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NEUROSCIENCES IN TEACHER TRAINING IN THE PANDEMIC CONTEXT AND ITS DEVELOPMENTS

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Abstract: The approach of 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 scenario of public policies. Currently, neuroscience discoveries demonstrate that emotions have come to be recognized as fundamental to teaching and learning. Knowing how the human brain works, knowing that emotions positively participate in human development, but that they can also limit 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 teacher planning? To respond to 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 continuing education was anchored in hermeneutic reflection of a qualitative nature as an epistemological paradigm in a collaborative approach with a view to continuous and systemic actions based on the understanding of the brain and its interfaces in the development of cognitive and emotional learning.
Keywords: Neurosciences, Skills, Socioemotional, Education, Pandemic.

INTRODUCTION

Neurosciences can collaborate for the re-elaboration/re-signification of pedagogical practices that are already carried out successfully and propose new interventions, paying attention to the fact that pedagogical strategies that respect the functioning of the brain will possibly be more efficient. It is important to emphasize that advances in neuroscience allow a more scientific approach to the teaching-learning process, based on the understanding of mobilized cognitive processes. However, it never hurts to remember that we must be cautious, even with all the optimism regarding the contributions arising from the interlocution between neurosciences and education (VIZZOTO, 2019).

The neurosciences can be understood, in view of their terminological breadth, as a mixture of disciplines that deal with the study of the brain, dealing, more specifically, with its chemical, structural, functional and pathological development. Complementing this definition, the 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 anatomical-functional structure of the brain would have been stimulated by cultural elements, suggesting that the required functions increased along with the knowledge of the world, requiring an increase in the surface of the brain which, limited by the closed skull, was increasingly wrinkled into form of folds, thus giving rise to the turns, grooves and fissures found in the cerebral cortex, a layer assisted by subcortical gray matter nuclei, 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 coated with affective-emotional content (LENT, 2010 apud MOURA, 2021).

The integration of emotional content related to cognitive processes occurs in the orbitofrontal cortex complex (OFC) and ventromedial prefrontal cortex (PFC). Sensory impressions converge, through the OFC, to the ventromedial PFC, from where the synthesized information is taken to the dorsomedial PFC and inferolateral 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 the "R-complex". Known as the "instinctive brain", it is characterized by 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 nuclei of the base of the telencephalon, responsible for gross motor skills; by the diencephalon, constituted by 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 the 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 subjects that promote citizenship, 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 building a fairer and more equitable society, has been one of the challenges posed 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 IN TEACHER TRAINING: METHODOLOGICAL PATH

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

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

consequently, of learning. During the months of May and June 2022, the first interview with the teachers was carried out.

We opted for the semi-structured interview, given the numerous possibilities that may arise during the conversation. In this type of interview, the guiding questions were previously selected. The culmination of the experience was a course on neurosciences for teachers. The course was given in June and July 2022, during the weekly meetings of the professors, totaling 20 hours of activities.

The planning involved conducting a new interview 30 days after the course. This temporal interval is justified by the fact that learning happens when, after a certain time, the information is evoked, which denotes that they have been stored in long-term memory, that is, they persist over time (IZQUIERDO, 2011). Regarding this process, Lent (2008) differentiates short-term memory, which remains active from 30 minutes to 6 hours, from long-term memory, which, after a sequence of biochemical events, is consolidated and can be recalled after many hours, days or years. This interval, therefore, was essential to identify the processes of mental reorganization and self-perception of teachers about their practice.

The purpose of the interview, after the course, was to observe possible alterations in teachers' knowledge through lexical/semantic data constituents in teachers' speeches, in a possible demonstration of the usefulness of scientific knowledge in pedagogical practice. For Tardif (2014), teaching knowledge is similar to stocks of technically available information, renewed and produced by the scientific community and capable of being mobilized in practice.

At the end of the course, not only the conceptual mastery in the area of Neurosciences was identified, but also the relevance of this knowledge in the daily life of the classroom. Thus, given the need to provide opportunities for the application of neuroscientific knowledge in teaching practice and to encourage a process of reflection on the relationship between theory and practice, this time interval was used to carry out the interview.

