful is **when we combine it with space repetition**. This means that we **not** only mix **different content** in one session, but that this content **reappears after a few days, weeks, and months**.

For example:

- In the second week of study, we interleaving derivatives with limits and integrals.
- After a month, we do another session in which derivatives also appear mixed with other types of problems.
- After three months, we still find derivatives within a session of interleaving.

This has two major benefits:

- **It strengthens active recall:** every time a piece of content reappears, it is not fresh in our minds; we have to search for it in our memory and reconstruct it. This effort to remember greatly strengthens retention.
- **It keeps automation alive:** by having to apply the technique at different times and in different contexts, the brain does not "put it away in a drawer" or forget it, but keeps it available, allowing us to maintain the quality of the technique.

In other words, if we only do interleaving practice for a short period (e.g., an intensive month), we are improving, but it is still concentrated. **The leap in quality occurs when that interleaving practice is prolonged and distributed over time.** This makes learning deeper, more flexible, and more lasting.

BENEFITS OF interleaving

To conclude, here are some general benefits of interleaving.

1. Improved automation

interleaving consists of **training the brain to recognize more quickly which procedure to apply**. When we practice in blocks (many identical exercises in a row), the brain does not have to think much: it knows that they all require the same technique. But when the exercises are mixed, **we must decide on the correct strategy before acting**.

By repeating this process of **detecting** → **deciding** → **applying**, the brain becomes more agile and needs less and less time to make the right decision. This is precisely what automation is: not only knowing how to do the technique, but recognizing it and applying it almost without hesitation.

In addition, it can help us **reduce** procedural **errors** through practice and clearly differentiate between similar concepts.

2. Relationship between techniques

Another benefit is that interleaving allows us **to compare and connect different procedures**. When techniques are practiced in close succession (one after another or mixed in the same session), the brain perceives their **similarities and differences** more clearly.

This helps to establish a more solid network of knowledge: not only do we know each technique separately, but we also understand **when they are similar, when they differ, and how they relate to each other**.

The reason is that the information is fresh in our minds; this makes it easier to compare than if we had forgotten the procedures.

3. Improved mastery

Blocked practice is especially helpful for **repeating** a technique until we get it right, but that is not the same as **truly mastering it**.

Interleaving takes us one step further, because:

- It forces us to recognize when we should apply it.
- It forces us to compare it with other techniques.
- It makes us practice it in varied and more realistic contexts.

This combination is what transforms a skill that we simply "know how to repeat" into a skill that **we have mastered and can use with confidence in new situations**.

4. Improved retention

Interleaving not only helps in the moment, but also in the long term, because it **naturally combines with space repetition**.

Instead of practicing all the exercises on a topic in a single session (which would be mass practice), Interleaving causes these exercises to reappear mixed with others **over time**.

This forces the brain to **retrieve the information from memory** each time the concept reappears, and it is precisely this effort to remember that strengthens retention.

So far, we have seen that interleaving is a very powerful strategy for consolidating learning. However, we can go even further. Learning is not just about applying a technique at different times, but also about **looking at content from different perspectives**, that is, using different perspectives that allow us to understand and integrate it more deeply.

SUMMARY

interleaving

1. WHAT IS interleaving

- Alternating different types of problems, content, or skills within the same session, rather than practicing a single type repeatedly.
- Example: in mathematics, doing derivatives → limits → probability on the same sheet; in basketball, alternating shots from different points or situations.
- Objective: to force the brain to recognize the problem and apply the correct strategy, reinforcing deep and flexible learning.

2. COMPARISON WITH BLOCKED PRACTICE

- **Blocked:** you repeat the same thing until you master it; immediate effect but fragile long-term memory.
- **interleaving:** More demanding, consolidates knowledge, makes learning lasting and applicable in varied situations.

3. EFFECTIVE APPLICATION

3.1. Prior blocked practice

- This is necessary to master the basic technique before alternating content.
- Example: learning a sports movement or a mathematical calculation before combining it with others.

3.2. Effective interleaving

- Mix similar content, but with clear differences.
- Do not mix topics that are too different (e.g., math with literature and English in the same session).
- Common points: create the necessary confusion to force attention.
- Clear differences: select the right strategy and avoid mechanical repetition.

3.3. Combine with space repetition

- Repeat content interspersed over days, weeks, and months.
- Benefits: strengthens active recall and keeps automation alive.
- Example: derivatives → limits → integrals today, repeat in two weeks and again after a month.

4. BENEFITS OF interleaving

4.1. Improved automation

- The brain learns to quickly recognize the correct technique and apply it with fewer errors.

4.2. Relationship between techniques

- It allows similar and different procedures to be compared and connected, establishing a more solid network of knowledge.

4.3. Improved teaching

- Transform a skill that we "know how to repeat" into a skill that we have mastered and can apply with confidence in diverse contexts.

4.4. Improving retention

- interleaving combined with space repetition forces us to retrieve information repeatedly, reinforcing long-term memory.

5. FINAL KEY

- interleaving prepares learners to apply knowledge in real contexts, observe it from different perspectives, and integrate it deeply.
-

PERSPECTIVES

We often hear phrases like *"you have to think outside the box."* We are told that if we want to have good ideas, we must go beyond what we already know. But here a very logical question arises: **how can we think outside the box if our way of thinking is already shaped by what we know and experience every day?** Doesn't that seem like a contradiction?

In fact, it's normal for it to seem strange to us. If we only have our experience and our ideas, how can we generate something truly different? It seems almost impossible. And yet, it's not. There is a very powerful resource that helps us and also provides benefits that go beyond having good ideas: **varying perspectives**.

Think about it this way: imagine you are looking at an object, for example, a cup, from only one side. You will see a handle and a certain shape. But if you look at it from another angle, what you see changes. From one side it looks like one thing; from the other, something different. The object is the same, but your view of it depends on where you are standing.

The same thing happens with **perspectives**.

A perspective is, in essence, **a particular point of view on reality**. It is not the whole reality, but a way of interpreting it, depending on where you observe it from and your own background. In other words, perspective is the filter that makes you see and understand the world in a particular way.

When we learn to play with perspectives, we are suddenly no longer trapped in a single way of thinking. We can place ourselves in other points of view, look at the same situation from different angles, and discover options that were previously invisible to us.

HOW DO PERSPECTIVES WORK?

When we use a perspective to think, we carry out two main processes:

1. SETTING GOALS

When we adopt a perspective, **we naturally set goals**. That is, we decide—consciously or unconsciously—what we are looking for. These goals act as a kind of compass that guides us through the sea of information.

For example, if I am **a historian**, when I study a topic, I focus primarily on:

- the **causes** of a phenomenon,
- the **consequences**,
- the **chronology of events**,
- the **social repercussions**.

And in this process, our brain does something very powerful: **it activates the mental schemas** it has stored.

2. ACTIVATION OF MENTAL SCHEMAS

As I explained earlier, mental schemas are like boxes or shelves that we already have built in our memory, representing the things we already know in a structured way. When we open one of these boxes, it is much easier to put new information inside because the space is already primed. Therefore, when we study with a specific perspective, the data that fits into these schemas enters easily and is better fixed in our memory. In this way, when we study with a specific perspective and objectives, we look for information that fits into these mental schemas.

Let's imagine a more specific example. Suppose a **historian** decides to study the subject of electricity. A physicist, faced with the same subject, will focus on what exactly electricity is, how electrons work, and what physical laws describe it. The historian, on the other hand, will approach the question differently: they will look at **when** artificial electricity was first produced, **who** the pioneers were, **why** it happened at that time and not another, and, above all, what **social consequences** it had. In other words, he will analyze electricity not so much as a natural phenomenon, but as a **historical event** that transforms people's lives: streets lit up at night, more productive factories, new ways of living and working.

Why does this happen? Because once you activate **your researcher's** perspective, your brain also activates the appropriate schemas: **timelines**, cause-and-effect relationships, **patterns of how an invention can transform a society**. **These schemas are the filter through which you interpret information. Thanks to this, when you encounter a piece of information such as "the year when a street was lit with electric light for the first time," you immediately find the perfect place to fit it in, almost like when you find a puzzle piece that fits exactly into the empty space. Since the historian had activated his timeline schema, he would place this information there, before or after other dates he had learned. In other words, he would know how to place and organize that detail among the knowledge he has. On the other hand, if someone talks to him about electrons and electromagnetic fields, he will surely see it as a piece that he does not know where to place and, therefore, he will find it more difficult to retain.**

This mechanism has **many advantages** because it allows us to learn more **quickly** and in a **more organized** way. But it also has its **limits**: if we stick to only **one perspective**, we run the risk of **overlooking valuable** information that does not fit into the **activated frameworks**, in other words, the perspective with which we were thinking. That is why it is often useful to combine different perspectives. It is as if we could change our glasses: first we put on the historian's, then the physicist's, and perhaps later the economist's. Each time we see different aspects, and thus our understanding of the subject is much more complete and profound.

And... how can we do this effectively?

HOW TO USE DIFFERENT PERSPECTIVES?

The key to taking advantage of different perspectives when studying lies in **two essential attitudes: intention and variation**.

- **Intention**, because if we are not aware that we can approach a subject from different perspectives, we will simply stick with the first explanation we find, as if it were the only one possible.
- **Variation**, because it is precisely when we dare to change our point of view that we discover new connections, questions, and answers that we had not seen before.

WHY DON'T WE EVER USE MULTIPLE PERSPECTIVES?

At first glance, it seems obvious that any topic can be studied from different points of view. For example, the French Revolution can be analyzed from the perspectives of politics, economics, philosophy, or even art. But in practice, we rarely stop to do so.

This is because **we are accustomed to thinking in only one way**, the way we have been taught since childhood or the way imposed on us by the materials we use. A textbook, for example, may present a historical topic solely as a succession of chronological data. But if we stick to that view alone, we will lose sight of the human, economic, or cultural dimension behind the facts.

The problem is that **thinking differently from the norm requires a conscious effort**. It involves stepping outside the comfort zone of mental routines, and that can seem difficult or even uncomfortable. However, this is where the true meaning of "*thinking outside the box*" lies. Neither books nor notes make it easy for us; therefore, we ourselves must **actively seek other perspectives** and make the effort to step outside our mental framework.

Another important point is that books, even when they include several sections (political, social, economic, etc.), often present them **in isolation by topic**, as if they were unrelated. This can cause us to miss the opportunity to see how all these aspects are connected within the same perspective. We must do the integration ourselves.

THINK LIKE AN EXPERT

A practical way to start using different perspectives is to imagine: **"How would an expert in this field think?"**

This does not mean becoming a doctor, engineer, or philosopher overnight, but rather using our imagination to put ourselves in their shoes, even if only for a few minutes.

- **If we think like a doctor**, our interest will turn to causes, consequences, and solutions. For example, when faced with an illness, a doctor would ask: What causes it? What happens to the body when it appears? And what treatment could improve the situation?
- **If we think like a historian**, we can organize the data in a chronological order and ask ourselves: What event led to another? What people or contexts influenced it?

And what consequences arose?

- **If we think like an engineer**, we will see information as a tool for building something new: How can I apply this to solve a problem? What can I improve? What structure or mechanism can I create?

This exercise has great power: it forces us to **form new questions** that we would not otherwise have imagined, thereby greatly enriching our learning.

LIMITATIONS

However, we also need to be realistic. **If we tried to study all the possible perspectives on a single topic, we would never finish.** The amount of information that can be generated is almost infinite.

That is why it is useful **to select a few key perspectives** that will help us according to our objectives. For example:

- An engineering student does not need to make a deep philosophical analysis of a collapsed bridge, but it may be useful to understand the **historical context** of its construction and the **health consequences** of a structural error.
- A medical student does not need to understand in detail the economic processes of a historical period, but it may be useful to see how a war or economic crisis influenced the spread of an epidemic.

In these cases, the value of perspectives is that they help us to **better integrate information and give it a broader meaning.**

FREEDOM OVER SOURCES OF INFORMATION

The situation changes when we are not limited to a textbook and can consult different sources. In these cases, **perspectives become even more useful** because they allow us to compare different versions.

For example, if we are studying the concept of **freedom in philosophy**, we can confront two opposing views:

- That of those who argue that we have **free will**, that is, that we can choose our actions autonomously.
- That of those who think that freedom is an **illusion**, since our decisions are determined by biology, society, or other external factors.

This contrast not only helps us to better understand the two positions, but also forces us to **take a stand**, to reflect critically, and to construct a more personal and solid line of thinking.

Once we understand this, there are different ways to apply multiple perspectives to the study.

WHEN WE STUDY A TOPIC FOR THE FIRST TIME

When we encounter a new topic, our first reaction is often to open a book or read an article and begin memorizing facts. But if we want **to deeply understand** what we are studying, it is not enough to accumulate information: we need **to organize our perspective** before we begin. Therefore, the initial process is very important.

1. CHOOSE THE TOPIC

The first step is simple but fundamental: decide **what topic we want to study**. It may seem obvious, but naming and defining the object of study is what will give us direction. It is not the same to say "I want to study history" as it is to say "I want to study the causes of World War II" or "I want to study how RNA vaccines work." The clearer the topic, the easier it will be to focus.

2. BRAINSTORM PERSPECTIVES

Once we have the topic, we must think: **from what points of view can it be analyzed?**

We can do this by brainstorming, writing down everything that comes to mind. We will group these perspectives into three broad categories:

1. General perspectives

These are the broadest and most common perspectives that can be applied to almost any topic. Some classic examples are:

- **Politics:** How has a government, law, or ideology influenced this topic?
- **Economy:** What resources, benefits, or losses are involved?
- **Science and technology:** What role has scientific or technical development played?

These perspectives offer us a global framework, a broad context that helps us understand how the topic fits into society.

2. Perspectives based on personal or professional relevance

Here we put ourselves in the shoes of a **specific professional**. Or we think about the personal usefulness of this knowledge. It is the exercise of "how would a doctor, a banker, a programmer, a teacher... think about this issue?"

- A doctor would look for causes, consequences, and treatments.
- A banker would analyze risks, costs, and benefits.

- A programmer would think about practical solutions and technological applications.
- A teacher would focus on how to convey this knowledge to others.
In this way, the topic ceases to be just theory and connects with professional and personal life.

3. Perspectives based on key questions

These are open-ended questions that serve as a compass to guide our research. For example:

- How has World War II affected contemporary life?
- How has the digital revolution influenced human relationships?
These questions help us focus our attention and not get lost in the excess of information.

3. CONSIDER THE MAIN OBJECTIVES OF EACH PERSPECTIVE

Each perspective leads us to give more importance to some things and less to others. **Objectives** are the goals that will determine what is relevant to remember.

- If we adopt the perspective of a doctor, the objective will be to find elements that serve to improve health, such as the causes and consequences of diseases or treatments.
- If we adopt the perspective of a historian, the objective will be to understand the causes and consequences over time.
- If we adopt an economic perspective, we will focus on resources and material impacts.

This step is important because **it helps you filter information** and identify what we are most interested in highlighting from each approach.

4. CHOOSE ONE MAIN PERSPECTIVE AND A FEW SECONDARY ONES

A common mistake is to want to study a topic from all perspectives at once. This is impossible and becomes an unmanageable burden of information. The best strategy is **to choose a central perspective** (the one that interests us most or best suits our objective) and complement it with **some related perspectives**.

For example, if we are studying the **treatment of diseases**:

- **Primary perspective:** that of **the doctor** (to understand diagnoses and treatments).

- **Secondary perspectives:**

- A **historian**, to analyze the causes and consequences of how treatments have evolved.
- A **teacher**, to analyze how this knowledge has been taught over time.
- **Science and technology**, to understand the advances that have made new treatments possible.

This gives us a broader view, without getting lost in too many details.

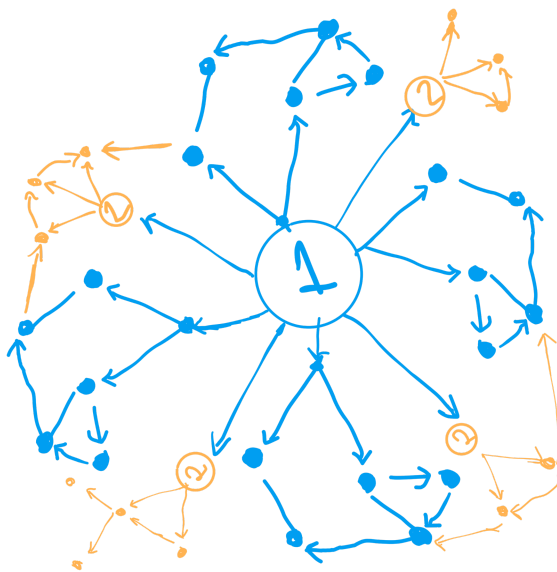


Figure 28: Image representing the structure of a mind map with multiple perspectives.

5. CREATING A MIND MAP

Starting from the central perspective, we write the secondary perspectives and associated ideas around it, as if they were branches of a tree.

- This allows us to identify gaps in information: if one branch of the map is very full and another is empty, this already tells us where we need to investigate further.

6. FORMULATING QUALITY QUESTIONS FROM THE OUTLINES

Once we have a mind map or initial outline, our mind begins to generate more precise questions based on the information represented and to use *Inquiry-based learning* more effectively.

Example: if in a timeline we indicate that one director was at the helm of a company from 2000 to 2004, and another from 2020 to today, our outline will make us notice the gap: *"Who ran it between 2004 and 2020?"*

These types of questions are more useful because they arise from a **mental order** and not from simple vague curiosity.

In addition, there are other ways in which we can use multiple perspectives, such as **when reviewing a topic we have already studied**.

WHEN WE WANT TO REVIEW A TOPIC

When we have already studied a topic for the first time and it is time to **review it**, what we usually do is try to recall exactly what we have already learned: the same notes, the same facts, the same outlines. But this method has a limitation: we only reinforce what we already know, without detecting weak points or broadening our understanding.

