

# HOW KNOWLEDGE IS MADE IN THE BRAIN

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## ABSTRACT

This essay provides information on how knowledge is in the brain and how important it is to take this into account when transmitting knowledge, or at the time of approaching our processing or teaching work is done. It gives an idea of how the transmission of knowledge is determined in a direct way with the brain that represents and evolves every time we acquire new knowledge.

**Keywords:** Neuro pedagogy, Knowledge, Brain, Transmission.

Considering that the transmission of knowledge is subject to how? The brain represents and evolves according to the acquired knowledge and that the representation or as an evidence that there is knowledge, two positions can be given, on the one hand one can represent the transmission of knowledge as a regular pouring of knowledge in the head of the student and achieves that he learns regularly, the other, is a progressive gift but that accumulates in the learner, to produce or cause stepwise progress this can also be given by sudden jumps that are motivated by traumatic situations that can cause impact, which cause them to remain in the brain.

I believe that there is no transmission of knowledge, but a construction of knowledge through the exchange of clues between the teacher and the student. But the construction of knowledge must be done in association between the cognitive and affective, but this requires that whoever wants to learn must first unlearn previous false or spontaneous knowledge.

The way knowledge is transmitted has been widely studied and has been the basis for the scientific development of psychology, evolutionary biology, anthropology, sociology, education and neuroscience.

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When thinking about how knowledge is transmitted, this can be given conceptually and ecologically, the first is based on the existence of certain formal structures that we call concepts, which are represented by concepts that represent words or images and are transmitted from one person to another and from generation to generation, on the other hand the ecological is based on the context and the way in which actions are developed and evidenced by the practice, which has influence of the concepts and how they arise.

According to (Charles M, Keller and Janet Dixon Keller, 1999) any answer to the question “*How knowledge is transmitted?*”... mental representations, our actions, and the context in which they develop are intimately connected....

All this refers to a very important fact, quite studied, but that at the time of teaching praxis is not taken into account and it is cognitive neuroscience or neuropedagogy, that is, how the brain learns. It is known that this Cognitive Neuroscience emerged as a scientific discipline in the 80’s, thanks to the scientific advances where the brain was studied with specialized machines that allow to see the human brain acting at a structural and functional level, this has allowed to study the brain activity associated with complex psychological functions in humans and has advanced in knowing how the brain learns evidencing the transmission of knowledge, to know this, it is very important to know and develop strategies to empower the brain in its way to learn and make or achieve meaningful learning and that this should be focused on the study of neural forms that are involved in the psychological processes of human cognition, not only in the aspects (attention, memory, language, etc.), but in the emotional part.

The brain is an organ that is always learning, we all have the ability to learn something, motivated by different needs that we can call stimuli and the way is the nervous system, which adapts according to the need and the sensory information it receives.

Knowing that the functional unit of the reception and response of stimuli is the neuron, which are the cells of the nervous system and have the function of transporting information in the form of nerve impulse by the process of synapse.

When someone studies can learn visually through the eyes, this information reaches the brain region responsible for processing what is read and thanks to the synapse the information travels to the place where the brain memorizes what is studied, this has the ability to form many synapses and respond much better to stimuli in this case learning. All this can be given easier through repetition or recall of something memorized, then mnemonics arise by which we get the brain to memorize.