Bardin's (2011) content analysis 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 adopted theoretical discussions served as a basis for understanding the analyses, taking as a point of reference the teachers' records obtained in interviews before and after the completion of 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 outline of questions, however, it is not rigidly applied, allowing for some flexibility in the face of the necessary adaptations. Parallel to the specific practice, teachers reported the existence of individual differences among students, which also need to be considered at the time of pedagogical planning. These differences constitute the second category. At the end of the research, the teachers suggested repetition as a possibility of reducing forgetfulness, requiring the use of 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 to continuous training, which takes place throughout the entire teaching career. The teachers who participated in the interviews recognize little or no knowledge about Neurosciences, as well as socio-emotional skills and competences.

It is important to resume here the records of the last question of the first interview, in which 64% of the research collaborators said

they knew very little and 36% said they had no knowledge about socio-emotional skills from the perspective of neurosciences. Among the factors necessary for learning to occur, the most remembered were emotion, motivation, attention, memory and activation of prior knowledge.

The teachers interviewed recognize the relevance of socio-emotional skills for learning, recognizing that the interdependence of these factors interferes with the result of teaching. Once the students' socio-emotional skills were recognized from the perspective of Neuroscience, the teachers also identified the need for teaching to be based on differentiated methodologies. Through the answers obtained, it is assumed that the exploration of the neurosciences theme seems to have contributed to revise the beliefs of the professors by improving the vision of the potentialities, there will be chances of pedagogical actions being re-signified.

The Neurosciences course, by contributing significantly to the enhancement of the teaching action, justifies the propositions regarding the increase of the student's motivation and pleasure in learning. Therefore, the role of Neurosciences in the face of the teacher's task of understanding his student and seeking a space in such a pleasant and positively exciting way, where he feels at ease for learning, is indisputable. Experiencing positive emotions has stimulated the formation of memories, as advocated by Neurosciences, as executive functions are activated through emotional involvement, performing activities such as executive and inhibitory control, abstraction capacity, attention, flexibility, working memory and problem solving (IZQUIERDO, 2004; LENT, 2010).

When comparing the professors' responses to the interviews before and after the Neurosciences course, with a constant exercise of dialogue with the adopted basic theory during the analysis, some positive aspects were noticed through a movement of knowledge reconstruction on the part of the professors. As learning subjects, faced with new concepts presented, teachers expand their semantic memories and change their implicit theories related to education. Remembering that semantic memories are declarative, that is, we can make them explicit through language, they translate our knowledge of the world, including scientific knowledge.

The Neurosciences course, by significantly contributing to the enhancement of the teaching action in different ways, as we saw in the two previous questions, justifies the teaching propositions regarding the increase of the student's motivation and pleasure in learning. Thus, neuroeducation arises, whose objective is to show how the brain and the educational process are interconnected, helping teachers to understand how information is processed. Scientific knowledge about students' brain conditions has enabled teachers to understand who their students are and what their needs are. This increased the teacher's ethical commitment towards them, as they felt responsible for offering teaching that meets their specificities, generating greater learning opportunities and fulfilling the social role of teaching.

EMOTIONAL SKILLS IS: CHALLENGES AND POSSIBILITIES

In the current pandemic, the closure of schools has affected more than 1.5 billion students, that is, 91% of all students in the world, something unprecedented in history. According to Unesco, the natural drop in learning could spread for more than a decade if public policies are not created that invest in improvements in infrastructure, technologies, training, methodologies and wages, in addition to reinforcing meals, better use of time, tutoring outside the usual class

hours and additional material when possible (UNESCO, 2020).

Socio-emotional skills are understood in their relationship with the framework of emotional intelligence based on Gardner's work (1983/1994) on multiple intelligences and on Goleman's (1995) publication 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 assume 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 have a direct impact on the lives of these subjects. This way, the scientific dissemination of this knowledge can support the (re)thinking of praxis from the perspective of neuroscience knowledge.

