

International Journal of Health Science

NEUROSCIENCES IN TEACHER TRAINING POST PANDEMIC

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Abstract: The approach to socio-emotional skills in the field of education is marked by a process of change in society as well as the need to consider the integrality of the human being. This way, the premise for living in modernity indicates an intrinsic relationship which enters the public policy scenario. Currently, neuroscience discoveries demonstrate that emotions have become recognized as fundamental to teaching and learning. Knowing how the human brain works, knowing that emotions participate positively in human development, but that they can also hinder it, is an essential tool for those who deal with the learning process. Thus, the definition of the research problem raises several questions, which aim to guide the understanding of the research object, among them: How can socio-emotional skills contribute to the teacher developing and using methodological strategies? What are the contributions of neurosciences to teaching planning? To answer the research problem, the present study is justified by the teachers' lack of knowledge about the neurophysiology of learning as well as the socio-emotional aspects involved in the main failures in the teaching-learning binomial. To this end, the proposal for continued training was anchored in hermeneutic reflection of a qualitative nature as an epistemological paradigm in a collaborative approach with a view to continued and systemic actions based on the understanding of the brain and its interfaces in the development of cognitive and emotional learning.

Keywords: Neurosciences, Skills, Socio-emotional, Education.

INTRODUCTION

Neurosciences can be understood, given their terminological breadth, as a mix of disciplines that deal with the study of the brain, dealing, more specifically, with its chemical, structural, functional and pathological development. Complementing this definition, neurosciences must be conceived as a set of sciences whose objective is to investigate not only the nervous system and its respective functioning, but also the relationships between brain activity, behavior and learning.

The word "Neurosciences" was written in the plural, as it comprises five major neuroscientific disciplines, according to Lent (2008): Molecular Neuroscience, Cellular Neuroscience, Systemic Neuroscience, Behavioral Neuroscience and Cognitive Neuroscience and Affective Neuroscience.

The development of the anatomo-functional structure of the brain would have been stimulated by cultural elements, suggesting that the required functions increased along with knowledge of the world, requiring an increase in the surface of the brain which, limited by the closed skull, became increasingly wrinkled in form of folds, thus emerging the gyri, grooves and fissures found in the cerebral cortex, a layer supported by subcortical nuclei of gray matter, which houses all the neurons capable of receiving, decoding, recoding, creating, comparing, analyzing, synthesizing, memorizing and express any and all functions, in addition to being covered with affective-emotional content (LENT, 2010).

The integration of emotional content related to cognitive processes occurs in the orbitofrontal cortex (OFC) and ventromedial prefrontal cortex (PFC) complex. Sensory impressions converge, through the OFC, to the ventromedial PFC, from where the synthesized information is taken to the dorsomedial PFC and infero-lateral PFC

regions (LEDOUX, 2003).

According to MacLean's triune brain theory (1990), the brain would be composed of the Reptilian Brain or basal brain, or even, "R-complex". Known as the "instinctive brain", its characteristic is survival, responsible for primary sensations such as hunger, thirst, among others. The brain of lower mammals or 'Emotional Brain' is the second functional level of the nervous system and, in addition to the components of the reptilian brain, it has the basal nuclei of the telencephalon, responsible for gross motor skills; by the diencephalon, consisting of the thalamus, hypothalamus, epithalamus; cingulate gyrus and hippocampus. These last components are part of the Limbic System, which is responsible for controlling the emotional behavior of individuals, hence the name "Emotional Brain".

The premise is defended that teaching knowledge in the area of neurosciences, especially with regard to learning and the development of socio-emotional skills, can contribute to an effective mediation of teaching. The research points to the reconfiguration of teachers' knowledge, mainly in the identification of brain functioning and, therefore, they were able to understand and direct their practice according to their performance.

This way, socio-emotional skills will contribute to the formation of more critical and ethical individuals who promote citizenship and respect, in addition to developing other characteristics, such as creativity. Reinventing oneself in the face of crises and conflicts, being able to overcome them in the construction of a fairer and more equitable society, has been one of the challenges imposed by the pandemic, especially in the field of education, to which socio-emotional skills are added as one of the possible paths for this transformation.

