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THE ROLE OF EMOTIONAL INTELLIGENCE IN THE DEVELOPMENT OF STUDENTS' CREATIVE ACTIVITY BASED ON A NEUROPEDAGOGICAL APPROACH

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Abstract: This article examines the role and importance of emotional intelligence in the development of students' creative activity based on a neuropedagogical approach from a scientific, theoretical and practical perspective. The article analyzes the neurobiological foundations of emotional intelligence, the relationship between the limbic system and the prefrontal cortex, and the influence of emotions on creative processes. Also, the Mayer-Salovey-Caruso model of emotional intelligence is reviewed in a neuropedagogical context, empirical studies are presented that prove the connection between emotional intelligence and creative activity, and neuropedagogical educational strategies aimed at developing emotional intelligence in higher education institutions are presented.

Keywords: emotional intelligence, neuropedagogy, creative activity, limbic system, amygdala, prefrontal cortex, emotional regulation, emotion and cognitive process, affective neuroscience, Mayer-Salovey-Caruso model, creative competence.

Introduction. At the intersection of modern educational psychology and neuroscience, an important question is on the agenda: why do students with the same level of knowledge differ sharply in creative activity? Why do some students easily generate new ideas, while others fall into thinking blocks? To answer this question, researchers have turned to studying not only the cognitive side of intelligence, but also the emotional-emotional side. The concept of emotional intelligence plays a crucial role in this path.

The concept of emotional intelligence was first introduced as a scientific term in 1990 by American psychologists Peter Mayer and Jack Salovey, and later Daniel Goleman brought it to the wider public. However, in the last decade, advances in neuroscience have added a fundamentally new dimension to this concept: it has become scientifically possible to identify which areas of the brain and through what mechanisms the neural substrates of emotional intelligence work.

In the context of a neuropedagogical approach, the relationship between emotional intelligence and creative activity is particularly interesting. Research shows that the free functioning of the Default Mode Network, which is necessary for creative activity, directly depends on the emotional state and the level of emotional regulation. In other words: emotional intelligence serves as a prerequisite for the brain to enter the creative mode.

In higher education in Uzbekistan, the issue of emotional intelligence has traditionally been considered within the framework of psychology and has not been integrated into the educational process. This article analyzes the neural connection between emotional intelligence and creative activity based on a neuropedagogical approach and develops practical pedagogical strategies.

To understand emotional intelligence from a neurobiological perspective, it is first necessary to get acquainted with the limbic system, the main structure of the brain that controls emotional processes. The limbic system is an evolutionarily ancient structure that combines the amygdala, hippocampus, hypothalamus, thalamus, and cingulate cortex.

A further breakthrough in neuroscience, the “two-track” theory (LeDoux, 1996), suggests that emotional information is processed in two ways: a fast, unconscious path (from the thalamus to the amygdala) and a slow, conscious path (from the thalamus to the neocortex to the amygdala). This dual mechanism explains why emotions sometimes trigger a reaction before logical thinking and is the neural basis for the development of emotional intelligence.

The amygdala, the “emotional sentinel,” triggers the “fight or flight” response when it perceives danger, threat, or novelty. This response, in turn, leads to the release of cortisol and adrenaline, which reduces the activity of the prefrontal cortex. Pedagogically, this means that in a stressful or unsafe learning environment, a student’s ability to think creatively is directly blocked at the neural level.

On the other hand, positive emotions such as curiosity, wonder, and joy activate the brain’s reward system. Dopaminergic neurons in the nucleus accumbens and ventral tegmental area are activated, increasing motivation to learn and engaging the DMN in a creative thinking mode. This mechanism provides a neural basis for one of the fundamental principles of neuropedagogy: that a positive emotional environment enhances learning effectiveness.

The prefrontal cortex, the brain's thinking, planning, and decision-making center, plays a central role in emotional regulation. The ventromedial PFC is important for social and emotional decision-making, while the dorsolateral PFC is important for working memory and critical thinking.

Damasio's "Somatic Sign Hypothesis" was a significant discovery: patients with vmPFC lesions retained the ability to reason but were unable to make effective decisions. This proved that emotions are not an obstacle that does not participate in the processes of decision-making and creative thinking, but a necessary participant.

Neuropedagogically, this means that instead of "excluding" emotions from the learning process, the basis of emotional intelligence is the conscious management of them, which encourages the prefrontal cortex to work at maximum efficiency and creates optimal neural conditions for creative activity.

