Chapter 5
The Ecosystem of Human Learning:
The Neuroscience of Education

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ABSTRACT

Any form of life is a complex system made of one, few, or billions of cells. Each cell is a complex system as well: an organism in itself, performing thousands of biochemical reactions each second, as a consequence of all sorts of stimuli/information. Living beings are lifelong learners. As long as we arrive to internalize this information—about us as "galaxies" of systems of cells—we are allowed to be conscientious of ourselves and to process all the stimuli in an efficient manner. For a human being, learning should involve introspection and external complex system analysis as well. The main preoccupation, in learning, should be to study and analyze our own thoughts, emotions, and experiences, connecting the knowledge we acquired on the nervous and endocrine system in a complex relationship with all the other systems that allow us to exist—from nano (quantum physics) to macro (newtonian physics)—with us as a link in this huge net of morphogenesis, which can be mathematically described.

INTRODUCTION

From the point of view of a Neurobiologist, the fundamentals of education, its theory and practice are ignoring the anatomic and physiologic substrate of learning. This happens because the traditional education is centered mainly on teaching, on passing on information and / or habits, but less on moral, ethical, emotional and motivational aspects.

The educational process has to be debunked and re-designed, according to the brain development – not only at a personal and individual level, but also at an universal scale, considering the overall evolution of nervous patterns along the living structures. Another perspective depends on the concept of neurodiversity, as neuroimaging became a powerful tool in identifying even the flow of thoughts in the

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human brain and it has been demonstrated that each brain is unique (Valizadeh et al., 2018): "Just 30 years ago we thought that the human brain had few or no individual characteristics. Personal identification through brain anatomical characteristics was unimaginable." It seems though that each neuron is unique, with its own DNA constellation, with its own somatic mutations, which can significantly affect individual neurodevelopment (McConnell et al., 2017). More than that, MRI (magnetic resonance imaging) studies confirmed that the brain processes the information differently at different ages. For the same information, we use different cerebral regions, according to the stages of our development: an adult uses mainly the frontal cortex, while children and teenagers use mainly the amygdala, part of the limbic system (the so-called "primitive" brain), the site of fight or flight (or freeze) reaction. The use of amygdala impedes abstractization – this is why abstract thinking in childhood and adolescence is lower than in adulthood. Becoming an adult means to develop better defined neural networks, and also cortical control and mediation of the reactions generated in the amygdala. The frontal cortex deals with order, rationality and morality; the emotional maturity and intelligence reside here. People with high intelligence exhibit a much more developed frontal cortex, with more neural connexions (synapses) that are better optimized – in terms of the brain regions involved.

According to the neuroscientist Joseph Le Doux (1996), the amygdala is connected to the frontal cortex by certain neural networks, which constitute the physical basis for the neurological mechanisms of the emotional life. Each emotion is "processed" in a certain part of the brain, these parts are connected directly with the limbic system and a whole spectrum of emotional memories is thus generated. The emotional memory from the hippocampus is influenced by the neuroendocrine system, as well. So, the amygdala is responsible for the direct, impulsive reactions, and the frontal cortex is the modulator / mediator for those reactions – but its reactions are slower. It is possible, though, to regulate the emotional reactions in children and adolescents by training.

Lisa Feldman Barrett (2017) argues that emotions are the result of our own brain interpretation – we learn our emotions from our family, from the society, and we inherit the way we react to different stimuli. Basically, living beings feel something as pleasant or unpleasant. We, humans, interpret the sensations and transform them into emotions, we construct them. Different cultures have different words for different emotions – the example Lisa Barrett uses is the word "sadness" which doesn't exist in the Tahitian culture, but their closest concept might be translated as "the kind of fatigue you feel when you have the flu". The main idea is that emotions are taught to babies and, during the human life, the brain combines and compares the experiences in the past with the new experiences and creates new representations that can fit a specific pattern of perception and reaction.

The emotional life is fundamental in learning – mostly in our early life – but we need to train this connexion between the limbic system and the frontal cortex by a holistic approach in education. Right now, our educational systems are focused on training the frontal cortex only, which is very similiar to training an nimal to do funny tricks.

Indeed, the nervous system is designed to allow consciousness and rational processing of stimuli, but also the background function of the whole body. We have two nervous systems: a somatic one, which is (more or less) under our own control, and the autonomic one, designed to perform all the activities we are not aware of such as breathing, heart beats, homeostasy and other extremely important processes outside our control. We are huge galaxies of small entities, individuals in themselves, which cooperate and work to keep us alive – with or without our knowledge.