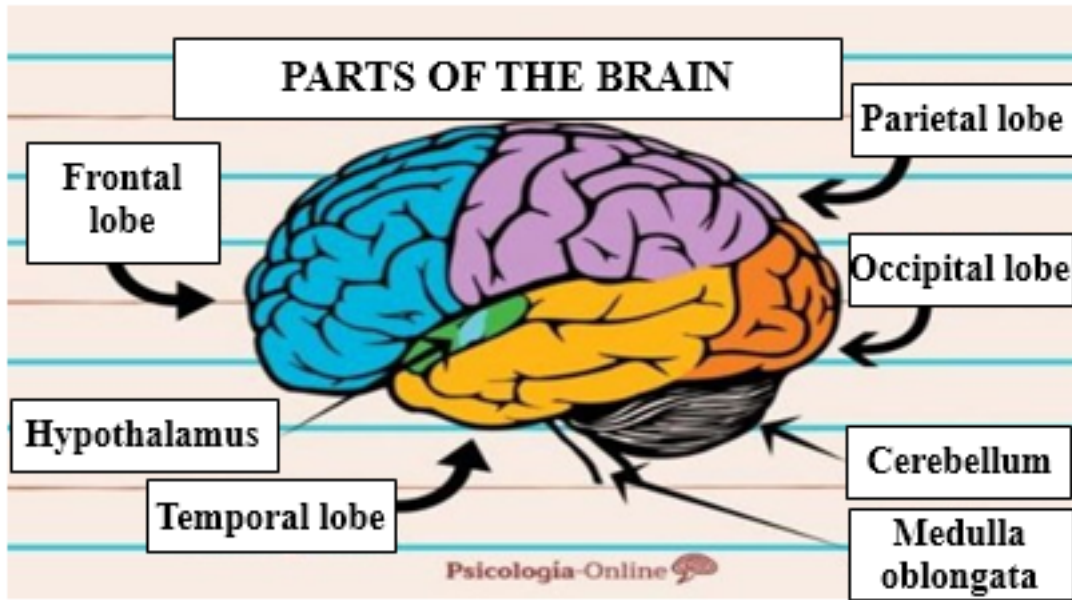
At the beginning of our existence, most neurons do not make synapses and as we grow and learn more, the stimuli allow synapses to occur, and as the popular adage says “*what is not used atrophies or dies*” and so it happens with our neurons. A clear example is that, in the school stage, many things can be learned, such as languages, arts, etc. Throughout history, man has always wondered how the brain works and has an automatic response capacity, or how it is possible to memorize names, telephone numbers, rules, addresses, mathematical formulas, etc. Of all this the most studied and proven is that it is easier to learn visually, since the brain works in a 50% and the bridge of all this so wonderful are the eyes, so that transmitting knowledge through images can guarantee a good transmission of this, especially the panoramic images, which draw more attention to our brain.

Something additional that we must take into account, is that our brain rests, so that it can learn and memorize, this study was made by a university of California that we will mention later where they demonstrated with some studies that to sleep before studying or working helps to obtain a better performance of the brain and they give a minimum time of 20 minutes, therefore the opposite not sleeping or the lack of sleep diminishes the learning, this we have it as teachers to take very into account to inquire in a child with low performance if he is resting the sufficient thing.

Harvard University with its Faculty of Medicine investigated this and came to the conclusion that “*not sleeping brings great consequences, one of them is that our brain suffers the lack of learning and memory by 40% or to be many hours in front of a computer or books learning something, since learning is null, since it does not have the rest the brain needs*”.

A fact that has been evidenced throughout my teaching career and that I have personally evidenced, is that they learn better if they teach others or if they help us, or when we intercalate things, that is, when they have to study several things (subjects or topics), if it is done in blocks or intercalated, this makes the brain develop better and learn better.

This is because in recent years, neuroscience researchers have been able to literally get into the brain and observe how it learns, they began by studying its physiology or anatomy, where they showed that the brain functions as a network of circuits by fibers of more than 100 billion neurons. We know that the brain has this structure.



**Taken from:** PARTS of the BRAIN and its Functions - with pictures! (psicologia-online.com)

Of these, the brain is the most important for learning, since it is there where the memorization of words and reasoning take place, and the different areas of the brain and their function are known exactly:

**Frontal lobe:** behind the forehead, controls personality, problem solving, memory, language, judgment and impulse control, the left side of this lobe is more language based, while the right side focuses on processes that do not require it. Damage to this area may affect critical thinking and problem-solving skills as well as vision, hearing, speech, touch, short-term and long-term memory, language, and reasoning.