NEUROSCIENCES AND EDUCATION

The importance of Neurosciences in teacher training involves, firstly, understanding which type of training, both initial and continuing, they have access to in order to meet the biopsychosocial specificities of students. Currently, many neuroscientists are working to clarify and facilitate the rapprochement between Neurosciences and education. For Rotta (2008), "The advancement of neurosciences, especially neurology, is of paramount importance for understanding the higher cortical functions involved in learning processes [...]". According to the author, knowing the neuromaturational process is important to understand school learning. Furthermore, knowledge in the area of Neurosciences can help to understand that at this stage, school performance, regardless of the children's wishes, may not be achieved due to the stimuli of the environment that surrounds them, as well as being influenced by socioeconomic difficulties and cultural affective.

Bardin's content analysis (2011) meets the needs of a researcher whose data source is communication processes, especially when focused on qualitative analysis. At this stage of the study, the theoretical discussions adopted served as a basis for understanding the analyses, taking as a reference point the records of teachers obtained in interviews before and after the course on neurosciences focused on teaching.

It is important to highlight that, in the case of a semi-structured interview, there is a basic scheme of questions, however, it is not applied rigidly, allowing some flexibility in the face of necessary adaptations. In parallel with the specific practice, teachers reported the existence of individual differences among students, which also need to be considered when pedagogical planning. These differences

constitute the second category. At the end of the research, teachers suggested repetition as a possibility to reduce forgetting, making it necessary to use mnemonic resources that establish clues for its consolidation.

From the perspective of Tardif (2014), the sources of professional training are not limited to that available at the University, during initial training, but continued training, which takes place throughout the entire teaching career. The teachers who participated in the interviews recognize the little or non-existent knowledge about Neurosciences as well as socio-emotional skills and competencies.

SOCIAL-EMOTIONAL SKILLS

Socio-emotional skills are understood in their relationship with the framework of emotional intelligence based on the work of Gardner (1983/1994) on multiple intelligences and the publication by Goleman (1995), entitled Emotional Intelligence. Interpersonal and intrapersonal intelligence, described by Gardner (1983/1994), make up what he called personal intelligence and have their origins, respectively, in the feelings experienced by the individual and in the direct perception of other significant individuals. It is through learning and the symbolic system of culture that personal intelligences take on their characteristic form. Understanding how the brain works is important for a better understanding of teaching and learning processes, which refer not only to the storage of information, but to the associated emotional content. The classroom is a context where students and teachers have emotional scenarios and interact actively, the memories produced there directly impact the lives of these subjects. This way, the scientific dissemination of this knowledge can support (re)thinking praxis from the perspective of neuroscience knowledge.

The National Research Council (CNP)

has been concerned with identifying the fundamental skills in the contemporary world and has grouped them into three sets: a) cognitive skills: critical and systemic thinking, ability to analyze and interpret, creativity, solving non-routine problems; b) intrapersonal skills: self-control and self-development, initiative, intellectual openness, behavioral flexibility; c) interpersonal skills: social and communication skills, teamwork, tolerance to diversity, responsibility and leadership skills (PELLEGRINO & HILTON, 2012).

Norms and social interrelations must be respected, ensuring a behavioral pattern appropriate to the context. We can summarize all of this as the capacity for self-regulation. Therefore, it is worth thinking about effective strategies to intervene in the education of these skills, essential for citizens in the 21st Century. Currently, much attention has been paid to the development of students' socio-emotional aspects in conjunction with cognitive development. However, teachers as interveners in the mediation process contribute to the improvement of these aspects in formal education because mediation is based on teaching knowledge and gaps and insufficiencies regarding the importance of socio-emotional skills in teaching can contribute to a result that is not so successful in achieving of this objective.

To decide, there is a need to regulate emotion to obtain the results that bring the most benefits or those that best suit what society expects. Patients with lesions of the ventromedial prefrontal cortex generally exhibit a reduced emotional response, as well as a marked reduction in social emotions that are closely associated with moral values. On the other hand, changes in emotion regulation and logical reasoning and declarative knowledge of social and moral norms are preserved (DAMÁSIO, 1990).