The National Common Curricular Base (BNCC) points to the mandatory implementation of socio-emotional skills in school curricula. It is noteworthy that in all competences proposed in the BNCC, there is a concern that involves socio-emotional development, since the student is the central axis of their learning process (BRAZIL, 2017).

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, resolution of 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 for diversity, responsibility and leadership skills (PELLEGRINO & HILTON, 2012).

Norms and social interrelationships must be respected, ensuring an appropriate behavioral pattern for the context. We can summarize all of this as the ability to self-regulate. Therefore, it is worth thinking about effective strategies to intervene in the education of these skills, essential for the citizen of 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, since mediation is based on teaching knowledge and gaps and insufficiencies regarding the importance of socio-emotional skills in teaching can contribute to a not so successful result in achieving of that objective.

In order to make a decision, there is a need for emotion regulation to obtain the results that bring the most benefits or those that are most in line with what is expected by society. 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, alterations in the regulation of emotions and in logical reasoning and declarative knowledge of social and moral norms are preserved (DAMÁSIO, 1990).

Damásio et al. (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 the interactions with the limbic system, especially the amygdala, an overactivity of the COF could facilitate the fear and anxiety conditioning process. Some studies indicate that alterations in the ventromedial prefrontal cortex (CPFVM) impair the ability to make decisions and inhibit inappropriate and impulsive behaviors. The CPFVM and 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 orbitofrontostriatal 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 has been demonstrated since the advent of functional neuroimaging techniques.

Dysfunctional connectivity of the front striatal region is implicated in the "Pandemic Brain" and 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 was proved during cognitive tasks, during painful stimulation and during tasks of emotional content, with this region of the cortex being a kind of conflict detector. Representations of "social pain" arising from the loss of social ties are superimposed on the anterior cingulate cortex by detecting probable risks to survival, as well as recruiting attention and promoting the acquisition of resources to minimize the danger. (EISENBERGER, 2004).

Interpersonal skills are basic, as we are, above all, a social species. Only in interaction with other people can we achieve our individual goals: from the most elementary, such as food and reproduction, to those that are determined by culture and living in the broader social group. In the context of these skills, the cognitive control made possible by attention is also important, and now the focus is on the people around us. Non-verbal language is critical for proper social interaction. Particularly important is the ability to identify the emotional expression of human faces, as basic emotions are invariably expressed by our species. Individuals from all cultures manifest 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 sustain 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 people understand 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, recursion, the order/disorder antagonism and the hologrammatic principle are present, the construction of teaching knowledge can be expanded, contributing to cognitive complexification and self-reorganization as subjects who learn throughout life. From the above, it is easy to deduce that emotion governs our cognition, in addition to being at the service of a universal communication that, above all, is unconscious (GOLEMAN, 2012; GOLEMAN, 2014; DAMÁSIO, 2007).

Education in times of a pandemic is going through an unprecedented moment, where the difficulties and challenges regarding the alternatives used to maintain teaching activities in several countries are evident. The mere transposition of face-to-face classes to remote classes proves to be unfeasible given that each of these teaching models has specific characteristics. Therefore, in-depth discussions are needed on how to conduct teaching during the pandemic (BROOKS, 2020).

The results obtained demonstrated that the emotional and physiological aspects of social distancing during the pandemic 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 of the pandemic on the teaching-learning process. The growth in the number of studies on this topic shows a tendency for debates that contribute to facing the consequences of the pandemic in Brazil and in the world (LI et al., 2020; WANG et al., 2020).

According to WHO, Brazil was already the most anxious country in the world and the highest incidence of depression in Latin America, impacting about 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 in the pandemic period is the hippocampus, which is important for memory.

Chronic stress can also alter the prefrontal cortex, the brain's action control center, and the amygdala, the fear and anxiety center. A high flow of glucocorticoids for a long time can disrupt 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 fear, aggression, and anxiety center unchecked. Probably, the social isolation caused by the pandemic was also harmful to brain structure and function.