Therefore, review can be much more effective if we take a step further and **change our perspective**.

The first thing to keep in mind is that review should not be a mere mechanical repetition. We can use it to look at the topic **from a new angle** that we had not considered in our initial study.

For example, if we first studied the **water cycle** solely from a scientific point of view, we can now review it by thinking like a **politician or an economist**: what impact does it have on natural resource management? Or like an **ecologist**: what happens if this cycle is altered by climate change?

When we review by simply trying to remember what we already know using a mind map, as I explained earlier, we are doing free recall in its most basic form: extracting information from our minds as we learned it.

But if, instead of repeating, we create a mind map **from another perspective**, we must think about other aspects and other ways of representing the information that we had not considered before, which makes the review **more active and more powerful**.

For example:

- Instead of redrawing the same diagram of the water cycle with the same details, we can review it from the perspective of an **urban architect**: how does this cycle affect the management of cities and water resources?
- This raises new questions such as: "What happens to the water cycle in areas of extreme drought?" or "What human infrastructure can alter it?"

These questions are a clear sign that we have activated new mental frameworks and that our brain is making deeper connections. In this way, we can find **blind spots**.

When we repeat the same explanation we have already learned, we tend **to reinforce the details** we have already mastered. But when we force ourselves to look at the subject from another angle, the parts we had not fully understood, or the details we had ignored, come to light. This is due to the new questions that come to mind and that we are unable to answer or develop sufficiently well.

For example:

First time (initial study): You have learned to drive thinking only as a driver: green light → accelerate, red → stop, turn on your turn signal before turning.

Review from another perspective: Now you decide to think like a **pedestrian** or a **traffic officer**. You ask yourself: *"When I cross a crosswalk, how might the driver react?"* or *"Which parts of the city are most dangerous for pedestrians?"*

What do you discover? That, at first, you only focused on the mechanics of driving, but you hadn't thought about the importance of visibility, blind spots, or reaction times. This leads you to new questions: *"How can I anticipate the movement of a child who might suddenly cross the street?"* or *"How is traffic regulated during rush hour?"*

Thanks to this new perspective, you detect gaps in your understanding and force yourself to expand your knowledge, achieving a much more complete and deeper learning experience. This process better prepares us for situations in which we are asked unexpected questions, such as in an exam, since the change in perspective forces us to think more flexibly and cover aspects that had been dealt with superficially.

However, reviewing from multiple perspectives is not only useful for preparing for exams. Even if we are not going to be evaluated, **approaching a topic from a new perspective** is a valuable technique for our learning and for the way we think, and it provides a number of benefits:

BENEFITS

IN LEARNING

1. More comprehensive and in-depth knowledge

When we learn a subject from different perspectives, we avoid getting stuck in a narrow view. This allows us to:

- Gain a **general and comprehensive** understanding of the topic.
- Learn to apply the information in different contexts.
- Make **new and unexpected connections**: when we combine two ideas that we knew separately but had never related, connections appear that were not

evident before and that help us better understand the subject or a detail.

2. **Better distribution of focus and attention**

Each perspective has its own priorities. This forces us to look at details that previously went unnoticed or to give more importance to things that seemed secondary.

- Example 1: If you think of the year **1789**, you might only think of the French Revolution. But if you adopt the perspective of an American historian, you discover that George Washington was elected the first president that same year. Suddenly, two pieces of history are connected.
- Example 2: You know that philosophy is about the **meaning of life**. But if you adopt the perspective of **nihilism** (life has no predetermined meaning), this detail becomes much more relevant and key, leading you to rethink issues that previously seemed simple.

3. **Better retention of information**

When we look at the same detail from different points of view, we remember it better because we give it more meaning and find more connections. In addition, if we use different perspectives at different times (review), we employ the technique of **space repetition**, which is key to long-term memorization.

OTHER BENEFITS

1. **Increased empathy**

Changing our perspective helps us put ourselves in other people's shoes: understand why a doctor sees a problem in a certain way, why a banker thinks differently, or why a society acts the way it does. This makes us more understanding and tolerant.

2. **More robust critical thinking**

If we analyze a political issue from different media or perspectives, we avoid falling into biased versions. We learn to contrast, compare, and not settle for a single "truth."

3. **Ability to better nuance**

When we approach an issue from different points of view, we understand that things are not simply "good" or "bad." We discover nuances, exceptions, and conditions. This gives us a more mature and realistic view.

4. **Greater general knowledge about society**

Imagining how a doctor, teacher, programmer, or artist thinks helps us gain a broader view of the world. We avoid excessive specialization and better understand the dynamics of society, whether in the scientific, artistic, or philosophical spheres.

5. **Greater adaptability**

If we have studied a subject from multiple angles, we are able to explain it to others

by adapting to their interests. For example, if you want to explain the theory of evolution to a friend who loves art, you can use examples of the evolution of shapes and colors in nature. This flexibility helps us connect better with others.

6. **Better quality questions**

When we practice looking at things from different points of view, we become accustomed to asking more specific and useful questions. These questions guide both Inquiry-based learning and creativity. The better our questions, the deeper our knowledge.

7. **Increased creativity and problem-solving**

Thinking from diverse perspectives gives us more tools to find original solutions. Instead of getting stuck in a single way of doing things, we can imagine alternatives and "think outside the box." This is useful both for resolving personal conflicts and for innovating at work or in creative projects.

ANSWER TO THE ACTIVITY 12

SUMMARY

PERSPECTIVES

1. **WHAT IS A PERSPECTIVE?**

- It is a particular point of view about reality, a **mental filter** according to how we see and interpret things.
- Example: looking at a cup from one side shows one shape; from another side, it looks different.
- It allows us **to see options that are invisible** from a single perspective.

2. **HOW PERSPECTIVES WORK**

a) Goal setting

- Each perspective activates goals that guide searching and learning.
- Example:
 - Historian: causes and consequences of an event.
 - Physicist: laws and principles that explain the phenomenon.

b) Activation of mental schemas

- Schemas are "boxes of knowledge" that facilitate the integration of new information.
- Example: a historian remembers dates and cause-and-effect relationships, while a physicist focuses on electrons and fields.
- **Limitations:** Staying within a single perspective can cause valuable information to be overlooked.

3. HOW TO USE DIFFERENT PERSPECTIVES

- **Key:** intention and variation.
 - **Intention:** Be aware that we can view the topic from different points of view.
 - **Variation:** Change your perspective to discover new connections and questions.

a) Think like an expert

- Imagine yourself in the role of a specialist (doctor, historian, engineer, etc.) to generate new questions and enrich your learning.
- Example:
 - Doctor: causes and treatments of a disease.
 - Historian: chronology and social impact.
 - Engineer: practical applications and solutions.

b) Limitations

- It is not possible to study all perspectives.
- Select **key periods and perspectives** according to the objectives.
- Example: an engineering student prioritizes the historical context and health impact of a structural error, not the underlying philosophy.

c) Freedom regarding sources

- Consulting different sources allows you to compare versions and develop critical thinking.
- Example: debates on freedom in philosophy (free will vs. determinism).

4. PRACTICAL APPLICATION TO STUDY

When studying a topic for the first time

1. **Choose the topic:** clearly define the subject of study.
2. **Brainstorm perspectives:** write down possible points of view.
 - **General:** politics, economics, science/technology.
 - **Personal/professional:** how would a doctor, teacher, or programmer think?
 - **Key questions:** guide the search.
3. **Define objectives for each perspective:** what is relevant to remember.
4. **Choose primary and secondary perspectives:** avoid information overload.
5. **Make a mind map:** branches with perspectives and associated ideas; detect information gaps.
6. **Ask quality questions:** arising from the outlines, not just from curiosity.

WHEN YOU REVIEW A TOPIC

- Changing perspectives makes reviewing more active and powerful.
- Example: water cycle

- Initial study: scientific.
- Review: political, economic, urban planning, or environmental → new questions and connections.
- **Benefit:** Identifies blind spots, broadens understanding, and better prepares you for unexpected questions.

5. BENEFITS OF USING PERSPECTIVES

Learning

1. More complete and in-depth knowledge.
2. Better distribution of focus and attention.
3. Better retention thanks to space repetition and variation in perspectives.

Other benefits

1. **Increased empathy:** understanding how other professionals or people think.
 2. **Critical thinking:** comparing information and avoiding bias.
 3. **Ability to nuance:** understanding nuances and conditions rather than "good/bad."
 4. Broader general **knowledge** about society.
 5. **Better adaptability:** explaining a topic according to the audience.
 6. **Better quality questions:** more useful and focused on research or creativity.
 7. **Increased creativity and problem solving:** thinking "outside the box" and generating original alternatives.
-

What if we could make this review even more effective? By adding space repetition, free recall, and interleaving?

COMBINING REVIEW STRATEGIES

When we learn, there is no single technique that works magic on its own. What really makes a difference is the intelligent combination of different strategies that reinforce each other. For example, **active recall** (or free recall) forces us to retrieve information from our minds rather than simply rereading it. **Space repetition** ensures that this recall is activated at increasing intervals, which reinforces long-term memory. **Interleaving** introduces variety, mixing similar content to train our ability to distinguish and apply it correctly. And finally, using **different perspectives** allows us to see the same topic from multiple angles, enriching our understanding and establishing deep connections.

This combination becomes a very powerful strategy because it adds cognitive benefits that, when applied together, multiply both retention and real mastery of what we study. However, we should first learn to use them individually and then combine them, as without the basics, mastering them would be very difficult.

Here is an example of how you could use them together:

When we learn a topic such as the **French Revolution**, the first step is always a rather block-based practice. This means understanding the general structure: what the causes were, what the main phases were, and what consequences resulted from it. In addition, we could use the technique of **multiple perspectives** when studying, with one main perspective and other secondary ones for better understanding and integration of details. This initial contact helps us lay the groundwork and ensure that what we have in mind is correct, because without that initial framework, it is very easy to get lost when we later begin to combine techniques.

However, when we want to review this content, it is not enough to **simply reread it** from top to bottom. This is where the technique of interleaving comes into play. Instead of devoting an entire session solely to the French Revolution, we combine it with other similar or related historical processes, such as the **American Revolution**, the **liberal revolutions** of the 19th century, or the **European absolutism** against which it erupted. In this way, the brain is forced to distinguish and recognize each case in its context. It may seem more difficult at first, but it is precisely this effort to differentiate that helps us learn better and avoid confusion.

But it's not just about mixing topics. When we review the French Revolution, we can do so by adopting a different perspective each time. Once we can look at it from a **political** point of view, analyzing how it went from monarchy to republic and then to Napoleon's Empire. On another occasion, we can emphasize the **economic** perspective, examining the financial crisis and the burden of taxes at the beginning of the process. We can also work on the **social** dimension, understanding how the hierarchies between the social classes were broken down, or the **cultural and ideological** dimension, observing how the ideals of liberty, equality, and fraternity spread and marked an entire era. And it is even more enriching to use a **comparative** perspective, comparing what we know about the French Revolution with

other revolutions, such as the American or Russian Revolutions, to detect both similarities and differences.

This approach, combined with **space repetition**, becomes even more powerful. Instead of concentrating all these practices in a single week or quarter, we revisit the topic after a month and again before the final exam. In this way, the brain is forced to retrieve the information from memory and reuse it, which strengthens the memory and prolongs its duration over time. In addition, each review can be approached from a different perspective, so that it is not limited to repeating the same process, but each time we add a new layer of understanding.

The result of this method is extremely clear. On the one hand, we are able to better **automate** the recognition of techniques and historical contexts, and we reduce the likelihood of confusing processes that may seem similar at first glance. On the other hand, by establishing connections between perspectives and topics, we move from simply repeating facts and dates to truly mastering them, understanding them in depth. And finally, the combination with space repetition ensures that this knowledge does not disappear in the short term, but remains consolidated in the long term.

So, when someone later asks us why the **French Revolution** was so important, we won't just recite four facts from memory. We will be able to respond from different **angles—political, social, economic, or** cultural—and show a much richer and more complete view, which is what really differentiates those who have memorized from those who have truly learned.

SYSTEMS

Think about this for a moment: before you open a book to study, do you really know what you are doing? Do you prepare in any way, have a ritual, or just open the pages and dive in? And while you are studying, are you aware of each action—how you read, repeat, underline, or memorize? And then, once you're done, do you have a defined process, or do you just close the book and hope the information has stuck?

Many people respond that they don't have a study "system." But the truth is that we all have one, even if we're not aware of it. A system is simply **the set of things we do over and over again in hopes of achieving a specific result**. It can be as simple as **reading the book**, mentally **repeating the information five times**, rereading everything the night before the exam, and finally, doing a quick review minutes before entering the classroom. If you always follow this pattern, that's already a system. The question is not whether you have one or not; the question is whether this **system** is really **effective**.

Learning **does not** depend solely on a **specific** technique—such as mind mapping or visual summaries—but on the entire **process we apply** to the **information**: from the first contact to each time we return to it. Reducing learning to a single method is like trying to build a house with a single tool. It's true that the first step, the way we initially integrate information, is extremely important. But what makes the difference is everything that happens afterwards:

how we review, how we relate, how we test what we know, and how we make it evolve within us.

So, if you really want to understand why you sometimes don't remember what you studied, or why the results aren't what you expected, you need to take a step back and look at your system. This is where awareness comes in: being able to clearly answer two essential questions: "What am I doing?" and "Why am I doing it?"

Without this critical perspective, we become students who **ignore** the **problems** with our method and simply treat the **symptoms**. It's like trying to cure a headache by drinking coffee to stay awake: it may seem to work for a moment, but the underlying problem persists. On the other hand, when **you are aware** of what you are doing and why you are doing it, you can identify the weak points in your system and correct them. This is the first step in stopping blind studying.

Think of it this way: you're in the middle of a **game** with a circuit full of mazes and obstacles. Your goal is **to reach the end**. But instead of learning how the controller works, you just **press buttons randomly**, hoping that one of them will take you further. Maybe, with luck, you'll reach the goal someday, but it won't be because of your skill, but because **of chance**. This is the situation for many students: they work hard, devote hours and energy, but **don't** really **control** the process.

On the other hand, if you learn what each button does and how to use it in the right sequence, you no longer depend on luck. You ensure a steady path toward your goals. This is the **function** of a **conscious learning system**: it gives you **control** over your **progress**, allows you **to predict results**, and frees you from the spiral of excessive and unprofitable effort.

Conscious learning is like going from walking in the dark with a cane to turning on a flashlight that illuminates your path. And when you see where you're putting your feet, you not only move forward more confidently, you move much further.

ANSWER TO THE ACTIVITY 11

GENERAL SYSTEM

When we think about studying, we often focus solely on the moment of "getting down to it": sitting down with a book, opening our notes, or watching an explanatory video. But in reality, learning is much more than that. Our brain does not function as a simple container that is filled with information, but as an active system that **prepares, processes, and consolidates what it receives**. Therefore, the **general study system** that I present in this manual is organized into three main stages, each with an essential role that, when combined, form a **complete process** that explains what we do **before, during, and after** learning information.

The first stage is **Priming**. Before we start studying, we need to put our brain in the best possible condition to understand and absorb what is to come. It's like warming up before playing sports: it's not a waste of time, but a way to activate the structures that will make the main effort more productive.

Then comes the **Main Study Session**, the moment when we really face the information. This is not just about "reading and repeating," but about seeking to understand deeply: connecting ideas, relating concepts, and making sense of them. It is the heart of the process, but for it to work well, it depends on how we have prepared beforehand and how we will manage the next step.

And that step is **Review**. Many people forget this stage, thinking that learning is a matter of doing everything at once and that's it. But the brain forgets quickly if we don't reinforce the information. Reviewing doesn't just mean rereading everything, but applying strategies that help us consolidate our memory and make it more resilient over time.

These three stages—preparation, study, and review—form a basic and universal system. Whether you're studying to pass an exam, want to become a good professional, acquire a new skill, or simply learn for pleasure, you need to go through all three. What changes is how you adapt them according to the type of content, the time you have, and your goals.

However, there is one element that runs through this entire system from start to finish: **questions**. Questions are like a thread that guides our attention and helps us think better. When we prepare, we ask ourselves questions to activate what we already know: *What do I know about this topic? What do I expect to find?* During study, questions allow us to delve deeper: *How is this explained? Why does it happen this way? In what cases could it be applied?* And in review, questions become the best tool for checking whether we really remember and have mastered what we have learned: *Can I explain it without looking? Can I solve a problem on my own? What were the main classifications?* Thus, the quality of our learning depends largely on the quality of our questions. Therefore, throughout this manual, you will find strategies for using them more accurately and effectively. Learning to ask the right questions is, after all, one of the most powerful skills you can develop to optimize your study system.

Once we understand this, we can move on to **how the system works**.

MAIN SESSION

When we talk about study sessions, we are referring to those moments when we concentrate intensely on learning a specific topic or section. These sessions can take place either at home, studying on our own, or in class, following a teacher's explanation.

IN CLASS

In this section, we will focus primarily on **how to get the most out of a study session in class**. If your main session is in class, your goal is to get the most out of everything the teacher explains. To achieve this, there are several strategies:

These strategies focus more on the **Priming** we did before class:

1. Seek to answer questions

When we review the syllabus, many questions may arise about the topic, as it is completely new to us. So, we can write them down in a short list and refer to them while listening in class. These may be very general questions or intuitions about how the concepts relate to each other.

When the teacher begins the explanation, you already have a "radar": you look to see if what they say answers your questions. This keeps you much more attentive and makes the content make more sense, because you are not only listening, but also checking and comparing.

2. Testing hypotheses and connecting ideas

Another resource is to try to predict how concepts are related and what some concepts mean before the teacher explains them. Then, in class, you check whether your intuition was correct.

This is very valuable because when you see that you were wrong, you learn more than if you hadn't thought about those concepts. It also increases your attention in class, as you seek to verify those theories.