Damásio and colleagues (2000) observed patients with ventromedial frontal lesions, involving the orbitofrontal cortex (OFC), have a significantly blunted autonomic response to stimuli with social significance. Hyperactivity of the bilateral orbitofrontal regions, the caudate nucleus, and the cingulate gyrus. Furthermore, due to interactions with the limbic system, especially the amygdala, hyperactivity of the OFC could facilitate the process of fear and anxiety conditioning. Some studies indicate that changes in the ventromedial prefrontal cortex (VMPFC) cause impairment in the ability to make decisions and inhibit inappropriate and impulsive behaviors. The CPFVM and the COF maintain an important relationship with the amygdala and both contribute to decision-making by promoting an assessment of the behavior that will be adopted. Studies using volumetric approaches have found reductions in the orbitofronto-striatal system, including smaller volumes in the bilateral orbitofrontal cortex (OFC), bilateral anterior cingulate cortex (ACC), left amygdala, bilateral thalamus, and left hippocampus compared to healthy controls.

According to Goleman (2001), emotional memory can be a repository of emotional impressions and memories. In this dynamic and complex process in which emotions and the entire cognitive apparatus directly interfere with the human communication system, learning directly interferes with the structuring of the brain, allowing new neural connections to be connected, giving greater plasticity, or what is called neuroplasticity. The participation of the anterior cingulate cortex in the scenario of emotions was possible to be demonstrated with the advent of functional neuroimaging techniques.

The dysfunctional connectivity of the fronto-striatal region implicated overlaps the networks responsible for executive functions.

Spatial working memory captures the ability to retain and organize visuospatial information, which involves frontoparietal circuits. Using image recordings, the involvement of this anatomical structure during cognitive tasks, during painful stimulation and during tasks with an emotional content was proven, with this region of the cortex being a type of conflict detector. Representations of “social pain” resulting from the loss of social ties are superimposed in the anterior cingulate cortex to detect probable risks to survival, as well as recruit attention and promote the acquisition of resources to minimize danger. (EISENBERGER, 2004).

Interpersonal skills are basic, as we are, above all, a social species. Only by interacting with other people can we achieve our individual goals: from the most elementary, such as nutrition and reproduction, to those that are determined by culture and coexistence in the broader social group. In the context of these skills, the cognitive control enabled by attention is also important, and now the focus is on the people around us. Non-verbal language is essential for adequate social interaction. Particularly important is the ability to identify the emotional expression of human faces, as basic emotions are expressed invariably by our species. Individuals from all culture's express emotions such as fear or pleasure in the same way. The ability to identify human faces is already evident in babies and continues to improve until the end of adolescence, as a result of social interaction and the maturation of the neuronal circuits in the brain, which support it (ADOLPHS, 2009).

Education as a locus of social interaction undoubtedly contributes significantly to the socialization process, to the development of students' cognitive and socio-emotional skills. After all, humans are very susceptible to the social context, rules, standards and values of

other people that directly affect our way of thinking, feeling and acting. Undoubtedly, knowledge about human behavior favors our social cognition, as it deepens the mental processes through which a person understands themselves, others and social situations (GAZZANIGA; HEARTHERTON, 2007).

The educational system will include as a routine practice the instillation of essential human skills such as self-awareness, self-control and empathy. Thus, recursivity, order/disorder antagonism and the hologrammatic principle are present, the construction of teaching knowledge is capable of expansion, contributing to cognitive complexification and self-reorganization as subjects who learn throughout their lives. From the above, it is easy to deduce that emotion governs our cognition, in addition to being at the service of universal communication that, above all, is unconscious (GOLEMAN, 2012; GOLEMAN, 2014; DAMÁSIO, 2007).

The results obtained demonstrated that emotional aspects have significant potential to directly impact the physical and mental health of individuals. This work reveals that much still needs to be done to understand the affective and social impacts on the teaching-learning process (LI et al., 2020; WANG et al., 2020).

According to the WHO, Brazil was already the most anxious country in the world and had the highest incidence of depression in Latin America, impacting around 12 million people. In a systematic review published between January 1, 2020 and January 29, 2022, there are 53 million new cases of depression and 76 million of anxiety worldwide. One of the areas of the brain most affected by chronic stress is the hippocampus, important for memory.

Chronic stress can also alter the prefrontal cortex, the brain's action control center, and the amygdala, the center of fear and anxiety.

A high flow of glucocorticoids for a long time can damage connections within the prefrontal cortex and between it and the amygdala. As a result, the prefrontal cortex loses its ability to control the amygdala, leaving the center of fear, aggression and anxiety unchecked. Probably, the social isolation caused by the pandemic was also harmful to brain structure and function.