Recent advances in affective neuroscience have more clearly defined the neural intersection of emotion and creativity. fMRI studies show that during creative processes, there is an increased connection between the limbic system and the neocortex, which means that both systems must work together for successful creative thinking.

According to Izard's Differential Emotions Theory, positive emotions such as interest and surprise act as neural signals that increase DMN activity. Therefore, arousing a sense of curiosity and wonder in a student has not only a psychological but also a neurological purpose: these emotions generate dopaminergic signals that activate the DMN.

The four-layer EI model developed by Mayer, Salovey, and Caruso—perceiving emotion, using emotion, understanding emotion, and managing emotion—takes on a new practical dimension when reinterpreted in a neuropedagogical context. The following table analyzes each EI component in relation to its neural substrate and creative activity:

1-Table.

Mayer-Salovey-Caruso Model: Neuropedagogical Interpretation

EI component	Definition	Neural substrate	Impact on creative activity	Development Method
Emotion perception	Identify, read, and express one's	Fusiform cortex, amygdala, insula, mirror	Expands sources of creative	Face reading, emotional journaling, art

	own and others' emotions	neurons	inspiration; grounds empathetic design	analysis
Emotion use	Direct and use emotions for cognitive tasks	Dorsolateral PFC, anterior cingulate cortex, dopamine system	Activates interest and wonder in challenging tasks	Creative interest generation, motivational self-talk
Understanding emotion	Know the logic of emotions, predict their changes	Orbitofrontal cortex, temporal cortex, hippocampus	Creates creative narratives; enriches character and plot	Emotional vocabulary, emotional scenario analysis
Managing emotion	Regulate negative emotions, enhance positive ones	Prefrontal cortex-amygdala connection, vmPFC, insula	Removes creative block; increases willingness to take risks	Mindfulness, cognitive reappraisal, nefas technique

Reuven Bar-On's EI model places great emphasis on personal and social competencies. His model includes five blocks: the personal intra-block (self-awareness, assertiveness, independence, self-esteem, self-actualization), the interpersonal block (empathy, social responsibility, interpersonal relationships), adaptability (problem solving, reality assessment, adaptability), stress management (stress tolerance, impulse control), and general mood (joy, optimism).

From a neuropedagogical point of view, the most valuable aspect of the Bar-On model is that it describes EI not as a static trait, but as a dynamic set of skills that can be developed. Neuroscience, however, proves the neural mechanism of this development by strengthening the connection between the prefrontal cortex and the limbic system.

Daniel Goleman's EI model is widely used in pedagogy and organizational psychology. His five-component model (self-awareness, self-regulation, motivation, empathy, social skills) has formed the basis of emotional and social learning programs in educational institutions.

Goleman argued that EI plays a more important role in work and educational success than IQ. His concept of the "social brain" was confirmed by neuroscience with the discovery of mirror neurons: we not only understand the emotions of others, but also "feel" them at the neural level. This provides an important neural basis for empathic learning and collaborative creativity.

In the last decade, the number of empirical studies examining the relationship between EI and creative activity has increased significantly. The main results of these studies are as follows:

-Ivcevic and Brackett: In a study of more than 1,000 students, a moderately strong positive correlation ($r = 0.43$, $p < 0.001$) was found between EI and creative thinking. In particular, the components of "emotional understanding" and "emotional management" were the strongest predictors of creative performance.

-Zenasni and Lubart: A study by the University of Paris found that emotional regulation ability predicted divergent thinking tests (Torrance) scores much better than IQ. This correlation was particularly strong for students in the field of artistic creativity.

-Averill: Averill, who developed the concept of emotional creativity, identified three components of emotional creativity (EC): novelty (unexpected, unusual combinations of emotions), effectiveness (directing emotions towards a goal), and authenticity (authentic expression of emotions). The level of EC showed a strong correlation with creative performance.

-Kaufman (2012): A meta-analysis (45 studies, n > 8000) determined the overall correlation between EI and creative performance as r = 0.37. The larger effect size was observed in situations where the emotional environment was favorable.

-Zuo et al.: A longitudinal study of 500 students showed that an EI development program (8 weeks) increased creative self-efficacy by 34% and divergent thinking by 28%.