3. Use a mind map in real time

Instead of starting your notes from scratch and writing everything down in a linear fashion, you can bring a **basic mind map** to class that you have created by analyzing the most superficial layers of the topic, with the main ideas of the content.

As the teacher delves into the details, you can add new information directly to the map, connecting concepts and expanding on the parts that are explained in greater depth. It's true that during class the map may become a little chaotic, but that doesn't matter: the goal is **to grasp the connections** and make sense of what you hear.

Later, at home, you can review this map, reorganize it, and make it clearer. This helps you both review and reinforce your understanding of what you have learned.

For a more detailed explanation of each of these methods, return to the section on Priming.

Now, there are other ways to get the most out of class, such as capturing as much information as possible and learning in the moment, using **active listening**.

ACTIVE LISTENING

Imagine if you could learn, process, and integrate the information you hear more easily. Whether it's a live class, a video lesson, a podcast, a talk, or even a deep conversation with a friend. We often feel that understanding and retaining all this information is almost a "superpower" and that it's only possible if we take constant notes, repeat the content several times, or spend hours listening to it again.

But, in reality, there is another way. There are techniques that allow us to make much better use of the time we spend listening, and that help us learn and retain ideas without always

having to write or repeat the same content. These techniques are part of what we call **active listening**.

Active listening is the ability to listen deeply and consciously, that is, not just receiving sounds or words, but **thinking about what is being said to us** as we listen. It is a process that combines attention, reflection, and connection with the prior knowledge we already possess.

Unlike passive listening—when we let words go in one ear and out the other—active listening involves **mentally processing** the content. When we do this, each piece of information ceases to be just "what the other person is saying" and becomes a piece that we integrate into our own thinking.

Another important aspect is that active listening **does not mean obsessively taking notes** or mind mapping every video or class. That would be unfeasible and would overwhelm us. What really matters is doing **small mental exercises** that help us concentrate and activate our prior knowledge. With this, listening ceases to be a passive act and becomes an active learning process.

MENTAL PRIMING FOR ACTIVE LISTENING

When we set out to listen to content—whether it's a class, a podcast, a lecture, or even a personal conversation—our minds are not always in the right mode to understand and integrate what we are about to receive. The secret to active listening is that **preparation begins before listening**. Just as an athlete warms up before competing, we must also prepare our brains to be attentive and open to learning.

1. Ask yourself why you are listening to what you are about to hear

Before you begin, it is important to be clear about your intentions. Ask yourself:

- **What am I going to listen to now?**
- **Why am I going to listen to this?**
- **What goal do I want to achieve by listening to this?**

This reflection allows you to put your brain into "selective attention" mode. Listening to an entertaining podcast to pass the time is not the same as watching a video of a class to prepare for an exam, or a talk by an expert to improve a professional skill.

For example, if you listen to an interview about healthy habits, your goal may be to "learn a new strategy to apply to my routine." This approach means that, instead of simply letting the information pass you by, your brain will actively seek out ideas that meet the goal you have set for yourself.

2. Think of hypotheses about what will be discussed

The second step is **to activate prior knowledge**. Try to anticipate what you think the content will be about.

Ask yourself:

- "Based on what I know, what do I think they will talk about?"
- "What topics or concepts do I think will come up?"

When the brain tries to predict, it automatically searches for information stored in long-term memory and brings it into working memory. This means that when the content actually appears, it will be easier to connect it to what you already knew.

In addition, **hypotheses also activate attention**. When you have made a prediction, you are on alert, waiting to see if what is presented confirms or refutes what you had thought. This has two positive effects:

- If the content matches your hypothesis, it will be much easier for you **to remember it and connect it** to what you already knew.
- If it does not match, you will still have been paying attention, and the discrepancy will help you **readjust your understanding** of the topic.

In both cases, hypotheses act as a "mental hook" that better anchors the information.

For example: if you are going to attend a talk entitled *"Artificial Intelligence and Education,"* you can formulate hypotheses such as:

- "They will probably talk about the automation of educational tasks."
- "Perhaps they will mention the risks of technological dependence."
- They may discuss how to personalize learning with AI.

Even if you don't get it exactly right, the effort of predicting has already prepared your brain to connect the new information with what you already knew.

3. Decide that you must extract one main idea

The third step is to set yourself an **active goal while listening**: force yourself to choose the main idea you will retain from the content so that if someone asks you what the most important idea is from what you have heard, you can quote the most relevant one. Thus, we must keep this goal in mind even before listening, so that we can analyze each idea explained.

This means that, as you listen, you must constantly evaluate:

- "Is this concept relevant enough to be the main idea?"
- "Is this concept more important than the others I've heard?"

This exercise keeps your mind alert and critical because, instead of getting carried away by the flow of information, you are assessing the weight of each idea. In the end, if someone asked you, "What did you get out of this class/podcast?", you would have a clear answer.

Example: You are listening to a podcast about productivity. You might think:

- First they talk about planning techniques → seems important.
- Then they talk about rest and health → maybe this has even more impact.
- Finally, you conclude: "The most important idea is that without proper rest, no productivity technique works."

This synthesis not only improves understanding, but also helps you retain the main message in the long term.

And... what should we do while we listen?

WHILE WE LISTEN

Once we have primed ourselves mentally, the key moment arrives: listening. But active listening does not just mean letting the words ring in your ears. It means maintaining a critical attitude, selecting, pausing when appropriate, and not being afraid to take a step back to understand better.

1. LOOK FOR THE MAIN IDEA

As I explained in the previous section on finding the main idea, we must critically evaluate each piece of information in order to choose a main idea that we will decide to remember. Doing so not only forces you to choose, but also makes you think actively about all the ideas discussed, helping you to remember much more than if you just tried to remember absolutely everything.

2. CRITICIZE WHAT IS SAID

Listening carefully also involves activating a kind of critical radar. This does not mean being rude or systematically contradicting the speaker, but rather asking ourselves internal questions as if we were experts on the subject, even if we are not. When the speaker or teacher says something, you can *ask yourself*: "Does this make sense? Does it agree with what was mentioned before? Are there any contradictions? Is there enough evidence to support it?"

For example, imagine that someone says at a conference: "Drinking a glass of water every fifteen minutes improves physical performance by 50%." You can activate your critical

thinking and *think*: *"In what context? Really 50%?" Is it a general study or only in high-intensity sports? Isn't that an exaggeration?"* These types of questions make you much more attentive because you look for details, consistency, and nuances.

Another example: you hear a historian say, "All revolutions can be explained by taxes." Here, too, you might think, *"Really, all of them? Doesn't the French Revolution also have to do with social inequalities and political ideals? Aren't there other equally important causes?"* Even if you don't have all the answers, the simple act of looking for weaknesses in what is being explained forces you to listen more carefully and retain what has been said better.

This exercise turns listening into a silent debate within yourself: you are not a passive receiver, but an active participant who analyzes and contrasts.

3. TAKE BREAKS

When we listen, our brain is not a machine capable of absorbing information without limits. If we don't give it a break, the information gets mixed up and ends up collapsing. Therefore, taking pauses is one of the most important strategies for learning and listening actively. However, not all pauses are the same: there are two main types, and both are necessary.

1. Pauses to digest information

These pauses are like when you eat and need to chew before swallowing. There is no point in swallowing without chewing, because your body will not assimilate what you eat properly. The same thing happens with information: when you listen, you need to pause for a few seconds to process what you have just been told.

In practice, this means that after an important concept, you can pause and rephrase it in your own words. You might think, *"In summary, what he said is that student motivation depends more on the environment than on grades."* Or, *"If I understand correctly, the central message is that saving should be automatic and not depend on willpower."*

These pauses don't need to be long; they may only be a few seconds, but they have a huge impact. This is when information begins to transform into real knowledge. You can also use them to ask yourself questions that keep you active: *"How does this relate to what I already know?"* or *"What practical example could fit with what is being explained?"*

Example: Imagine you are in an online course on leadership and the speaker says that *"leadership is not about commanding, but about creating conditions for the team to function on its own."* If you don't pause, the statement may go unnoticed. But if you pause the video and think, *"How could I apply this to my team?" Perhaps by giving more autonomy to X person..."*, suddenly that sentence has much more value and sticks in your mind.

2. Pauses to rest

The second type of break is longer and has another purpose: to allow the brain to rest from cognitive effort. When we listen attentively and analyze critically, our brain works intensely, and that is tiring. There comes a point when you may feel overwhelmed, as if you cannot take in any more information even if you wanted to.

This is when you need to take a break to rest. You can get up, look out the window, stretch a little, or even take a deep, slow breath. The key is to get away from the information stimulus. These breaks are comparable to when you exercise: if you don't rest between sets, your muscles don't respond. The same thing happens with the brain. These breaks may seem like a "waste of time," but the opposite is true: if you don't take them, you lose much more information and, in the end, your overall performance is lower.

However, taking breaks to rest carries a risk: if you slow down too much, you may lose track of what you were thinking or the exact point you had left off. It's like interrupting a conversation and then, when you resume it, having trouble remembering what the topic was.

To avoid this, there is a very effective strategy: **ask a question before taking a break**. This question acts as a "reset point" or "*starter question*" that helps you quickly pick up your train of thought when you start listening again. It's like leaving a bookmark in your brain: instead of listening to everything from the beginning to remember where you were, you have a thread that takes you back to the same point.

The key is for this question to be clear and accurately reflect where you were in your reasoning. It is not a generic question, but one closely linked to the content and the doubt or idea you were working on.

For example, imagine you are listening to a podcast about education and the speaker says: *"The role of the primary school teacher is not only to impart knowledge, but also to guide students towards autonomy."* This makes you reflect and you decide to pause for a moment because you feel tired. Instead of simply stopping, you ask yourself the question: *"To what extent should a primary school teacher give their students freedom to develop autonomy?"*

When you resume listening, this question helps you quickly recover your previous line of reasoning: you already know what you were wondering, what you wanted to check, and how it connected to what the speaker was saying. You don't have to reconstruct the whole thought from scratch.

In addition, this habit has two additional benefits:

1. **It saves you time:** you don't have to rewind or listen to an entire section again to remember where you were.
2. **It keeps you active:** even during a break, your brain has a clear focus for when you resume, and that keeps your attention and connection to the content alive.

WHEN WE CAN'T TAKE BREAKS (live)

When we're listening live—whether in a class, lecture, or meeting—we often don't have the option to pause as we would with a video or podcast. This is where we need alternative strategies to stay on track and maintain comprehension.

1. Ask questions in the moment

The best way to "create a pause" live is **to ask the speaker a question**. A good question not only resolves your doubt, but also breaks the rhythm of the explanation, slows it down,

and creates a space for you to assimilate what has been said. It's an indirect way to pause without stopping the entire session.

For example, if you are in a philosophy class and the professor is talking very quickly about Kant, you can intervene: *"Excuse me, could you clarify what you mean by 'pure reason'? I'm having trouble connecting it to the example you gave."* This not only helps you, but also others who may have the same question.

2. Write down questions for later

If you can't interrupt or it's not the right time, another strategy is **to write down your question**. Writing down the question serves two purposes:

- It allows you to pick up the thread of your thoughts later.
- It prevents you from getting stuck trying to understand a point while the speaker has already moved on to another topic.

For example, in a work meeting, you are listening to a very technical explanation and a question arises: *"Will this have an impact on the quarterly budget?"* Instead of missing the rest of the presentation trying to answer the question right away, write it down and continue listening. Later, you can ask the question at the end, review your notes, or think about it calmly.

3. When you can't ask questions or take notes

. Sometimes you may not have any means of taking notes or be able to intervene. In that case, you have to accept an uncomfortable truth: **you won't be able to grasp and understand everything**. But this doesn't mean giving up, rather applying a conscious strategy: sacrificing some of the information to better prepare your mind and get more out of what comes next.

For example, imagine you are at a two-hour conference. After half an hour, you already feel overwhelmed: too much data, too many ideas. If you try to understand everything, the next 90 minutes will probably be chaotic and you won't assimilate anything. But if you decide, at that moment, to stop trying to understand everything and simply listen in a more relaxed way to rest your mind, when the speaker changes the subject or introduces a new section, you will be able to regain your attention with greater clarity. You may miss some of the content, but you will gain more attention and understanding later on.

It's like doing a mental "reset": we give up one part so we can better understand the next.

AT HOME

Now that we've seen how to get the most out of a session when we're in class, it's time to talk about what happens when we're alone at home. Here, we don't have a teacher in front of us, there's no pace set by anyone else, and it's up to us to decide how to study and manage our energy. That's why it's essential to have a clear strategy.

1. MENTAL PRIMING

Before you start studying, it is always a good idea to perform a mental priming. This is not a waste of time, but an investment: it allows you to approach your studies with an active and more receptive mind.

You can follow three basic steps:

1. **Activate prior knowledge:** briefly brainstorm what you already know about the topic, try to anticipate concepts, and formulate hypotheses about what you think you are going to learn.
2. **Encourage curiosity:** look for a connection with your interests, or watch a short video of interesting facts related to the topic. If you want to know more, your attention will increase on its own.
3. **Get an overview:** before getting into the details, get a broad idea of what you will be studying. You can consult a summary on the internet, an outline, or create layers of content: start with the most superficial and then go deeper.

*(In the **Mental Preparation or Priming** section, you will find a more detailed explanation of each step.)*

2. Layering

If you have to study specific material (e.g., a book or article), one of the first steps is **to organize the information into layers**: start with the general ideas, then look at the connections, and finally focus on the more specific details. This greatly helps you understand and retain the information better.

Now, if you don't have a single book, but rather many scattered materials (for example, several books on the same topic), the temptation is to study them one after another. But there is a much more effective strategy: **merge them by layers**.

Instead of finishing one book and then moving on to another, compare the information in all of them at the same level. For example:

- First, review all the general sections of the books and create a layer of basic ideas that they share.
- Then, do the same with the details or examples.
- Finally, look for differences and develop your own synthesis.

This allows you to observe similarities, contrasts, and, above all, create your own knowledge, which is much richer and deeper.

Practical example: imagine you are consulting three cookbooks on the same dish. In the first layer, you simply examine the ingredients in each one and compare them: why does one

include ginger and another doesn't? What is the reason for this? Then, in the second layer, you compare the preparation methods: perhaps one book recommends baking it in the oven and another recommends frying it in a pan. After analyzing this, you end up creating your own recipe, which combines the best of all of them.

This same process works for cooking, but also for history (comparing different versions of the same event), science (different explanations of the same concept), or even languages (comparing different grammars or dictionaries).

3. CONSUME AND DIGEST.

As I explained in the section on *layers distribution*, a very common mistake when studying at home is wanting to "swallow" pages and pages of content without pause. The problem is that this only creates the illusion of having studied: in reality, no time is spent **processing** and integrating the information.

To avoid this, we must conceive of studying in two phases:

- **Consume**: read, listen, or do exercises.
- **Digesting**: pausing, reflecting, taking notes, making connections, reviewing what you have just seen.

In addition, to reduce the cognitive effort we make when studying, we should pause to use our energy more effectively.

Methods such as **Pomodoro** (study for 25 minutes and rest for 5) or what we call **Fowmodoro**, which is similar but more flexible, are very useful: you take advantage of your concentration and, when you notice that your mind is getting tired, you take a break.

Breaks are not wasted time: they are like breathing between sips of water. If you don't stop, you end up "drowning" in information. If you stop, you have time to digest it and turn it into useful knowledge.

4. MIND MAPS

As I have pointed out several times in this manual, **mind maps** are one of the most powerful tools for studying. They allow us **to interrelate ideas**, see how concepts are connected, and understand how information is organized within our minds.

Therefore, it could be said that mind maps should be one of our **main tools** when consuming and studying information.

However, many people, especially those who study highly practical disciplines such as **engineering, computer science, music, or sports**, wonder to what extent mind maps can help them. It is a completely reasonable question.

Indeed, mind maps **are especially useful for declarative content**: concepts, theories, definitions, relationships between ideas, abstract processes... In other words, anything that can be explained with words or diagrams.

However, when we talk about **procedural** knowledge—such as solving a math problem, playing a piece of music, conducting a physics experiment, or executing a sports move—practice comes into play. And it is true that mind mapping alone **will not make you more skilled** in these procedures.

But... is it really useless?

This is where many people go wrong. As I explained in the section "*Reviewing with Questions*," it is often believed that **declarative knowledge** (knowing what something is or how it works) and **procedural** knowledge (knowing how to do it) are separate worlds. But in reality, they complement each other:

- Without **declarative knowledge**, it is practically impossible to execute a procedure well. For example, you cannot correctly apply a formula if you do not understand what each symbol represents.
- And, at the same time, when we practice a procedure, it helps us **consolidate and refine our declarative knowledge**: new questions arise, we notice details we hadn't noticed before, and we understand the theory better.

This is where mind maps can be useful even for procedural content: they help us **organize the declarative part** of the process, which indirectly **improves our practice**.

MIND MAPS FOR PROCEDURAL KNOWLEDGE

So far, we have seen that mind maps are a powerful tool for understanding and organizing theoretical knowledge. But what happens when we want **to improve a practical technique or procedure**? They can also help us, and a lot.

In fact, there are **two main ways** to do this:

1. The "Black Box Effect": understanding and optimizing what we do

Imagine that everything we do—writing, solving an exercise, playing an instrument, programming, playing sports—is like a **black box**. We perform certain actions and, in the end, we get a result. But what happens inside the box is often not entirely clear to us: we act automatically, without thinking too much about each step.

This is fine for day-to-day functioning, but if we want **to improve a procedure**, we can't just try things at random and hope for the best. We need **to understand what happens inside the box**.

This is where mind maps come into play. They allow us **to break down and analyze a process step by step**, as we did at the beginning of the manual when we studied our own study system.

- For example, imagine that every time you solve an equation, you forget to reverse the sign when you move a number to the other side. If you represent the procedure in

a mind map, you can detect that "weak point" and mark it as a critical step to pay attention to.