**Parietal lobe:** area of general sensitivity, psycho-sensory area and center of comprehension of written words.

**Occipital lobe:** psycho-visual area, visual area.

**Temporal lobe:** here information is processed and organized, memory, speech, controls memory retrieval, visual memory and memory of facts or experiences, it is an auditory area, center of understanding spoken words, psycho-auditory area.

**Amygdala:** located in the lower part of the temporal lobe, it is responsible for the storage and

organization of memory, related to emotions, these memories are later recalled and used to react to similar circumstances and plays an important role in the choice of memories that are stored and in the organization of the storage of all memories, something very important for knowledge.

**Hippocampus:** involved in the formation of new memories, it does this by creating concepts and organizing experiences into them, this helps to identify the contexts of actions and events, the organization of a storage system that makes sense to the brain.

**Lateral Hypothalamus:** When this area is damaged, the appetitive phase of motivation (no eating, no drinking) ceases to appear. This area will be associated with different centers according to the type of motivation (thirst, hunger, sleep, etc.). The most important bundle or most important fascicle is the median prosencephalic, which crosses the lateral hypothalamus connecting in two ways, the rostral encephalon with the hypothalamus and the brainstem, which are responsible for motivation, most of the neurons belonging to these structures are catecholamines, that is, they activate with less amount of stimuli the motivational reward centers.

(<http://psicologiamx.blogspot.com/2012/04/motivacion-y-emocion.html>

<http://www.ebowenespanol.com/partes-del-cerebro-cargo-del-aprendizaje-sobre70191/>)

Now I want to emphasize other aspects of the literature found. Many parts of the brain are involved in learning, some in similar aspects of learning and others control more specific parts, each area of the brain develops over a period of time that varies from 2 to 3 years to 8 years and there have been several investigations on the subject. Thus, for example.

**Language:** most language learning is in the left frontal lobe and that in Hesch's gyrus, which is used for foreign language learning in adults.

**Mathematics:** different brain structures are used for mathematical skills, these depend on the subject, exact mathematical calculations are related to the language centers of the left frontal lobe, while estimation is related to the parietal lobe where spatial and analogical tasks are processed.

**All this is linked to praxis:** *"the more we practice and rehearse, the easier it is for our brain to transmit these experiences efficiently and store them so that we can access them quickly later"*.

Study conducted at the Martinos Center for Biomedical Imaging in the Department of Radiology at Massachusetts General Hospital and Harvard Medical School.

Another key to understand how our brain learns is that if there is emotion (fear, anger, laughter or love), this will be part of the memory and reinforces it, we live this in our daily life, since the birth of a child, the achievement of a partner, or the breakup and death are not forgotten.

With all the studies already done, it is known that we have 2 types of memory, a short-term memory, which is in a volatile region of the brain that acts as a reception center of information perceived by the senses, of what we live daily, this memory in older people is easily forgotten.

When this information is processed, the neurons or neural circuits of the brain transport those memories to the structural nucleus where the memorized is stored, there they are compared with existing memories and stored in long-term memory, where it is the repository of everything we have experienced in our lives, this is instantaneous, but it is not perfect, that is why many memories are incomplete or include false fragments that we invent to fill in the gaps of real memories.

*“Neurologists have long believed that learning and memory formation result from the strengthening and weakening of links between brain cells.”*

**Researchers from the Center for the Neurobiology of Learning and Memory at the University of California.**

These researchers, with studies conducted with mice, were able to isolate and observe how the brain acted while learning a new task and that when two neurons interact frequently, they form a link that allows them to transmit information more easily and accurately. Here we continue to emphasize the importance of training our brain with Sudokus, word search, mathematics, so that our brain transmits information more easily.