There is strong evidence that the creative block is a state of inspiration and stagnation of ideas, which is associated with hyperactivation of the amygdala and subsequent deactivation of the prefrontal cortex by neuroscience. This condition is also called "amygdala hijacking" and occurs during negative emotional states such as stress, fear, and the threat of criticism.

An important neuropedagogical conclusion can be drawn: the educational environment can be one of the main causes of creative block or a major protective factor against it. If the teacher creates an environment that creates a fear of "being humiliated if I make a mistake", the amygdala is activated and creative thinking is blocked. Conversely, feelings of psychological safety, acceptance, and interest "calm" the amygdala and keep the prefrontal cortex in a creative mode.

A 2018 neuroimaging study (Beaty et al.) showed that creative individuals with high EI engaged the DMN and ECN in parallel and coordinated fashion when performing creative tasks. In contrast, participants with low EI showed lower creative productivity as a result of the conflict between these two networks, which inhibited each other.

2-Table.

Types of emotions and their neural impact on creative activity

Emotion type	Neural mechanism	Impact on creative activity	Pedagogical significance	EI Intervention
Interest	Dopamine, nucleus accumbens, DMN activation	Increases idea generation; increases exploratory behavior	The main engine of creative motivation	Creating Emotional Attachment to the Subject
Awe	DMN hyperactivation, time perception expansion	Thinking deepens; strengthens conceptual connections	"Wow" experiences: art, nature, big ideas	Designing Exciting Stimuli
Joy	Serotonin + dopamine, prefrontal cortex expansion	Thinking expands; increases divergent associations	Games, fun exercises, improve the quality of communication	Consciously Creating a Positive Emotional Environment
Anxiety	Amygdala hyperactivation, cortisol, PFC deactivation	Creative block; forcing convergent thinking; decreases	Stress management is important	Cognitive Reappraisal Techniques

		divergent thinking		
Frustration	Anterior cingulate cortex, dorsal striatum response	In moderate levels — creative perspective, in extreme cases — block	Skills for managing "productive struggle"	Developing Frustration Tolerance
Elevation	Oxytocin, vagal system, pro-social neurotransmitters	Increases social creativity; increases collaborative idea sharing	Inspiring role models, spiritual stories	Designing Experiences That Inspire Joy

The first and most important condition for the development of creative activity is the creation of an emotionally safe environment. This environment should meet the following neuropedagogical requirements:

-Normalization of error: The teacher reduces the amygdala response by reframing errors as "learning information". The phrase "This is not an error, this is information" is a simple example of a cognitive reappraisal technique that activates the prefrontal cortex.

-Temporal separation of criticism: The strict prohibition of criticism during the brainstorming phase protects this DMN. Critical evaluation is carried out only in a separate phase (when the ECN is active). This is the neural justification of Osborn's (1953) classic brainstorming rule.

-Positive expectation environment: Delivering the message "you can do it" to the student at the neural level increases the release of dopamine at the end. Positive expectation signals in the teacher's verbal and nonverbal communication resonate with the student's neural state through mirror neurons.

-Collaboration instead of competition: A competitive environment increases cortisol and noradrenaline levels, increasing amygdala reactivity. A cooperative environment increases oxytocin and serotonin levels, creating a favorable neural environment for creative thinking.

Mindfulness, a practice of consciously focusing attention on the present moment, occupies a special place in neuropedagogy. fMRI studies have shown a decrease in amygdala volume and an increase in prefrontal cortex-amygdala connectivity after an 8-week mindfulness course. These changes are directly related to improved emotional regulation and increased creative activity.

Neuropedagogical emotional regulation techniques that can be used in the educational process:

-Breath regulation (4-7-8 method): inhale for 4 seconds, hold for 7 seconds, exhale for 8 seconds. This technique activates the parasympathetic system, reduces cortisol, and restores PFC functionality. A 2-minute breathing exercise at the beginning of class is a neurally effective way to “calm down” the amygdala.

-Emotional Naming: When the emotional state of the brain is verbally named, amygdala activity has been found to decrease. Saying “I am anxious right now” paradoxically reduces anxiety. Using this technique in a self-awareness diary develops the first component of EI.

-Cognitive Reappraisal: Seeing a negative event from a different perspective, such as “this challenge is an opportunity for me to grow,” is one of the most powerful mechanisms for consciously controlling the amygdala by the PFC. Studies show that the effectiveness of this technique for emotion regulation is significantly higher than expressive suppression.