- Or, if you are learning a sports move, you can break it down into phases (starting position, movement, finish) and see at which step you lose coordination or effectiveness.

In this way, the mind map is not just a diagram: it becomes an **active analysis tool**. It helps you identify recurring errors, find solutions, establish a clearer system, and ultimately refine the process.

2. Inquiry-based learning: improving by asking questions

The second way to use mind maps for processes is through **active research**. Here, we don't just describe what we do, we ask questions to better understand **how and why** the procedure **works**.

Questions are key. Instead of limiting ourselves to the classic ones ("What is the difference between this and that?" or "How are these concepts related?"), we can go further with questions that link us to practical application:

- **"What would happen** if I skip this step?"
- "How can I apply this concept to a real project?"
- "Is there a faster or more efficient way to do this?"
- **"What would happen** if I changed the order?"

We can **capture** these questions, and the answers we get, **in a mind map**. The result is a kind of **fusion between a flowchart and a mind map**, where we represent:

- Conditions (if I do A → B happens; if I don't do A → C happens).
- Variations (how the result changes depending on time, temperature, intensity, etc.).
- Alternatives (different paths to reach the same goal).

This is especially useful when we learn through **practical projects**. For example:

- If you are learning to program and trying to make a website, you can represent all the questions and solutions that arise along the way in a mind map ("What happens if I use this function?" "How can I reduce the code?").

- If you are learning to cook, you can compare what happens if you change an ingredient or vary the cooking time.

As you collect questions and answers, the mind map becomes a **visual research notebook** that not only helps you improve your technique, but also allows you to better understand the theory behind it.

In short, when we use mind maps in these two ways—**process analysis with the "black box effect" and research through** questions—we achieve a double improvement:

1. **We refine the technique or procedure** (how to solve problems better, faster, and more effectively).
2. **We consolidate and deepen the theoretical knowledge** we need to practice.

ANSWER TO THE ACTIVITY 13

SUMMARY

MAIN SESSION

When we talk about study sessions, we are referring to moments when we concentrate intensely on learning a specific topic. These can be at home, studying on our own, or in class, following a teacher's explanation.

IN CLASS

If your main session is in class, the goal is to make the most of everything the teacher explains. Key strategies:

1. **Seek to answer questions**
 - Review the syllabus before class and write down any questions or insights you have.
 - During the explanation, check whether what the teacher says answers your questions.
 - Stay focused and make sense of the content.
2. **Test hypotheses and connect ideas**
 - Predict relationships or meanings of concepts before the teacher explains them.
 - Checking whether your predictions are correct increases learning and attention.
3. **Use a real-time mind map**
 - Keep a basic mind map with the main ideas.

- As the teacher goes into more detail, add details and connections.
- At home, review and organize the map to reinforce understanding and review.

ACTIVE LISTENING

- Active listening: listen deeply, process, and connect with prior knowledge.
- It is not about obsessively taking notes, but rather performing mental exercises that activate attention and comprehension.

Priming for active listening

1. Ask yourself why you are going to listen

- Set clear goals: what you will listen to, why, and what you want to achieve.
- Examples: podcast on habits → goal: learn a strategy for your personal routine.

2. Think of hypotheses about what will be discussed

- Anticipate topics and concepts.
- Connect with prior knowledge to facilitate understanding.
- Hypotheses serve as mental hooks that anchor information.

3. Decide on the main idea to extract

- Mark what will be the most important idea of the session.
- Evaluate each concept you hear: Is it relevant? Is it more important than others?
- Example: podcast on productivity → main idea: without adequate rest, no technique works.

While listening

1. Look for the main idea

- Select and prioritize information; this helps you remember better.

2. Critique what is being said

- Activate critical thinking with internal questions: "Does this make sense?", "Are there any contradictions?", "Is there any evidence?"
- Example: general statements, compared with prior knowledge, help you retain information better.

3. Take breaks

1. Pauses to digest information

- Briefly reflect on what you have heard and rephrase it in your own words.
- Ask yourself questions to stay active.

2. Pauses to rest

- Let your brain recover cognitive energy.
- Asking a question before the pause helps you quickly pick up where you left off.

When we can't take breaks (live).

1. Ask questions in the moment.
 - Questions create a pause and help assimilate information.
2. Write down questions for later.
 - This allows you to pick up where you left off and avoid getting stuck at a certain point.
3. When you can't ask questions or write them down
 - Accept that you can't take everything in; listen more relaxed to better prepare your mind.

Main session → AT HOME

MENTAL PRIMING

1. Activate prior knowledge: brainstorming, hypotheses.
2. Encourage curiosity: connection with interests, short videos.
3. Get an overview: outline or general map before the details.

LAYERED DISTRIBUTION

- Organize information gradually: general → connections → details.
- Merge scattered materials by comparing similar layers.
- Example: compare ingredients and preparations from three cookbooks to create your own recipe.

CONSUME AND DIGEST

- Consume: read, listen, do exercises.
- Digest: reflect, take notes, make connections.
- Methods such as Pomodoro or Fowmodoro help manage energy and breaks.

MIND MAPS

- They allow you to relate ideas, see connections, and understand mental organization.
- They are especially useful for declarative content: concepts, definitions, and theories.
- They also help with procedural knowledge if the declarative part of the process is analyzed.

Mind maps for procedural knowledge

1. Black Box Effect

- Analyze processes step by step to detect weak points and optimize procedures.
- Example: equations, sports movements → identify critical errors.

2. Inquiry-based learning: improve by asking questions

- Questions about application, variations, and alternatives.
- Example: programming → what happens if I use a different function?
- Mind maps serve as a visual notebook for research and consolidation of theoretical knowledge.

Final benefit:

- Double improvements: refinement of the procedure and consolidation of the theoretical knowledge necessary for practice.
-

In addition, we can think of other ways to use mind maps to improve our procedures, but first we must master the technique of mind mapping. So, here are some ways to improve systematically:

HIIT: Intensive mind mapping practice

Imagine an athlete preparing for a competition. He knows that to have a chance of winning, he needs to lift 100 kg off the ground. But right now, he can only lift 60. What should he do? We all intuitively know the answer: train consistently, with discipline and using a method that will lead him, step by step, to increase his strength. If he simply lifted weights haphazardly, without a plan, he would hardly achieve his goal. On the other hand, if he works regularly, with adequate intensity and well-designed techniques, his muscles will respond and he will eventually reach 100 kg.

Now let's apply this example to our case. We don't want to lift weights, but rather improve our **ability to make mind maps**. But the logic is the same: if we want to progress, it's not enough to do it occasionally or in a scattered manner. We need specific training, with repetitions, intensity, and progression.

This is where a concept from the world of sports comes into play: HIIT, which stands for *High Intensity Interval Training*. Athletes use it to improve their physical performance in a short time, alternating periods of very intense effort with short rest periods.

We will adapt this same idea to learning: we will hold short but highly concentrated sessions on creating mind maps. The goal is not so much to "learn a specific topic" as it **is to train our ability to think and organize ideas quickly**. Just as an athlete does not lift weights just for the sake of lifting them, but to gain strength, we will practice mind mapping not only to memorize a topic, but to gain agility, clarity, and quality in the way we represent knowledge.

WHY DOES IT WORK?

The HIIT method applied to mind mapping works because:

- It forces us to work with **mental intensity** in a short period of time, which accelerates the automation of techniques.
- It helps us improve our **speed of analysis and synthesis**, because we don't have time to get lost in unnecessary details.
- It helps us **think in layers**: distinguishing the essential from the secondary.
- It creates a habit: if we repeat short, intense sessions, the brain gets used to this type of organized thinking.

So, even if our first mind maps are rudimentary or full of words instead of symbols, intensive repetition will mean that, over time, we improve without even realizing it.

DIFFERENT PARTS OF THE TRAINING

1. CHOOSING THE CONTENT

Imagine that you want to train your mind in the same way that an athlete trains their body. Athletes choose the right exercises for each goal (strength, speed, endurance, etc.). Well, the same applies in our case: not all content is equally suitable for practicing mind mapping. Some texts are more appropriate because they allow you to clearly see ideas, relationships, and hierarchies; others, on the other hand, can confuse you or waste your time.

Therefore, the first question is: **What type of content should we choose?**

1. Declarative content

Declarative content is mainly made up of **concepts, data, and theories**. For example: a biology topic on the nervous system, a history chapter on the French Revolution, or a philosophy section on Kant.

These texts are usually full of ideas that need to be **structured** and **connected**, and that is precisely what a mind map does best. On the other hand, if the text were just a narrative story, with dialogues or anecdotes, there would be little to distill and we would not get as much out of the exercise.

2. Dense content:

The second criterion is that the text should be **dense**. This means that it should not be full of parallel stories or details that do not contribute much to understanding.

For example, a chapter in a textbook is usually dense: in just a few pages, there are many important ideas, definitions, and related concepts. In contrast, an informative article or a novel can be much more scattered.

3. Well-defined content:

Another criterion is that the content should be **well-defined and objective**. This means that it should have few possible interpretations and not be overly abstract.

If the text is too ambiguous or philosophical, you can get lost in debates and subjective interpretations, which would defeat the purpose of our training: to practice **clarity and structure**.

For example, it is easier to practice with a summary of geology than with an essay on "what is freedom."

4. Relevant content

Finally, there is one very important criterion: the content must be **relevant to you**.

Motivation and curiosity are powerful fuels for learning. If the topic interests you, it will be easier to concentrate, you will make the effort more naturally, and the mind maps will be more vivid and useful.

Therefore, you can start by choosing topics that you already like and, later on, when you have more practice, venture into other fields that you initially find less appealing.

WHAT SOURCES CAN I USE?

Wikipedia articles are a simple and effective resource. They are encyclopedic-style texts, dense, declarative, and with clear and structured information. In addition, you can always start with topics that catch your attention: a scientific concept, a historical period, an artistic movement...

If the document is too long or complex, it is not necessary to cover everything. **You can select a specific perspective or** subtopic that you want to understand better and focus the exercise on that.

You can also ask artificial intelligence to explain the main topics on a subject in detail. This way, you can ask specific questions about the aspects that interest you most, asking the artificial intelligence to follow the first three requirements.

2. SET A TIME LIMIT

Once we have chosen the appropriate content, it is time to put it to the test. And here comes into play an element that may seem simple but makes all the difference: **limited time**.

What makes this study session special is not only what we work on, but **how we do it in a very short period of time**. The goal is to force our brains to think more intensely, more clearly, and with greater capacity for synthesis.

The rule is clear: the next steps must be completed in **30 minutes maximum**.

And... **why so little time?**

When we have little time, our brain cannot get distracted by secondary details or long and complicated notes. We are forced to:

- **Think more deeply:** there is no time to copy the entire text, so we must capture the essence of the ideas.
- **Summarize and simplify:** we cannot write long sentences. We must reduce it to keywords, outlines, or drawings that help us understand the relationships and represent them.
- **Automate the process:** by repeating this process so intensely, we will learn to find connections and summarize information faster and faster with practice.

Furthermore, we cannot expect to master every detail of a topic. This is actually an advantage: we learn to **prioritize**. First, we focus on the **most general layer**: the basic ideas, the essential concepts. Then, if we have time, we add deeper layers of detail to better understand. We do this because, if time runs out, at least we already have a solid mental map with the main structure of the topic.

It's like training a muscle: at first it may seem stressful, but as we repeat it, our mind becomes more skilled and efficient.

3. ACTIVATION OF PRIOR KNOWLEDGE

Before we start building a mind map, we need to activate what we already know. It's like **warming up before playing sports**: it prepares the brain and makes it easier for new information to stick to existing knowledge.

1. How do we do this?

We can use techniques we've already seen:

- **Quick brainstorming with a mind map** → In a couple of minutes, write down everything that comes to mind about the topic. It doesn't matter if it's correct or incomplete. The goal is to bring ideas to the surface.
- **Hypotheses about what we will find** → Write down what you expect to find in the content before reading it. It's a way of "predicting," and this will make the brain more attentive to confirming or correcting those predictions.

The key difference

Regular brainstorming can be slow and thoughtful. Here, however, **we have to move quickly**. The limited time forces us to activate as much prior knowledge as possible in a very short time.

4. CONSUME

Once we have activated what we already know, it is time **to absorb the new information**. But not just any old way: we must learn to **deconstruct**.

That is, we must separate the content into its most essential parts so that we can then reconstruct it into a clearer mental map. The main steps are:

- **Extract keywords** → instead of complete sentences, note down key concepts.
- **Layering** → organize the information according to its level of importance. What is essential? What is secondary?
- **Ask lots of questions** → question the information: is it well structured? Is it complete? What is missing? And try to find answers in the content itself or with the help of artificial intelligence.

However, unlike a normal study session, **we don't stop** here. The idea is to work as hard as possible for a short period of time, even if it seems tedious or even too much. This overload

is **at the heart of the exercise**: just like at the gym, you can't ask someone else to lift the weights for you. You build endurance and strength by making the effort yourself.

At first, doing this intense exercise will quickly exhaust you. But, just as when we train physically, with repetition:

- **You gain mental endurance.**
- **You become more agile** at summarizing and organizing ideas.
- **You see concrete results** in your ability to grasp and process information.

5. DIGEST

After consuming and breaking down the content into smaller parts, it's time to digest. This step is key because it's when we stop being passive receivers and become creators of mental structure.

Here we take the list of key concepts that we have classified by layers and compare it with the initial **brainstorming** we did to activate our **prior knowledge**. It is as if we were placing two maps in front of us: one of what we already knew or intuited, and the other of what we have discovered. The task now is to bring them together, see where there are similarities, where there are differences, and, above all, where new connections appear that we had not seen before.

This process takes shape in the construction of **the mind map**. It is not just a pretty picture or a quick outline: it is a tool for making the relationships between concepts visible. The more interconnected it is, the better. This is where symbols, metaphors, and visual aids come into play to help us better fix ideas in our minds. The mind map thus becomes the place where **you** really **learn** the content, because you restructure it with your own understanding and express it in a way that makes sense to you.

6. TEACHING: Testing our knowledge

Once we have built the mind map, there is still one final step to get the most out of it: **teaching it**, or **checking that we have learned it**. Trying to remember and explain to someone else—even yourself—what you have just learned is one of the most effective ways to consolidate knowledge.

The idea is clear: save the mind map and spend a few minutes trying to reconstruct it from memory, as if you were a teacher. Explain to yourself what each part means, how they connect, what metaphors or analogies you used, and whether they are really effective. This not only tests your immediate memory, but also the clarity with which you have structured the information.

Furthermore, even if very little time has passed since you learned the content, this small effort of immediate repetition already has a significant impact on its consolidation. With

practice, you can take it further: instead of just repeating the same thing, try to explain it from another perspective or with a different example. This forces the brain to rethink the content from new angles, making it much more flexible and profound.

Ultimately, this last step is what turns learning into solid knowledge: you not only understand, but you are able to explain, reinterpret, and apply what you have learned.

7. ANALYZE AND CRITICIZE:

When the session comes to an end, we have everything we have produced in front of us: the initial brainstorming, the main mind map, and, in some cases, notes or memory versions. This is the time to stop and analyze.

First, let's go back to the **initial brainstorming session**. What went well? Did we remember useful concepts or did we just ramble in one direction? Are there patterns that helped us connect ideas, or did we just repeat irrelevant aspects? Criticism here helps us understand how we activated our prior knowledge and how we could do better.

Next, we review the **original mind map**. We look at it with a critical eye: does it really meet the requirements of a good map? Is it grouped? Does it have clear and interconnected connections? Does it have enough symbols and visual aids to help us remember? Are the ideas organized in a directional way with an emphasis on the most important ones? In this step, we not only look for what is wrong, but also what has worked well, so that we can repeat and refine it in future sessions.

Finally, we identify the **weak points in our understanding**. What parts did we not remember when trying to reconstruct the map from memory? Why did we not fully understand a part of the topic? Perhaps a metaphor was missing, perhaps the symbols were too poor, or perhaps we did not pay enough attention to a key detail. Here we can circle those weak points in red, as a visual reminder to return to them with greater awareness.

This reflection gives rise to a very useful tool: the **list of mistakes and successes**, or a **logic sheet**. Here we note down both things to improve and positive points. Over time, this list becomes a mirror of our habits: we will identify patterns of mistakes that we repeat, but also good practices that are becoming established. This makes us more aware of our own learning process: we can pay more attention to our weaknesses, recognize the positive aspects, and document our progress.

8. NEW IDEAS: IMPROVING AND LOOKING TO THE FUTURE

Once this critique has been made, it is time to look toward solutions and new opportunities. It is time to generate **new ideas**: how could we have made the mind maps better?

Here we can do a quick brainstorming session with alternatives: perhaps we could have avoided so many crossed arrows, added more visual metaphors, used more personal symbols that really evoke the idea, or organized the concepts more clearly. It is a quick and creative correction exercise that prepares us for the next session.

In addition, this is a good time to **think about new topics** we would like to study. After completing a topic, questions, connections, or curiosities usually arise. Writing them down provides us with material for future practice and keeps our motivation alive.

When all this is done, it is important to take a **short break**. Recovering mentally for a few minutes is key before tackling another intense session. This way, we will arrive with renewed energy and be able to put into practice the ideas for improvement that we have just generated.

Ultimately, this process of analyzing, critiquing, and proposing new ideas is not just for improving mind maps: it is a complete training of all the skills we need to study well. We learn to manage time, activate prior knowledge, analyze and contrast information, summarize, distinguish what is important, and review effectively.

At first, we may still take notes that are too linear, with too many words and little visual clarity. But that is precisely why we practice: because, little by little, this way of working accumulates. Although initially we only reap a few benefits, such as learning to layer information more quickly, over time this effect multiplies.

The key is to understand that it is not just about making a more aesthetic mind map, but about training our way of thinking and learning. Each session is an opportunity to detect patterns, correct them, and move toward deeper and more effective learning.