I want to cite another study that supports all this, it is a study conducted at the Martinos Biomedical Imaging Center of the Department of Radiology at Massachusetts General Hospital and Harvard Medical School, they discovered that the structural center of the brain receives information from the senses and from different regions, and combines them with fragments of data from a complete image, which becomes the memory of an event and this is reinforced if there are several sensory inputs and even more if there is an emotional reaction to something, the emotion will be part of the memory and will greatly reinforce it, that in addition, the brain is selective when processing the experiences we perceive, through the 5 senses and is programmed to pay attention to any experience that is new or unusual, but if it finds something in common it eliminates the new memory and when the new information contradicts what is already stored, it tries to explain the discrepancy and if the information is useful, it becomes a permanent memory that can be recovered

later and if it is not useful it is forgotten, our brain has the capacity or programming to learn.

These studies of the brain reveal many things about how it learns, therefore, as teachers we should be attentive to these advances and thus address new methods of learning varied to allow better transmission of information and make the brain learn more naturally.

**Table of the findings of the three studies and their implications for learning taken for this article.**

| <b>Findings from brain studies.</b>                             | <b>Learning implications.</b>   |
|---|---|
| The frequency and novelty of neuronal synapses increase memory. | Increase frequency through practice and maintain frequency of use.                |
| Emotions reinforce memories.                                    | Increase the attractiveness and emotions associated with learning.                |
| Learning causes changes in the physical structure of the brain. | Learning increases our capacity to learn throughout our lives.                    |
| Memories are stored in various parts of the brain.              | Involve all senses in teaching and learning.                                      |
| Our brains are programmed to focus on new and unusual inputs.   | Learning should encourage the brain's natural curiosity and intrinsic motivation. |

From all this arises the neuro pedagogy, which are a series of techniques or studies to insert knowledge, taking into account the nervous and brain processes, in our students and how to achieve that learning or the transmission of information is meaningful, adequate and efficient, focuses us on how to use the knowledge and advances in the nervous system, the brain and its development, to create strategies and methods of learning, becoming a new learning methodology, in an innovative way to banish the obsolete educational models that we have been applying.

It may seem repetitive, but this is an urgent call to us as teachers to be interested in the functioning of the brain of our students and how it learns, how emotions, information, behavior, feelings and how they perceive these stimuli are processed, this leads us to a neuro pedagogical approach that makes us restructure the way we train educators and thus have better results in the teaching and learning process, enhancing the development of the learner's brain, creating study habits.

I want to leave some tips that I think are important when it comes to transmitting knowledge and learning, which will help us to determine the best methods and techniques in the practice of teaching:

- Learning is a factor in brain development.
- The brain abstracts reality based on patterns.
- Emotions play a leading role in the teaching-learning process.
- Reliance on previous experiences is an elemental quality of the brain.
- The brain has the capacity to process and analyze information simultaneously.
- We must achieve more competent lessons in the classroom.
- Learning takes place faster and is fixed longer in the memory, when learning from experience, and teamwork (social brain) so it is important to encourage group work involving socialization among students.
- External stresses or the context where the student develops, many times, has a negative impact on learning and the environment where learning takes place should be set, favoring relaxation and tranquility, increasing the likelihood that learning is easier and more effective, it is recommended to periodically change the arrangement of the elements present in the classroom to break the routine.
- As the brain is an emotional organ, for learning to be more complete and lasting, it will occur when through emotions, we exchange knowledge, this will occur in an easy and better way, more if we include emotional stories that attract the attention of students.
- It has been proven that just like muscles, the brain requires exercise and rest time that allow it to recover after a session of acquiring new knowledge, that is, to take active pauses, taking into account that each student works and recovers in a different way (learning rhythms).
- Learning depends on memory, they are interdependent, because learning is impossible without memorization, that is why it is important to implement teaching strategies that favor the memorization process, for example, activities that introduce playful elements, such as gamification, learning through play.

Finally, I would like to leave a quote to keep in mind:

*“The brain is motivated through learning strategies, which are activities or mental processes that students intentionally carry out to process, understand and adopt the information they receive in the educational process” (Roux & Anzures, 2015)*



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