Elevated stress reduces volume in 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 the current literature, diagnoses of "pandemic 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 decrease stress-induced neuroplasticity with loss of neurons and synapses. In contrast, the largest social circles have more volume and connections in the prefrontal cortex, amygdala and other regions of the brain.

Chronic stress in the pandemic depletes levels of Brain-Derived Neurotrophic Factor (BDNF) that helps promote neuroplasticity. Without [6]BDNF, 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 didn't just affect our memory and concentration capacity. Some experts believe it's possible that some areas of our brains have also shrunk in size. Through imaging studies 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, being one of the areas most affected by the effects of the pandemic.

Dysfunctional connectivity of the front striatal region is implicated in the "Pandemic Brain" and overlaps the networks responsible for executive functions. Spatial working memory captures the ability to retain and organize visuospatial information, which involves frontoparietal circuits.

Thus, the so-called "Pandemic Brain" goes far beyond a mild memory impairment or decline in learning ability. It is evident, in this scenario, that socio-emotional skills need to be considered both in adapting to the virtual environment as well as for face-to-face activities. The 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 can be impaired, requiring support to develop skills that allow them to deal with stress and adverse situations (BROOKS, 2020).

Through imaging 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, being one of the areas most affected by the effects of the pandemic. Thus, the so-called "Pandemic Brain" goes far beyond a mild memory impairment or decline in learning ability. There are many receptors that are sensitive to cortisol, so several neural networks are affected, which is revealed in our possible frequent mood swings, feelings of fear or inability to concentrate, multitask or make decisions without hesitation.

The global pandemic caused by the coronavirus has been causing several socio-emotional impacts that affect the entire educational spectrum. Therefore, facing such a delicate historical moment and, subsequently, being able to rebuild and move forward is a premise for perfecting the brain, as it changes continuously while we learn from the experiences, we have lived to refine the mind and learn about any situation. thing.

Given the above, some recommendations for higher education institutions and public and private schools include: creating a technical commission to monitor mental health indicators, planning and implementing actions to respond to institutional needs, conducting studies to assess the mental health of students and teachers, carry out projects to welcome students during and after the pandemic and the implementation of a permanent support service to guide "Emotional Immunity". Therefore, it is necessary to investigate the contributions of neurosciences to education in a fruitful dialogue.

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. However, it must be considered that their knowledge is not a new education proposal. From Neuroscience and the neuroscientific knowledge generated by this science, a

dialogue with education can be opened in the sense of cooperation and partnership. It is important to clarify that they do not propose a new pedagogy or promise definitive solutions for learning difficulties. They can, however, collaborate to support pedagogical practices that are already successfully carried out 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 changes 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 made it possible to review teachers' previous beliefs and expand their knowledge systems, leading teachers to guide their practices with different intentions from those previously adopted. With the completion of the course and greater clarity about this reality, the teachers replaced practices that had repetition as their main scope, for the development of a more meaningful strategy.

The benefits of the study also reach education in general, in the sense that the knowledge arising from the neurosciences demonstrates, once again, that they contribute to the potentialization of teaching mediation. The research, by problematizing teaching and learning, adopting the need to bring the neurosciences and education closer together, collaborates to show how the biological sciences need to be present in teacher training, especially at a time when we are increasingly addressing differences so present and visible. The research was organized and carried out through actions that allowed teachers to reflect on their training and professional career. The experiences also intended to provide teachers with the acquisition of new knowledge, which could be incorporated into practice as potentializers of media coverage and, consequently, of 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 interweaving's that will give rise to new reflections, new practices and new research.

In addition, in the current context, emotional weaknesses, insecurities and uncertainties, resulting from the pandemic, are observed, which call people to exercise empathy, solidarity and resilience, these understood as important socio-emotional skills in life and education. Thus, it is proposed that neurosciences be included in teacher training, in order to contribute to the management of the effects of the pandemic in the field of education, enabling the reinvention of the function of teaching and learning.

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