ANSWER TO THE ACTIVITY 14

SUMMARY

HIIT

What is HIIT applied to mind maps?

- Inspired by **high-intensity interval training** in sports.
- **Short, intense** sessions to improve the ability to think and organize ideas quickly.
- Objective: to acquire **mental agility, clarity, and quality**, not just memorize content.

Why does it work?

- It strengthens **mental intensity** in short periods → automates techniques.
- Improves **speed of analysis and synthesis**.
- Helps you think in **layers**: essential vs. secondary.
- Creates a **habit**: intensive repetition → unconscious improvement.
- First rudimentary maps, then clearer and more efficient maps.

Parts of HIIT training

1. Choosing the content

- **Declarative**: concepts, data, theories. Example: history, biology, philosophy.
- **Dense**: concentrated, without unnecessary details.
- **Well-defined**: few interpretations, clear and objective.
- **Relevant**: interesting to you → motivation and concentration.
- **Recommended sources**: encyclopedic articles, Wikipedia, AI to summarize topics.

2. Set a time limit

- Sessions of **30 minutes** maximum.
- Advantages of short time limits:
 - Think **deeply** without getting distracted.
 - **Summarize and simplify** ideas quickly.
 - **Automate** the synthesis of information.
- Prioritize **general ideas** first, then details.

3. Activate prior knowledge.

- How to warm up before playing sports.
- Techniques:
 - **Quick brainstorming**: everything that comes to mind.
 - **Hypotheses** about what you expect to find.
- Difference: do it **quickly**, without extensive reflection.

4. Consume the information

- Separate the content into essential parts.
- Steps:
 - **Extract keywords**.
 - Layering: fundamental vs. secondary.
 - Ask questions: structure, gaps, relationships.
- Working nonstop → intentional mental overload.
- **Benefits: mental endurance, agility, better processing.**

5. Digest

- Combine prior knowledge with new information.
- Build the final mind map: relationships between concepts, symbols, and visual metaphors.
- Objective: transform information into understood and structured knowledge.

6. Teach

- Explain the mind map to yourself or someone else.
- Consolidation:
 - Recall the information.
 - Reinterpret it with new examples.

- **Result: solid and flexible knowledge.**

7. Analyze and critique

- Review:
 - Initial brainstorming → what worked and what didn't.
 - Final mind map → connections, symbols, organization.
- Identify **weaknesses and strengths**.
- Create a **list of successes and mistakes**. → Document progress.

8. New ideas and future

- Generate **improvements for the next mind map**: symbols, metaphors, clarity.
- Choose **new topics** → maintain motivation and curiosity.
- Take a **short break** before the next session.

KEY SUMMARY

- Objective: **train the mind** to create quick and effective mind maps.
 - Key: **intensive repetition, time limits, prior activation, digestion, and criticism**.
 - Final benefit: **better understanding, synthesis, mental agility, and consolidated knowledge**.
-

In addition, there is another way to improve our mind maps, and that is to develop them **based on metacognition**.

BASIC MIND MAPS

So far, we have mainly talked about applying techniques for working with information: consuming it, deconstructing it, reconstructing it, and representing it in a mind map, that is, practical ways to improve mind maps. But there is another equally important element: **theoretical understanding of the basics**.

It is not enough to make mind maps mechanically. If we do not thoroughly understand why we do what we do, how we learn, and how memory works, we remain on the surface. On the other hand, when we master these foundations of metacognition, each technique we apply gains depth and flexibility.

This means that the more we understand the fundamentals—why it is necessary to activate prior knowledge, why it is useful to vary perspectives, why metaphors and symbols work—the better we will be at adapting techniques to different content and situations. What's more, when our mastery is deep enough, we can even **invent new techniques** tailored to our particular needs, as I have explained in the different levels of mastery. We don't just copy what we already know, but open the door to go further.

FREE MEMORY OF THE BASICS

A powerful way to reinforce this mastery is to create **mind maps from memory** about the very foundations of learning and metacognition. In other words, we not only create maps about an external subject (history, science, languages...), but also about the very techniques and theories we are learning.

We can start with a quick brainstorming session: what do we remember about metacognition, layering, and the role of metaphors? Then, we transform these ideas into mind maps, actively looking for what we hadn't thought of yet, connections that aren't obvious, and new relationships between concepts.

Even if we have already created a map of that foundation when we learned it, the difference is **in creating new ones after assimilating the general concepts**. It is in this repetition, always looking for new connections, that deep learning occurs.

Many of these connections may seem **small** or **insignificant**. But, as with the drops of water that form a river, it is these small **accumulated** connections that make the difference in the long term. They explain the distance between what we know today and what we will know in five months if we continue this practice.

CHANGING PERSPECTIVES

A particularly useful resource for deepening our understanding is the technique of **multiple perspectives**. It involves "thinking outside the box" by comparing concepts that, at first glance, we may never have related.

For example, we can make a mind map comparing **interleaving** with the use of **multiple perspectives**. Both concepts have variation in common, but each works with it differently: one applies to the sequence of studying several topics, the other to observing the same concept from different angles. Making these kinds of comparisons forces us to find commonalities and differences that we had not seen before, and that enhances our understanding.

These types of maps not only reinforce memory, but also provide us with greater mental flexibility to apply knowledge in new contexts.

INTERRELATIONSHIP BETWEEN MIND MAPS AND BASES

Thus, when we do this work, a **positive feedback** effect occurs. The better we understand the foundations of metacognition, the better the mind maps we create. And, in turn, the more and better maps we make, the better we understand the foundations, because we are putting them into practice and seeing them "in action."

It is a **virtuous circle**:

Deep understanding → high-quality mind maps → greater understanding → even better mind maps. And so on.

So, to get even more out of this process, we can even devote some **HIIT study** sessions exclusively to working on the basics of the manual: for example, making a mind map about the difference between the **different levels of mastery** and the **different review techniques**.

These sessions force us to express and critique the nuances of the techniques, and in this way we internalize them better. It's like weight training, but instead of working out our bodies, we're strengthening our understanding and adaptability.

REVIEWING THE SYSTEM

Once we understand that every time we encounter information or think about it, we are reviewing it. And, as we have seen in the manual, there is no general and absolute way to review, as it varies according to our needs. However, we can always follow some "basics," such as:

1. Spread out reviews over a period of time rather than accumulating them all at once.
2. Look for variations, both in the tasks we choose in a review session (interleaving) and in the way we visualize the information (Perspectives).
3. Make the way we try to remember information as active as possible, avoiding passive rereading or simply recognizing the information. From answering questions to trying to extract everything we know about a topic through brainstorming.

So, considering that retrieving information in some way is essential for effective learning, here are some general ways to review:

1. Review, restructure notes or mind maps, clarify doubts, or answer questions asked in class on the same day after class. This works as a first review of the information, which significantly increases our retention according to space repetition.
2. Whenever we deal with declarative content, we look for ways to apply it: both in exercises (such as in mathematics) and by reviewing a procedure. In this way, we practice procedural skills to learn this information and actively extract knowledge from our minds to solve a problem. Thus, for each error or new way of solving or acting that we discover, we can write it down in a list of errors or on a logic sheet.
3. To review topics you studied some time ago, you can create a memory mind map to identify the parts you are less familiar with and reinforce your knowledge, or try to do it from another perspective to think "outside the box" and discover points of view that were not explored in the main sessions.
4. Explain the content we have seen during the day or summarize the entire topic to a classmate who does not understand it, looking for other ways to explain it to suit their knowledge or simplify the ideas. This helps you to remember freely and actively, and to find relationships you had not considered before, as you try to think of other ways that you had not needed to consider until then.

SYSTEM FOR UNDERSTANDING A CONCEPT

The challenge of when we "don't understand"

Imagine this situation: you are reading a book, following an explanation in class, or trying to solve an exercise, and suddenly you get stuck. The words are there, you have read them several times, but you cannot grasp the meaning. Perhaps you ask a classmate, look for an explanation in another book, or even resort to artificial intelligence, but you still feel the same sense of emptiness. What blocks you is not only the fact that you don't understand, but also not knowing why you don't understand or what to do next.

This experience is very common. It happens to all of us, from those who are just starting to study basic math to professionals reading specialized articles. And it's a disconcerting feeling: on the one hand, you want to move forward, but on the other, you feel like you're missing a piece of the puzzle, even though you don't know which one. It's a kind of mental fog, where the most unsettling thing is not having a compass to show you the next step.

At times like these, we tend to try different things: rereading the text, memorizing it mechanically, asking someone who knows more, or searching for summaries on the internet. Sometimes this works, but many other times it doesn't. And when it doesn't work, the tendency is to abandon that point and leave the question unresolved, as if it were an open folder in our mind that we never completely close. The result is that we accumulate half-baked knowledge, and that weakens our entire learning structure.

This manual has already presented several keys to how we learn: the importance of foundations, the role of mental frameworks, the value of relating new information to what we

already know... But one question remains: **what do we do when, even with these tools, we encounter a concept that we cannot understand?**

To this end, I present the system you will find below. It is a simple, practical, and flexible proposal that aims to provide you with **more clarity** when you are faced with a concept that you find difficult. It serves as a guide to help you overcome the feeling of "I don't know what to do."

This system is based on a fundamental idea: when we don't understand, it doesn't mean we are incapable of learning, but rather that we need to find a different way of approaching the problem. The system, therefore, is a way of orienting ourselves, of putting order into the steps we can take to make understanding possible again.

Why don't we understand?

Before getting into the system I propose, it is worth asking ourselves a basic question: **why do we find it so difficult to understand a concept the first time we encounter it?**

Often, when we get stuck, we feel that it is because "we are bad at that subject" or that "we don't have enough ability." But in reality, difficulties are usually due to some very specific and universal factors. When we know what they are, it is easier to identify what is happening to us and find a solution.

We can summarize the main causes into three broad categories: problems with the basics, conflict with what we already know, and cognitive overload. Let's look at them one by one.

1. Problems with the basics

Just as a house cannot be built without a solid foundation, no new concept can be understood if the "premises" that support it are missing. Here we find two types of difficulties:

a) Conceptual foundations

Sometimes we don't understand a concept because we lack essential prior information. For example, trying to understand the theory of relativity without first mastering the notions of acceleration and force is like trying to solve a puzzle without all the pieces. You may have some clear fragments, but the whole picture doesn't fit together.

It also happens when we have the basics, but we haven't connected them enough. Knowing what a derivative is and what speed is is different from clearly seeing how a derivative describes the change in speed. The connection is the key that transforms scattered data into understanding.

b) Linguistic foundations

Other times, the problem is not so much the concept itself, but the words used to describe it. Academic texts, especially in philosophy or highly technical disciplines, can use dense language, full of specialized terms or complex abstractions. This can make it difficult to

understand what a word means or how all the words relate to each other to understand the overall meaning of the sentence. So it's not that you don't understand the idea: it's that you don't fully understand the words that are trying to express it.

This becomes even more evident if you are studying in a language that is not your mother tongue. You may understand the literal translation, but you miss the nuances, and those nuances are precisely what give meaning to the whole. It's like reading a recipe where you understand the ingredients but not the cooking verbs: you may have the elements, but you don't know what to do with them.

A common case is when **two definitions seem to say exactly the same thing, but in reality they hide a subtle and important difference**. If you don't have sufficient linguistic sensitivity, you may conclude that they are synonyms and lose sight of the distinction. For example, reading that "education" and "training" are the same thing may seem correct at first glance, but in many contexts it is not: "training" can refer to a more technical or academic process, while "education" also encompasses values, attitudes, and personal development. If we do not perceive these nuances, our understanding becomes biased.

2. Conflict with what we already know

The second major reason we don't understand is related to how we relate (or don't relate) the new to what we already know.

a) Not making enough connections

A common mistake is to try to learn a concept as if it were an isolated island, without connecting it to what we already know. Imagine you want to learn the concept of "function" in mathematics. If you don't try to see how it is similar to and different from other ideas you already know (such as "equation" or "proportion"), you will find it much harder to assimilate. Understanding is built when we ask questions such as: *"What is this like?"*, *"How is it different?"* or *"How does it connect with what I already knew?"*

b) Making connections, but in a confusing way

The opposite can also happen: you try to make connections, but they don't fit. The new concept **conflicts** with what you already know. For example, you may have heard that "dieting" means eating much less, and when someone explains to you that it can also simply mean "learning to balance nutrients," your previous framework will clash with the new one. You have the basis for understanding it, but you can't integrate it because the connection seems contradictory.

The problem here is that, unable to establish a clear and meaningful connection, you end up leaving the concept in a superficial mental drawer. You vaguely remember it, but you can't rely on it when you need it.

This is exacerbated if the sources of information are not helpful. And here there are two possibilities: either the information is **poor or confusing** (it doesn't explain the key differences well) or it is simply **wrong**. In both cases, the effect is the same: you try to make the connection, but there isn't enough clarity to do it properly. That's why it's so useful to

compare different sources: not because you don't trust the first one, but because each perspective complements and reinforces your understanding.

3. Cognitive overload

Finally, sometimes the problem is not a lack of foundation or conflict with prior knowledge, but simply that the brain is saturated.

Imagine you've been studying a dense subject for hours, with lots of diagrams and formulas. Even though you know the words and have the basics, there comes a point where nothing else sinks in. It's like trying to fill a glass of water that's already full: the new water just spills out.

Cognitive overload is just that: too much information at once or too much fatigue to process it. At times like these, the best thing to do is not to keep trying, but **to take a break** or **break** the content down into smaller, more digestible chunks, or distribute the information in layers. Just as no one swallows an entire meal in one bite, the mind needs time and manageable chunks to "digest" information.

STEPS OF THE SYSTEM

This system is divided into three main parts: *Search, Understand, Relate*:

1. SEARCH

When we don't understand a concept on the first try, the problem is often not our ability to learn, but rather that we lack a solid foundation. Learning is like building a house: if the foundations are not well laid, no matter how much effort we put into putting up walls and ceilings, everything will be unstable. In learning, this means that before tackling a new concept, we must master certain prior ideas and have them sufficiently clear and connected.

Why is it key to seek out the foundations?

Let's imagine that we want to solve an advanced physics problem. To do so, intuition is not enough: we must have a solid **mathematical foundation** and a well-established **theoretical foundation in physics**. And these foundations, in turn, can be broken down into even more basic parts. For example, if we do not understand derivatives well, we will find it difficult to understand the concept of acceleration, and without this, we will not be able to work correctly with forces.

This research process is essential because it provides **clarity on the points we need to address first** before investing a lot of time in trying to understand a concept that may still be beyond our reach. In this way, we avoid frustration and gain a much more secure learning path.

How can we conduct this search for foundations?

There are several practical ways to identify and clarify what foundations we are missing:

1. **Brainstorm on your own**

Write down everything that seems related to the concept we want to learn. For example, if we are studying a physics topic, we can divide it into general blocks:

- *Procedural mathematical foundation* (calculations, formulas).
 - *Conceptual mathematical foundation* (what a derivative or a limit means, etc.).
 - *Procedural physics foundation* (problem solving, application of formulas).
 - *Conceptual physics foundation* (what is force, what is acceleration, etc.).
- Then, break down each block into more specific units: "derivatives," "acceleration," "types of forces," "sum of forces," etc. You can even break it down further according to your specific needs.

2. **Break down the concept into prerequisites**

Ask ourselves: *What does this concept depend on? What should I understand first?*

This method forces us to take a mental step back and discover if we are missing any intermediate steps.

3. **Consult external sources**

- Many books or courses already indicate the necessary prerequisites before starting.
- We can also take advantage of digital resources: for example, ask artificial intelligence or search the internet to find out what prior knowledge is necessary to master a specific topic. This can save us a lot of time and give us a clearer picture of what we are missing.

4. **Quick self-assessment**

Another method is to try to do an exercise or explain the concept in our own words. If, during the process, we realize that we cannot justify a step or that we are missing a key definition, we will have detected a gap in the basics that needs to be reinforced.

This allows us to draw up a complete list of the topics or subjects we need to review or study.

2. UNDERSTAND

Once we have a list of the fundamentals that need improvement, the next step is to study and understand them in depth. To do this, we must **classify this content** in order to better organize our learning and make the most of our time.

To do this effectively, we can classify the content according to:

- **Its importance.** Not all premises carry the same weight. Some are essential because, without them, we cannot move forward; others are secondary and can be added later. Prioritizing helps us invest our time more wisely.
- **Its type.** There is conceptual knowledge (theory, definitions, principles) and procedural knowledge (knowing how to apply, solve, use). There is also the linguistic dimension: understanding words and how they are articulated within a sentence.

An everyday example: imagine you want to learn how to cook a complex dish, such as paella. It is not enough to know the recipe (theoretical knowledge); you also need to master basic techniques such as sautéing or controlling the doneness of the rice (procedural knowledge). If you have one without the other, the result will be incomplete.

3. RELATE

Often, what really fails is not having read enough or memorized more, but **relating** what we learn to what we already know. Ideas do not live in isolation: they only acquire meaning when we connect them with others.

Returning to the example of cooking: you may know what "sofrito" means and you may have read about bomba rice, but if you don't understand how these elements relate to each other in the paella-making process, you will never make a good paella.

Conflict between pieces of knowledge

There are times when, despite having a solid foundation and having worked to understand a concept, we still find it difficult to assimilate it. As I explained earlier, one of the main causes may be that this new concept **conflicts with prior knowledge** that we have already consolidated. The key to solving this problem is to ask yourself quality questions and find out what your real doubt is, and that can take a little effort. So, I propose a strategy for identifying the knowledge that causes conflict when learning new information.

Strategy for resolving conflicts

1. Clarify what you already understand

Make a list or brainstorm similar concepts that you already master or concepts that appear in the same topic. Writing them down helps to unload your working memory and see clearly what ideas are at stake. Often, we fail to understand something because we have to think about several elements in order to connect them all effectively.