High stress reduces the volume of the hippocampus and amygdala as well as decreased connectivity in the prefrontal cortex. Not surprisingly, people who lived alone during the pandemic had higher rates of depression and anxiety. Ultimately, damage to these brain areas affects people not only emotionally, but also cognitively. According to current literature, diagnoses of "brain fog" are due to the impact of chronic stress on the prefrontal cortex and its evident damage to concentration and working memory. The changes reduce stress-induced neuroplasticity with loss of neurons and synapses. In contrast, larger social circles have more volume and connections in the prefrontal cortex, amygdala, and other regions of the brain.

Chronic stress depletes levels of Brain-Derived Neurotrophic Factor (BDNF) which helps promote neuroplasticity. Without ⁶BDNF, the brain becomes less able to repair or replace lost cells and connections. On the other hand, physical exercise increases BDNF levels, especially in the hippocampus and prefrontal cortex, which explains, at least partially, why exercising can improve cognition and mood.

Chronic stress and long periods of time don't just affect our memory and concentration abilities. Some experts believe it is possible that some areas of our brain have also decreased in size. Through imaging examinations of socially isolated people, changes were detected in the volume of the temporal, frontal, occipital and subcortical

regions, as well as in the hippocampus and amygdala. The hippocampus is the area of the brain responsible for learning and memory processes and is one of the areas most affected by the effects of the pandemic.

It is evident that socio-emotional skills need to be considered both when adapting to the virtual environment as well as to face-to-face activities. Students' learning process is more effective when they experience security and support from their teachers, aspects that are transmitted in the relationship. On the other hand, when they experience situations of fear or insecurity, learning may be impaired, requiring support to develop skills that allow them to deal with stress and adverse situations (BROOKS, 2020).

Through imaging tests, changes were detected in the volume of the temporal, frontal, occipital and subcortical regions, as well as in the hippocampus and amygdala. The hippocampus is the area of the brain responsible for learning and memory processes and is one of the areas most affected by the effects of the pandemic. This way, the so-called "Pandemic Brain" goes far beyond a mild memory impairment or decline in learning capacity. There are many receptors that are sensitive to cortisol, which is why several neural networks are affected, which is revealed in our possible frequent mood swings, feelings of fear or inability to concentrate, perform several tasks at the same time or make decisions without hesitation.

Given the above, some recommendations for higher education institutions and public and private schools are to create a technical committee to monitor mental health indicators, plan and implement actions to respond to institutional needs, carry out studies to evaluate the mental health of students and teachers and the implementation of a permanent support service to guide "Emotional Immunity".

FINAL CONSIDERATIONS

Education is characterized by a process that involves learning and this is measured by the structural and functional properties of the nervous system, especially the brain.

It is important to clarify that they do not propose a new pedagogy nor do they promise definitive solutions to learning difficulties. They can, however, collaborate to support pedagogical practices that are already being carried out successfully and suggest ideas for interventions, demonstrating that pedagogical strategies that respect the way the brain works tend to be more efficient.

Learning is closely related to memory, and can be defined as the process by which lasting modifications are incorporated into behavioral potential as a result of experience, while memory is defined as the record of experience that underlies learning (LENT, 2010).

It is considered that the scientific knowledge presented during the course provided an opportunity to review teachers' previous beliefs and expanded their knowledge systems, leading teachers to guide their practices with an intentionality different from those previously adopted.

The benefits of the study also reach education in general, in the sense that the knowledge arising from neurosciences demonstrates, once again, that it contributes to the enhancement of teaching mediation. The research, by problematizing teaching and learning, adopting the need to bring neurosciences and education closer together, helps to show how biological sciences need to be present in teacher training.

The research was organized and carried out through actions that allowed teachers to reflect on their training and professional trajectory. The experiences also intended to provide teachers with the acquisition of new knowledge, which could be incorporated into practice to enhance media coverage and,

consequently, learning.

The reflections arising from this investigative study allow us to establish some connections that mark the threshold between the theoretical discussions that the research raised and the formulation of intertwinings that will give rise to new reflections, new practices and new research.

Furthermore, in the current context,

emotional weaknesses, insecurities and uncertainties are observed that call on people to exercise empathy, solidarity and resilience, which are understood as important socio-emotional skills in life and education.

Therefore, it is proposed that neurosciences can be included in teacher training, in order to contribute to the reinvention of the function of teaching and learning.

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