2. Compare actively

Ask yourself: *What is the difference between the concept I want to understand and the concept I already know?* If the definitions seem the same to you, continue with more specific

questions:

- *Why does the definition seem to be the same?*
- *In what context does one concept apply and not the other?*
- *What specific examples differentiate them?*

3. Ask quality questions

This comparison process leads you to ask **fundamental questions**. Questions are key: when you find a clear and coherent answer, this can be the turning point in understanding and integrating the new concept. Thus, the clearer the question that represents your doubt, the more effective the answer will be.

In this way, we can see that conflict is not a problem, but an opportunity. When we manage to identify and overcome these contradictions:

- **We reinforce our understanding:** distinguishing between similar concepts forces us to understand them more deeply.
- **We promote mastery:** we can only say that we truly understand a concept when we are able to answer successive questions about it and differentiate it from others.

And... if after doing all these steps, I still don't understand?

BACK TO THE BEGINNING

Then it's time to go back: perhaps we are missing a premise, perhaps we have not understood a basic concept well enough, or perhaps we have not related it with sufficient depth. The system is not linear, but cyclical: Search → Understand → Relate → and, if necessary, start again.

CHECK

Finally, it's time **to check**. To certify that we have really understood something, we can check by solving an exercise, explaining our interpretation to a teacher or friend, or even asking an AI to ask us questions to verify that we have mastered it. If we can convey it clearly, it's a sign that we have really understood it.

ANSWER TO THE ACTIVITIES 15 and 16

SUMMARY

SYSTEM FOR UNDERSTANDING A CONCEPT

The challenge of when we "don't understand"

- We read or hear information, but we can't understand its meaning.
- The feeling: **mental fog**, with no compass to know what to do next.
- Common problem: rereading, rote memorization, asking questions, or searching for summaries often does not resolve the situation.
- Without a solution, **half-baked knowledge** is generated, which weakens learning.

WHY DON'T WE UNDERSTAND?

- Main causes: **problems with the basics**, **conflict with prior knowledge**, **cognitive overload**.

1. Problems with the basics

- **Conceptual foundations:** lack of essential prior information or connections between concepts. Example: derivative and velocity.
- **Linguistic foundations:** difficulty with terms or nuances of language. Example: "education" vs. "training."

2. Conflict with what we already know

- **Not making enough connections:** learning as if the concept were isolated → difficulty integrating it.
- **Making confusing connections:** the new concept clashes with prior knowledge → superficial memory and lack of clarity.
- Comparing sources helps reinforce understanding.

3. Cognitive overload

- Too much information or mental fatigue → information is not properly assimilated.
- Solution: rest, break down content, or distribute information in layers.

SYSTEM STEPS: SEARCH, UNDERSTAND, RELATE

1. Search

- Objective: identify **necessary foundations** before tackling a new concept.
- Strategies:
 - **Brainstorming:** break down into specific blocks and units.
 - **Break down prerequisites:** ask "What does this concept depend on?"
 - **Consult external sources:** books, courses, AI.
 - **Quick self-assessment:** Explain in your own words or do an exercise.

2. Understand

- Study the basics in depth.
- Classify according to:
 - **Importance:** essential vs. secondary.
 - **Type:** conceptual, procedural, and linguistic.

- Example: cooking paella → theory (recipe) + practice (frying, controlling the rice).

3. Relate

- Connect new knowledge with what we already know.
- Strategy for conflicts:
 - **Clarify prior knowledge:** brainstorm related concepts.
 - **Actively compare:** identify differences and contexts of application.
 - **Ask quality questions:** resolve crucial doubts → effective integration.

4. Go back to the beginning

- If you still don't understand: review the basics, comprehension, and relationships.
- The system is **cyclical**: Search → Understand → Relate → Start over if necessary.

5. Verification

- Validate learning by solving exercises, explaining to someone, or asking questions with AI.
 - Sign of success: **convey the concept clearly**.
-

ACTIVITIES

Here you will find the descriptions of the activities proposed in the manual:

MASTERY

ACTIVITY 2

Now that we have seen the different types of mastery, think about different content that you have at different levels of mastery (remember, understand, apply, analyze, evaluate, create).

INQUIRY-BASED LEARNING

ACTIVITY 3

From the previous activity, in which you classified some topics or concepts according to your level of mastery, look for ways to think more deeply about the concepts you classified as those you can only remember or understand individually, in order to increase your level of mastery.

For example, when you understand a concept individually, try to **contrast it** with other similar ideas. You can do this by asking yourself higher-level questions, such as:

- *What is the difference between A and B?*
- *In what contexts could I apply this information?*
- *Is my definition clear enough? Is there a better way to explain it?*

In this way, you follow a **Inquiry-based Learning process** that helps you deepen your understanding and formulate specific questions. This allows you to think more critically and gain greater mastery of the subject.

SCHEMA THEORY

ACTIVITY 4

If you had to assess the knowledge you classified as "high mastery" in exercise 2, do you think you have **quantity**, **quality**, and **clarity** in your mental schema on this topic? What about the knowledge you classified as low level (remembering, understanding)? Which of these three points are you lacking the most?

MIND MAPS

ACTIVITY 5

After reading how to make a mind map, try to practice the instructions provided. Read the following text and try to make a mind map following the **GRINDE** requirements, as best you can:

"Education (According to Wikipedia)

Education is the process by which knowledge, skills, and character traits developed in a person are transmitted. It can take various forms: formal education, which takes place within a structured institutional framework—such as public schools—following a specific curriculum; non-formal education, which also follows an organized approach but takes place outside the traditional school system; and informal education, which results from unstructured learning generated through everyday experience.

The different levels of formal education include early childhood education, primary education, secondary education, and higher or tertiary education. In addition, it can be further classified according to the teaching method—such as teacher-oriented or student-oriented—or according to the subject matter, for example, science, language, physical education, among others.

The term "education" can also refer to the mental state or qualities of a person considered "educated," as well as the academic field that studies educational phenomena. This field, known as education studies, investigates the nature of education, its objectives, its effects, and methods for improving it, encompassing subfields such as the philosophy, psychology, sociology, and economics of education.

The exact definition of education and its objectives are a matter of debate. There is disagreement about the extent to which education differs from indoctrination and how to encourage critical thinking. However, in general terms, education socializes children within society, transmitting cultural values and norms, and equipping them with the skills necessary to become productive members, thus promoting economic growth and awareness of local and global issues.

Various factors influence educational success: psychological factors such as motivation, intelligence, and personality; social factors such as socioeconomic status, ethnicity, and gender, often associated with discrimination; and other elements such as access to educational technology, teacher quality, and parental involvement.

In terms of historical context, education was mainly informal in prehistoric times, through oral communication and imitation. With the emergence of ancient civilizations and writing, there was an expansion of knowledge that facilitated the transition to formal education. Initially, this was reserved for the elite or religious groups. With the invention of the printing press in the 15th century, access to books became more widespread, improving literacy. The 18th and 19th centuries marked the importance of public education, driving the global movement to provide free and compulsory primary education. Today, more than 90% of children of primary school age attend school.

(Contains suggested answer)

ACTIVITY 6

From now on, try to take non-linear notes on all of the following content in this manual to deepen your understanding and develop more effective notes as a form of constant practice.

You can use **the summaries** in each section to help you find keywords and synthesize ideas.

Layering

ACTIVITY 7

Based on the explanation provided in this section on the different types of layers of information, identify the key words and information in the following text and classify them into the four types of levels.

Different learning styles

The theory of learning styles holds that each person has a preferred way of learning and that, if teaching is adapted to that way, academic results improve. This idea, although appealing and intuitive, is not supported by solid scientific evidence.

Over the years, various models have been proposed to describe these styles. One of the best known is the VARK model, developed by Fleming and Mills (1992), which distinguishes four types of learners: those who learn best with visual information, those who prefer auditory stimulation, those who rely primarily on reading and writing, and those who need a kinesthetic approach, that is, to manipulate and experiment. Also noteworthy is Kolb's model (1984), which distinguishes between active, reflective, theoretical, and pragmatic learners.

These models have had a strong influence on education, as they have led many teachers to personalize teaching strategies according to the supposed preferences of students. However, scientific research has cast doubt on this practice. For example, a study by Pashler et al. (2008) reviewed numerous studies and concluded that there is no solid evidence that adapting teaching to a specific style improves results. Similarly, an analysis by Newton and Miah (2017) pointed out that most studies supporting this theory are based on anecdotal evidence and that, furthermore, classifying students into rigid categories can be limiting. Other authors, such as Willingham (2009), have also warned that focusing solely on one style can reduce the opportunity to develop new ways of learning.

As an alternative, several researchers have argued that it is more effective to combine different learning methods and channels. According to Mayer (2009), a multimodal approach, including visual, auditory, and practical elements, promotes better understanding and retention of information. Similarly, research by Hattie (2012) shows that methodologies such as cooperative learning or problem-based learning lead to better results, as they actively engage students and encourage them to think and solve problems collectively. Examples of such practices include group discussions, simulations, and practical projects, which combine different styles and allow for more comprehensive learning.

In short, although learning style theory was very influential and continues to be recognized, current research indicates that it does not have a solid scientific basis. Rather than adapting teaching to a fixed style, what really benefits students is offering varied and flexible experiences that combine different ways of learning.

MENTAL PRIMING (PRIMING)

ACTIVITY 8

Based on what you have learned about priming when studying a new topic, prepare for the next topic, "Review," by following all of these steps:

a). First, activate your prior knowledge of the topic using the techniques explained above (brainstorming, hypothesizing about what will be explained or what you would like to be explained) **(Contains suggested answer)**.

b). Once you have activated your prior knowledge, read the following text, which summarizes the main points we will cover and corresponds to the most superficial part of this topic:

Review is one of the key parts of learning. It is not enough to understand content at the moment: if we do not review it, the information is erased over time. Reviewing helps to consolidate what we have learned, reinforce connections with prior knowledge, and keep our memory active. But not all reviews are the same: how we do it is as important as how often we do it.

One of the most effective techniques is **space repetition**. The ideal approach is not to repeat many times in a row, but to spread the repetitions out over time. Thus, when the brain begins to forget, reviewing forces it to retrieve the information, making it more solid. This idea is explained by **the forgetting curve**: immediately after learning, we remember a lot, but if we don't review, our memory quickly fades. Each active review reinforces the information and slows down its decline.

It is not enough to repeat mechanically: review must be **active**. This involves trying to remember without looking at the text, explaining it in our own words, solving problems, or relating it to other ideas. The quality of the initial learning is also important: if we have understood well from the beginning, reviews will be more effective and less frequent; otherwise, it will be necessary to insist more.

There are different ways to remember information:

1. **Recognition**: identifying information when we see it, as in a multiple-choice test. This is the simplest way, but it does not guarantee deep recall.
2. **Cue-based recall**: memory is activated by a question or detail that serves as a cue. This is very useful in education and therapy, as it focuses memory on specific information.
3. **Free or active recall**: retrieving information without any external help. This is the most demanding, but also the most powerful way to consolidate learning. Examples: explaining a topic to someone, brainstorming, or reconstructing a complete story.

In summary, reviewing is not just a matter of time, but of strategy: spreading out reviews, making them active, and combining different forms of recall helps information to be retained and transformed into consolidated knowledge. This priming allows us to better understand what we know, what we need to strengthen, and how to formulate questions to learn more effectively.

c). Now, based on the information you find in the summary, do the following:

1. Start stimulating your curiosity and asking questions that will later be answered when we actually study the entire topic. These may be aspects that you have not fully understood, asking yourself how different concepts are related, how we can apply them, etc. **(Contains suggested answer)**
2. Seek to understand and master the information you find in the summary as much as possible, assimilating as much as possible through mind maps, dividing the information... in order to create a solid foundation and more easily understand the concepts presented:

REVIEW WITH QUESTIONS

ACTIVITY 9

Now that we understand the importance of confidence, answer the following questions, taking into account your level of confidence when answering. (Contains answers)

1. What is the main function of **working memory**?
 - a) To store information permanently
 - b) To temporarily hold and manipulate information while we perform a task
 - c) To store personal memories long-term
 - d) Automatically deleting irrelevant information
2. According to the manual, what happens to information that **we do not initially pay attention** to?
 - a) It also goes into long-term memory
 - b) It remains only in short-term memory and quickly fades away
 - c) The brain stores it in latent schemas in case we need it later
 - d) It is automatically transformed into a meaningful connection.
3. Richard Feynman argued that we must "leave room for doubt." Explain how to apply his idea when studying and how it relates to **deep thinking**.
4. The manual suggests undertaking **personal projects** (such as creating a game, a podcast, or an experiment) as a learning method. Explain why this approach may be more effective than studying a book in a linear fashion.
5. If you wanted to prime yourself to get more out of a class, what should you do? Explain briefly.

6. **According to the manual, why do we remember better when we meet someone famous** (such as Messi) than when we meet anonymous people?
- a) Because we devote more attention to them
 - b) Because the brain prioritizes what is relevant and connects it with prior knowledge.
 - c) Because the brain has a special memory for important people
 - d) Because we tend to mentally repeat the names of famous people
7. Explain the advantages and disadvantages of the following techniques: **Pomodoro and Fowmodoro.**

BRAINSTORMING

ACTIVITY 10

Now that we understand how brainstorming works, let's try to apply it: brainstorm about a topic you want to understand better, get new related ideas, or a personal topic to improve self-awareness. **(Contains suggested answer)**

INTRODUCTION TO SYSTEMS

ACTIVITY 11

Brainstorm ideas focused on your current learning system. Try to understand every detail of how you usually study information, down to the smallest detail. **(Contains suggested answer)**

PERSPECTIVES

ACTIVITY 12

Find a topic that you already know and are interested in, and try to study it using multiple perspectives:

- a. Try to recall information freely, as if you were someone else with different priorities, using a mind map and trying to find perspectives you would never have explored, based on the key objectives that person would have. **(Contains suggested answer)**
- b. Once you have finished, new questions may arise and you may discover aspects you had not thought of. Therefore, try to find more information using Inquiry-based Learning on the internet and complete your understanding of the topic. **(Contains suggested answer)**

ACTIVE LISTENING

ACTIVITY 13

Practice active listening with an interesting video that contains information and requires comprehension. Choose a video that is not just quick entertainment (like many short videos), but one that explains or provides knowledge: for example, a historical event, a curiosity about a group you like, or instructions on how to do something. Watch it carefully, thinking and reflecting as much as possible on the content and critically analyzing what is being said. Remember to prepare before watching it, use the pauses to assimilate and rest, and follow the rest of the instructions given in this section. **(Contains suggested answer)**

HIIT

ACTIVITY 14

Now that you have finished reading the training, try to do a HIIT session following all the steps. Choose a topic you like, find a dense source, or ask artificial intelligence to provide you with a text that meets the requirements of good content so you can practice. Set a 30-minute timer and follow the training steps below. **(Contains suggested answer)**

SYSTEM FOR UNDERSTANDING A CONCEPT

ACTIVITY 15

Choose a concept that you do not yet fully understand. It can be from a subject, a book, or a topic that interests you. Write down what it is and try to classify your difficulty according to the main causes:

- Lack of foundations (conceptual or linguistic).
- Conflict with prior knowledge.
- Unclear or erroneous sources.
- Cognitive overload (being tired or overwhelmed).

(Contains suggested answer)

ACTIVITY 16

Now, use the unit's system (Search → Understand → Relate) to work on the concept you chose in the previous activity. Briefly explain how you would apply each step. **(Contains suggested answer)**

SUGGESTED ANSWERS

Here are the suggested answers:

ACTIVITY 5

SUGGESTED ANSWER:

Here is a suggested correction of the same mind map for each level, so you can compare the different mind map models with your own, understand your level, and see how to improve. It should be noted that there is no objectively correct answer, only different ways of representing ideas according to certain requirements:

Among the note levels, the same text would be **at level 0**. Now I will present suggestions for the other levels in order:

NOTES LEVEL 0.5.1

Definition

- Education is the process of transmitting knowledge, skills, and values.
- It can be formal, non-formal, or informal.

Types of education

- Formal: structured within schools, with an established curriculum.
- Non-formal: activities organized outside the traditional school system.
- Informal: everyday, spontaneous learning through experience.

Formal education (levels)

- Early childhood education.
- Primary education.
- Secondary education.
- Higher or tertiary education.
- It can also be classified according to teaching method (teacher or student) and subject (science, language, physical education, etc.).

Meaning of the term

- It can describe an "educated" person or a state of mind.
- It is also an academic field that studies education from disciplines such as philosophy, psychology, sociology, and economics.

Debates

- There are discussions about the objectives of education.

- There is debate about where education ends and indoctrination begins.
- A key question is how to foster critical thinking.

Social functions

- It socializes children into cultural norms and values.
- Provides skills to be productive in society.
- Contributes to economic growth.
- Develops awareness of local and global issues.

Factors influencing educational success

- Psychological: motivation, intelligence, and personality.
- Social: economic status, ethnicity, and gender, with risk of discrimination.
- Other: access to technology, quality of teachers, family involvement.

History

- In prehistoric times, education was informal, based on oral communication and imitation.
- In ancient civilizations, writing expanded knowledge and gave rise to formal education, initially reserved for the elite and religious groups.
- In the 15th century, the printing press promoted the dissemination of books and increased literacy.
- In the 18th and 19th centuries, public and compulsory education became widespread.
- Currently, more than 90% of primary school-aged children attend school.

NOTES LEVEL 0.5.2

Definition

- Education = transmission (knowledge + skills + values)
- Types →
 - Formal = school + curriculum
 - Non-formal = activities organized outside of school
 - Informal = everyday learning / experience

Formal (levels)

- Early childhood → Primary → Secondary → Higher
- Classifications:
 - Method (teacher vs. student)
 - Subject (science + language + physical education, etc.)

Term "education"

- Mental state / "educated" person
- Academic field = philosophy + psychology + sociology + economics

Debates

- Objectives?
- Education ≠ indoctrination
- Encourage critical thinking

Social functions

- Socialization → norms + values
- Skills → productive citizen
- Economic growth ↑
- Awareness (local + global)

Success factors

- Psychological → motivation / intelligence / personality.
- Social → economic class + ethnicity + gender → discrimination?
- Other → technology, teachers, family

History

- Prehistory → oral + imitation
- Antiquity → writing = + knowledge
- Initially elite / religion
- 15th century → printing press = literacy ↑
- 18th-19th centuries → public + compulsory schooling
- Today → +90% of children in primary school

Reflection: trajectory = only the elite → universality. Current challenges = quality + equality.

LEVEL 1 MIND MAP

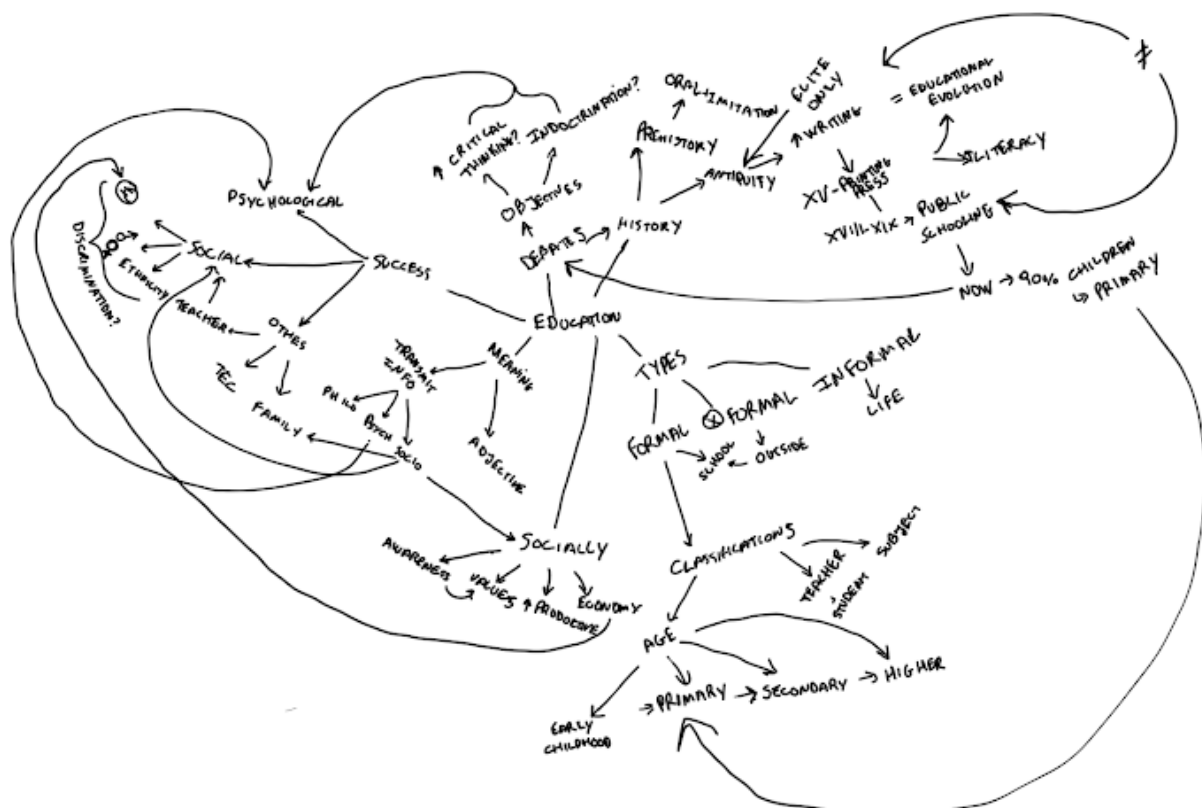


Figure A.1: Example of a level 1 mind map on education.

LEVEL 2 MIND MAP



Figure A.2: Example of a level 2 mind map on education.

LEVEL 3 MIND MAP

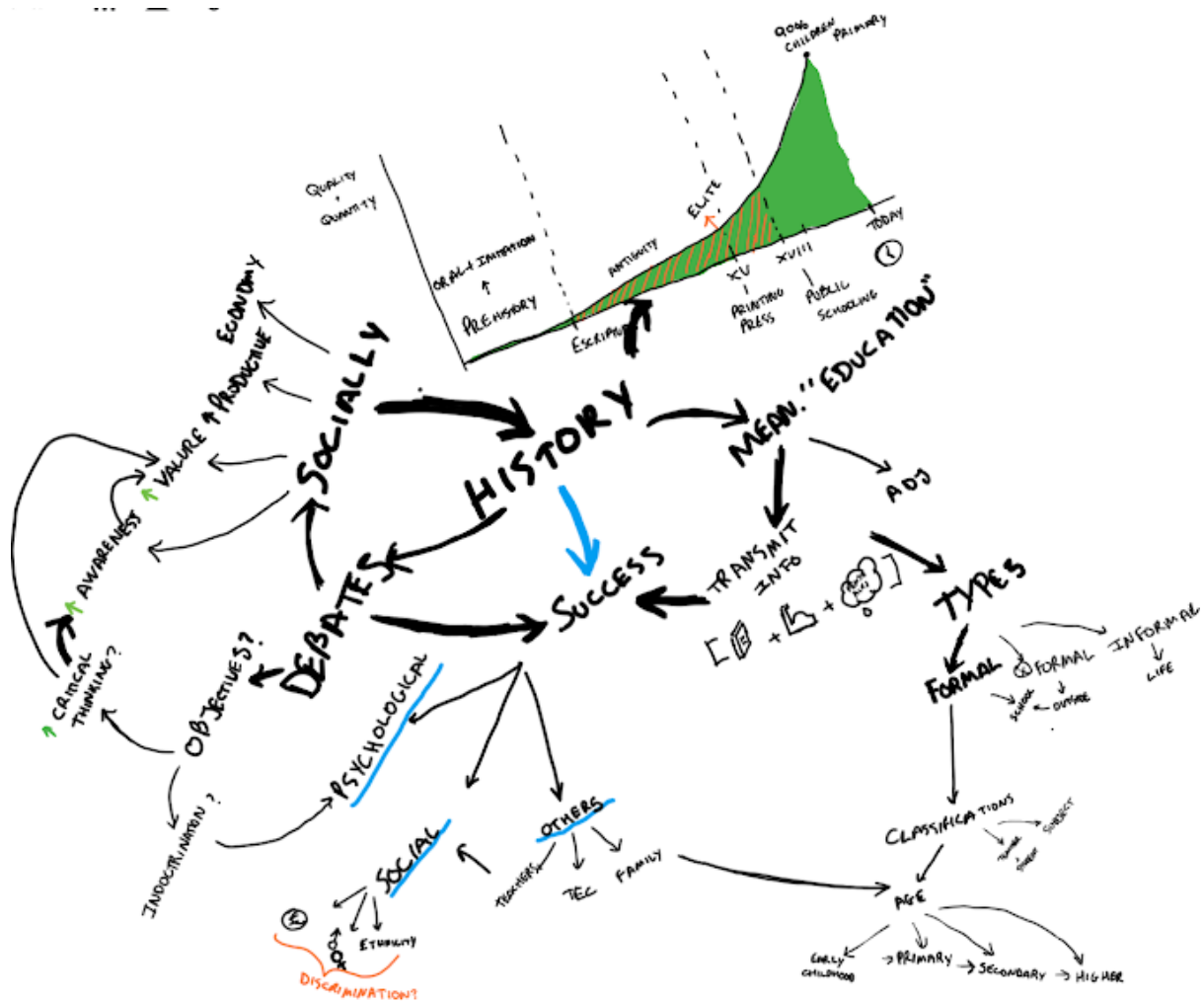


Figure A.3: Example of a level 3 mind map on education.

ACTIVITY 7

SUGGESTED ANSWER:

There are many ways to choose the words you consider most important and that help you understand the topic, but here is one suggestion:

Layer 1:

1. Learning styles
2. Criticism
3. Influence
4. Types of learning styles

Layer 2:

1. VARK Method
2. KOLB Method

3. Classroom personalization
4. Students
5. Teachers
6. No evidence of specific adaptation
7. Anecdotal evidence
8. Classification of students
9. Student limitations
10. 1 Style = No opportunity for development
11. Combination of different types

Layer 3: → Helps us understand the topic in some way

1. Auditory + Visual + Practical
2. Combination of problems
3. Example of groups and simulations
4. Visual + Readers + Manipulative + Auditory
5. Auditory + Reflective + Theoretical + Pragmatic

Layer 4:

All other details: data, names of people.

Here is a suggestion for how to make a mind map with the following layers of information:

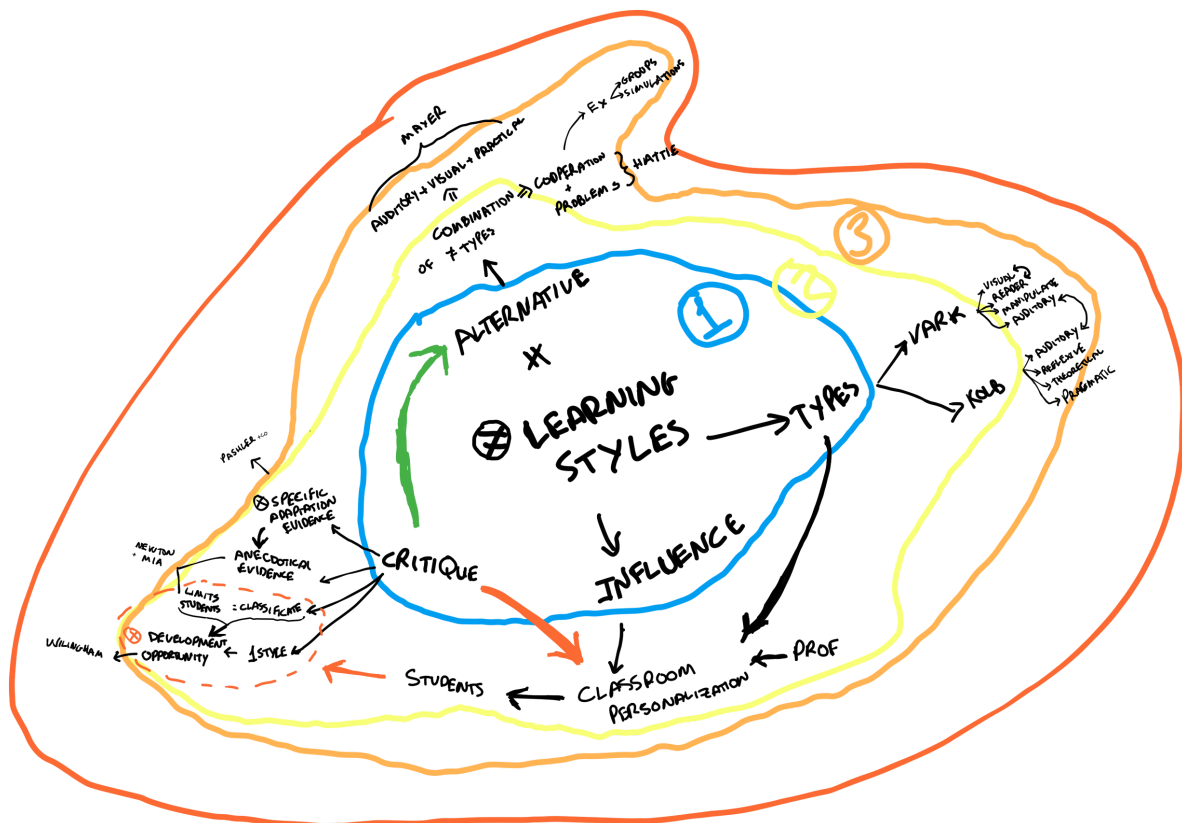


Figure A.4: Mind map with the different layers of information.

ACTIVITY 8

SUGGESTED ANSWER:

Here are some examples of possible questions you could ask after reading the summary:

1. About space repetition:

- Is there an app or practical technique that can help me apply this?

3. On active versus passive review:

- What specific activities can I do to transform passive review (just rereading) into active review?

4. About ways of remembering:

- What type of recall (recognition, cued, or free) is best in different situations, for example, in mathematics, history, or languages?

5. On practical application:

- How can I combine different techniques (spaced review, active review, free recall) into a real study routine?
- To what extent can the quality of initial learning reduce the need for so much review?

ACTIVITY 9

ANSWERS TO QUESTIONS:

Questions 1:

- b) Temporarily maintaining and manipulating information while performing a task.

Questions 2:

- b) It remains only in short-term memory and fades quickly.

Question 3:

- "Leaving room for doubt" means asking questions, looking for inconsistencies, and not passively accepting information.
- This activates deep thinking because it forces us to analyze, evaluate, and apply, not just remember.

Questions 4:

- Undertaking a personal project generates motivation, personal questions, and meaningful connections. You don't learn isolated facts, but rather solutions to real problems that you encounter while creating.

Question 5:

We should:

1. activate our prior knowledge
2. Formulate questions and hypotheses
3. Study the topic superficially
4. Create a mind map about the little we have studied.

Question 6:

b) Because the brain prioritizes what is relevant and connects with prior knowledge.

Question 7:

1. Pomodoro Technique

Benefits:

- Helps you get started easily, especially when it's hard to get down to work.
- It divides time into short blocks (25 min), which reduces the feeling of "too much work" and allows for frequent breaks.
- Suitable for specific, repetitive, or mechanical tasks.

Disadvantages:

- It can interrupt deep concentration just when you are getting into the "flow."
- Less suitable for creative or learning tasks that require long periods without interruption.

2. Flowmodoro technique

Benefits:

- Seeks to respect the flow state: working for longer periods (e.g., 50-60 min) when concentration is high.
- Allows you to make better use of moments of deep, immersive thinking.
- More suitable for complex, creative, or intensive learning tasks.

Disadvantages:

- Requires greater self-control: if you are not motivated or have low energy, it can be difficult to maintain long blocks.
- More difficult to apply in environments with constant interruptions.

ACTIVITY 10

PROPOSED RESPONSE:

Brainstorming is about learning styles and our possible perception before reading the text "Learning Styles":

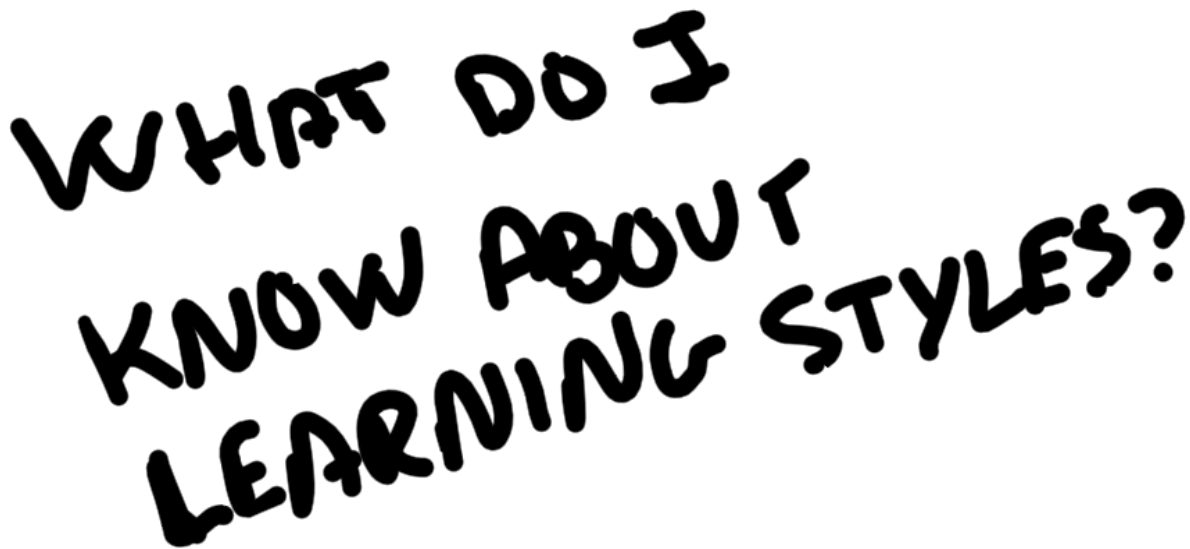
The image shows the text "WHAT DO I KNOW ABOUT LEARNING STYLES?" written in a bold, black, handwritten font. The text is slanted upwards from left to right, giving it a dynamic, hand-drawn appearance. The letters are thick and slightly irregular, typical of a marker or thick pen.

Figure A.5: The image represents the central question we will use for brainstorming.

As I explained, it is important to have a main question to help guide our thoughts and focus, as well as stimulate our curiosity.

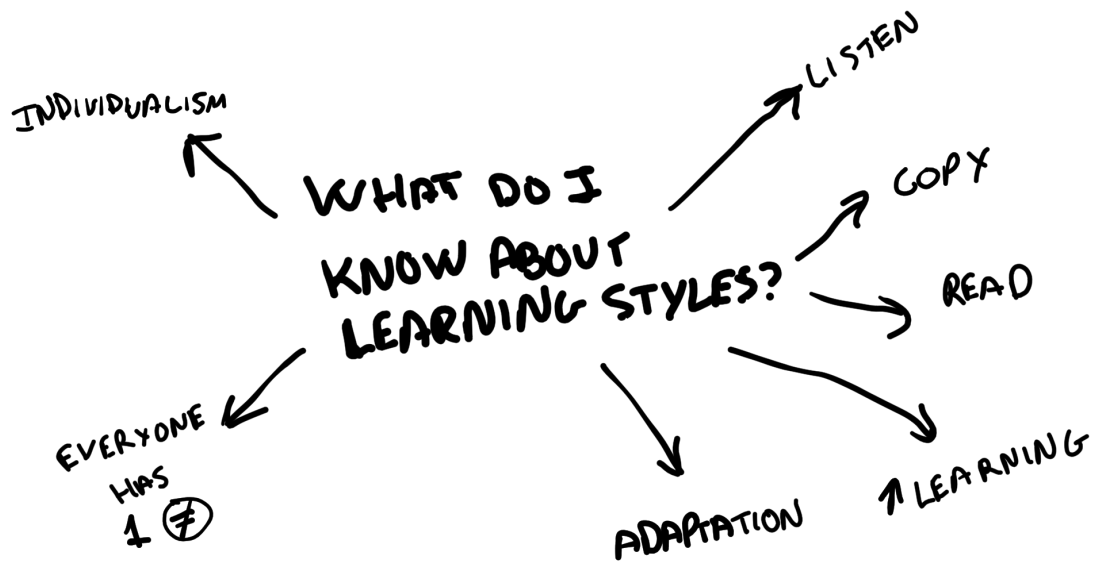


Figure A.6: The image represents when we express ideas spontaneously, without censorship: the first thing that comes to mind.

Not limiting our thoughts helps us generate new ideas, even if they are irrational.

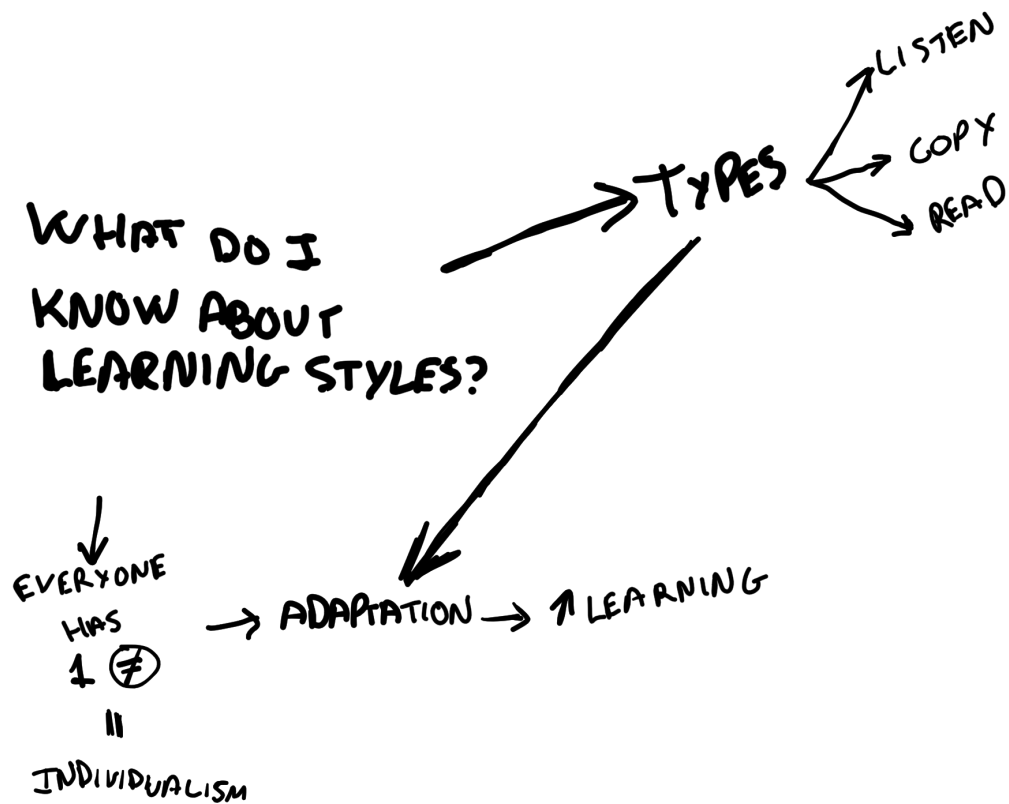


Figure A.7: The image represents when we pause to think about the information we have put on paper in order to digest and restructure it more meaningfully.

We should always pause and try to process and digest the ideas we include in the mind map, as well as try to relate them and find patterns to clarify them and encourage the flow of new ideas.

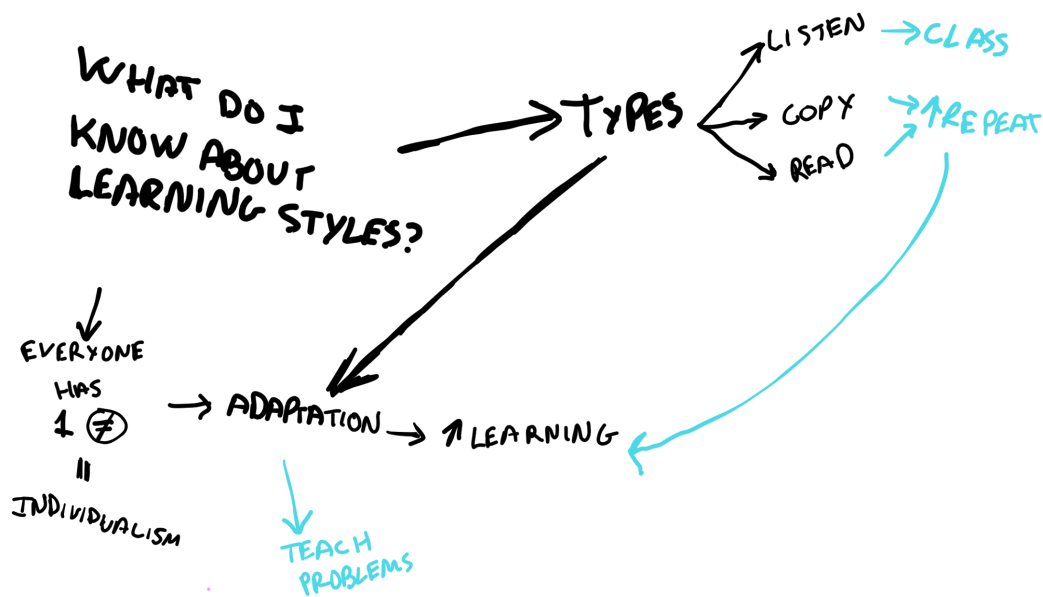


Figure A.8: The image represents another round of writing ideas uncensored, based on what we have already written on the sheet. This cycle repeats again and again, balancing when we put down ideas and when we structure them.

Once we have structured what we have written down, we repeat the process of thinking freely and always asking ourselves: "What do these concepts and structures I observe make me think of or remind me of?" and so the cycle continues.

ACTIVITY 11

SUGGESTED ANSWER:

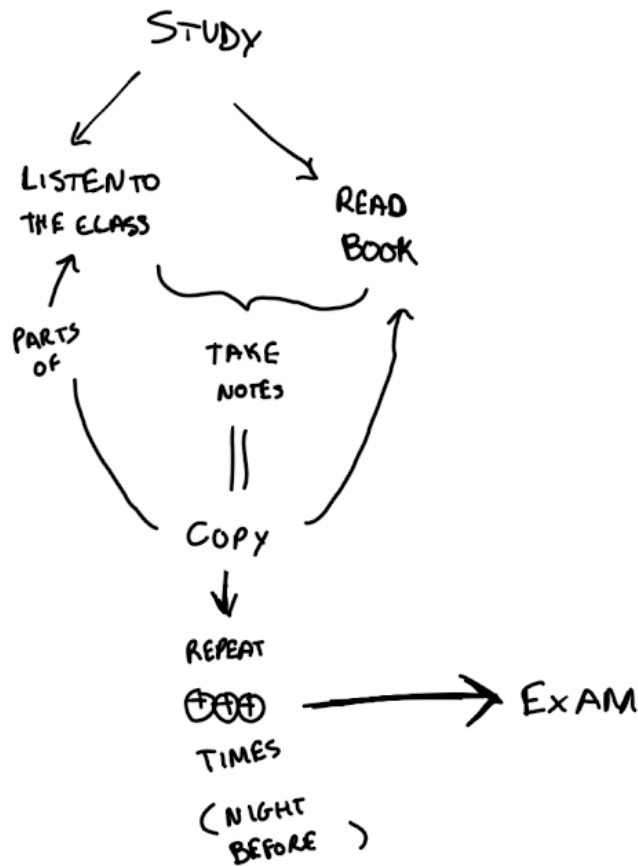


Figure A.9: Example of brainstorming about a learning system.

ACTIVITY 12

SUGGESTED ANSWERS:

- a. As the main topic to illustrate the study of multiple perspectives, I have chosen metacognition. After reflecting on general perspectives, professional perspectives, and key questions, I have decided to choose as my main perspective the question "How could we apply this knowledge of metacognition to the education system?" and as secondary perspectives, I have chosen that of a teacher, that of education in general, and another key question: "How could we standardize teaching according to the principles of metacognition?" Based on these perspectives, I have created a small mind map to help me find solutions and extract my knowledge on the subject:

ACTIVITY 13

SUGGESTED ANSWER:

1. Priming before listening

- **Ask yourself why you are going to listen to the video:**
"I will listen to this video because I want to better understand how sleep influences my ability to learn. My goal is to find an idea that I can apply in my daily life, especially now that I am studying and sometimes don't get enough sleep."
- **Make hypotheses about the content:**
"I'm sure they'll talk about the stages of sleep and their relationship to memory."
"They may mention that lack of sleep impairs cognitive performance."
"They may explain strategies for improving sleep quality."
- **Decide what I should take away as the main idea:**
"I want to be able to summarize the most relevant idea from the video at the end, even if they explain many things. If someone asked me, 'What did you take away from it?', I want to be able to answer clearly."

2. While listening

- **Look for the main idea (in progress):**
The speaker says: *"When we sleep, the brain reproduces the neural connections created during the day, reinforcing them."*
→ I think: "This is important; it could be one of the main ideas."

Then he adds: *"Lack of sleep causes our hippocampus, the part of the brain responsible for forming memories, to function much less effectively."*

→ I reflect: "Perhaps this is even more relevant, because it has a direct impact on learning."

- **Criticize what is said:**
When the speaker says, *"Sleeping six hours is as detrimental to learning as not sleeping at all,"* I wonder:
"Is it really that extreme? Is he referring to a specific study? Is he perhaps exaggerating to impress the audience?"
This keeps me alert and searching for more evidence.
- **Take breaks to assimilate the information:**
The speaker says: *"Sleep is not wasted time, but the moment when the brain consolidates memories."*
→ I pause the video and reflect: "This means that studying late and sacrificing sleep is counterproductive. I can apply this by organizing my study time better."

- **Take breaks to rest (cognitive rest):**
After 10 minutes, I feel overwhelmed because many technical terms have appeared (REM, hippocampus, delta waves, etc.).
I decide to stop for about 2 minutes, get up, and drink some water.
Before resting, I formulate a "starter question":
"What specific relationship exists between the different phases of sleep and memory? If I wake up in the middle of a phase, could it be harmful?"
When I return to the video, this question helps me pick up the thread again.
- 3. **At the end of the video**
 - **Find the definitive main idea:**
I have heard a lot of facts and examples, but the most relevant is:
"Sleeping well is not a luxury: it is essential for learning and remembering, because the brain consolidates memory during sleep."
 - **Final reflection (personal application):**
I think: "From now on, before an exam, I will prioritize sleeping well instead of staying up late studying. This is the practical action I can take away from the video."

ACTIVITY 14

SUGGESTED ANSWER:

The content used to come up with this topic proposal was the text "Different learning styles." Thus, brainstorming before reading the content would be equivalent to what we did in the brainstorming activity.

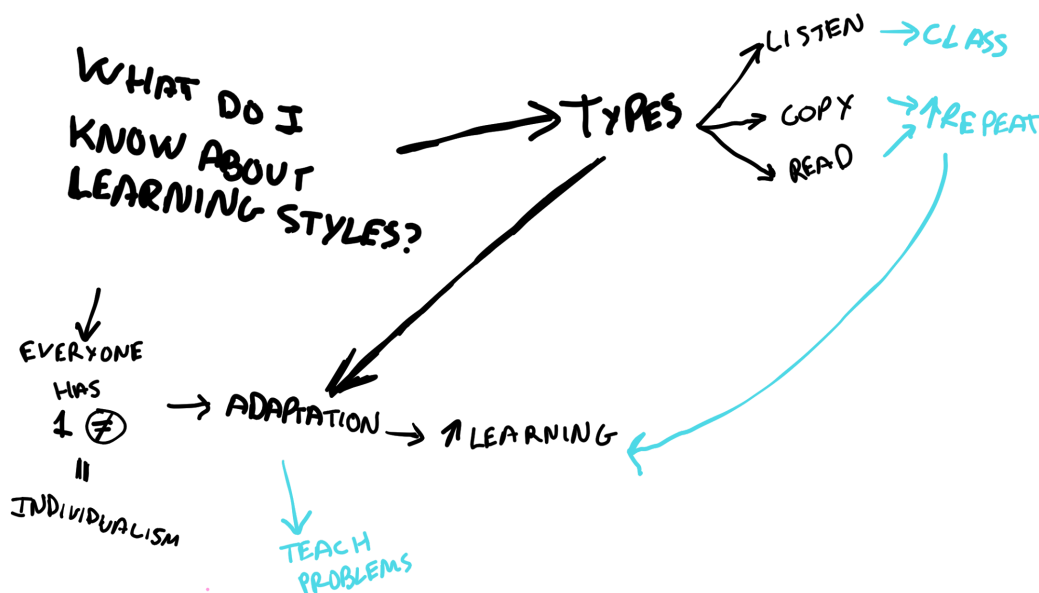


Figure A.12: Final brainstorming on the topic "What do I know about learning styles?". Image corresponds to Figure A.8.

CONSUME AND DIGEST: Now, when we consume the information and break it down, we carry out the same process we used in activity 7 on layering. Thus, when we reconstruct the content according to my interpretation, we obtain a mind map as a result:

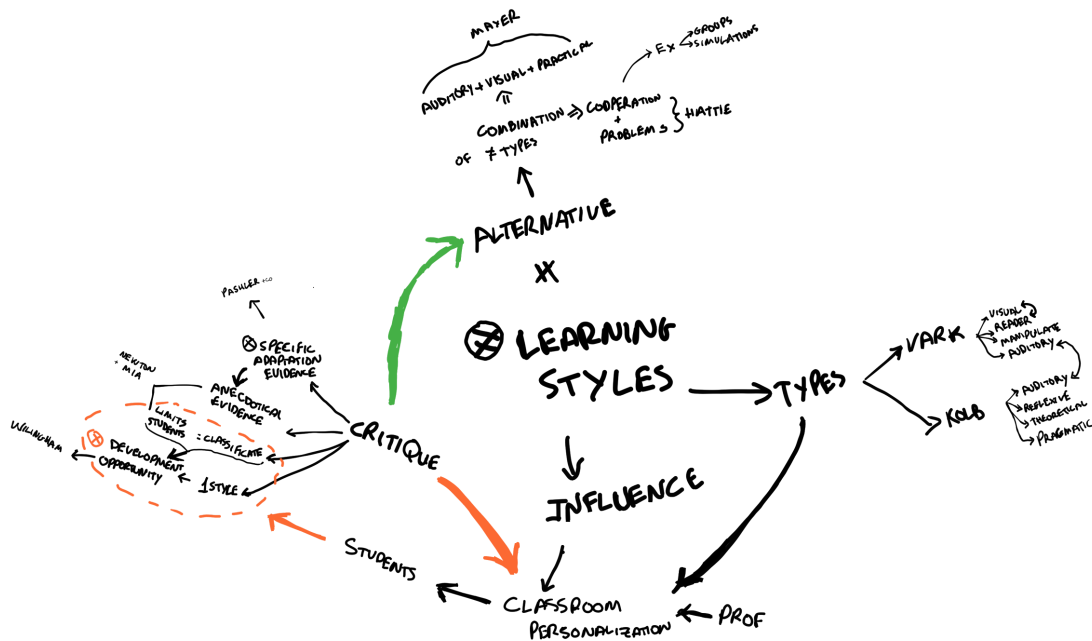


Figure A.13: Mind map representing the author's understanding of how the information provided in the text is related.

Review and analyze: When I try to remember the information, I notice that I forget specific details, such as the names of the authors of certain theories. Since these are part of a less relevant layer (layer 4), it is not serious if I do not remember them. On the other hand, I have been able to remember the key points and the relationships between ideas well, thanks to the structure I gave to the information. This confirms to me that the emphasis and flow I established have been useful. I make a note that I want to repeat this method in the future and also note the reasons why I forget some details.

Suggestions for improvement: To reinforce the less clear points, I could draw up a timeline showing the different scientific articles and their authors. In addition, to better understand Kolb's classification of learning styles, I could compare it with the VARK model, as one is derived from the other in some way.

ACTIVITY 15

SUGGESTED ANSWER:

Chosen concept: *cognitive load*.

Lack of understanding: mainly due to a **lack of background knowledge**. I have heard this term several times, but I am not clear on what it means exactly or how it differs from "attention" or "working memory." There is also a certain **conflict with prior knowledge**, because I thought it simply meant "having a lot of information," but I see that it has a more specific meaning in learning psychology.

ACTIVITY 16

PROPOSED RESPONSE:

Search: I brainstorm what I already know about 'cognitive load': it is related to working memory, fatigue, and the amount of information I can process simultaneously. I research what the foundations are: I should review what working memory is and what its limits are.

Understand: I consult clear definitions and organize what I find. I note that "cognitive load" is not just about having a lot of information, but about the level of mental effort a task requires in relation to our working memory.

Relate: I compare it with what I already knew. I thought it was synonymous with "being tired," but now I understand that it goes beyond that: I can be well-rested and still have too much cognitive load if the information is not well organized. I relate it to the example of making a slide with too much text: it's not that I'm tired, but that the information is not well structured.

(Sources of information will be provided once the trial period is over, in early October).