-Body Scan Meditation: Focusing attention on different parts of the body increases insula activity. The insula is the central organ for sensing one's internal state and is the neural foundation of EI.

Mirror neurons were discovered by chance in monkeys in the 1990s in the Rizzolatti laboratory and later confirmed in humans. These neurons are activated when they observe the actions or emotions of another person, creating an "internal simulation". This mechanism forms the neural basis of empathy and social learning.

From a neuropedagogical perspective, mirror neurons are important for collaborative creative activity. In group creative exercises, participants "catch" each other's emotions and ideas at the neural level through mirror neurons, and a common creative energy is generated. This phenomenon can be called "creative resonance" and, in properly organized group learning, leads to strong creative productivity.

Empathic learning is a pedagogical approach that encourages students to actively perceive each other's emotional perspective, training the mirror neuron system and simultaneously developing both EI and creative competencies. For example, the task of "writing from the other person's perspective" (perspective taking) is a powerful neuropedagogical tool that simultaneously develops empathy and creative narrative skills.

Csikszentmihalyi's "flow" state, a state of complete immersion, in which maximum creative productivity is achieved, has an interesting neuropedagogical and EI structure. fMRI studies have shown that transient hypofrontality, a temporary "shutdown" of certain parts of the prefrontal cortex, occurs during flow. This phenomenon, the weakening of internal criticism and self-monitoring, provides a necessary condition for creative freedom.

The two main conditions for entering a flow state are a balance of difficulty and ability, and a clear goal that must be emotionally controlled. Studies show that students with high EI are more adept at monitoring their emotional states and optimizing their ability to enter flow. Therefore, developing EI is also a specific neuropedagogical condition for entering a flow state.

3-Table.

System of neuropedagogical techniques that develop EI

Technique	Neural target	Implementation procedure	Impact on creative activity	Time
Emotional Journaling	Insula, vmPFC, limbic system integration	5–10 minutes daily: naming the emotional state and analyzing the cause and effect	Emotional self-awareness, identification of creative block	Daily, 8 weeks
Empathic Storytelling	Mirror neurons, temporal-parietal node	Breath-Creation Session	PFC-amygdala balance, parasympathetic activation	3 minutes of breathing (4-4-6) → 15 minutes of creative writing or drawing
Emotional Brainstorming	DMN activity,	Using emotional names as keywords in	Unusual connections	In group work

	temporal removal of critical block	idea generation	through emotional associations	
Mirroring	Mirror neurons, empathic resonance	In pairs: one explains the idea, the other repeats the emotion and content	Creative collaboration, enrichment of ideas	1–2 times a week
Mindful Observation	Insula, anterior cingulate, attention networks	Observing and describing the object with emotional completeness for 5 minutes	Perception deepens, emotional detail is enriched	1 time a week

This article proposes an integrated model of "SEL-NEP" (Social-Emotional Learning + NeuroPedagogy). The model is implemented in three layers:

First layer Neural preparation (8 weeks): Introducing students to their emotional states, neural mechanisms, and EI concepts. Using breathing regulation and emotional journaling in each lesson. Goal: reducing amygdala reactivity and increasing prefrontal cortex activity.

Second layer Creative-Emotional Integration (8 weeks): Integrating EI components into creative tasks. Using empathic scenario-building, emotional brainstorming, and mirror thinking techniques in each lesson. Goal: strengthening DMN + EI neural connectivity.

Third layer Reflective reinforcement (4 weeks): Analysis of students' creative portfolios and emotional journaling. Metacognitive reflection: "How has EI affected my creative activity?" Goal: consolidating neural changes and forming skills for continuous development.

In the SEL-NEP model, the teacher plays two important roles, not just a transmitter of knowledge. First, the Emotional Modeler: the teacher openly demonstrates his own emotional states, methods of managing them, and emotions in his creative processes. Through the mechanism of mirror neurons, students acquire this model at the neural level.

Second, the Neural Facilitator: the teacher observes the neural states of students during the lesson (physical posture, breathing rate, attention indicators) and, if necessary, adjusts the environment through lighting, music, movement, or breaks. This role requires the teacher to develop his EI skills to a high level.

Simultaneously assessing EI and creative activity is a complex but necessary task. The following multidimensional assessment system is proposed:

1. Mayer-Salovey-Caruso Emotional Intelligence Test: A standardized test that objectively measures the four components of EI. Used as a preliminary and final measure.

2. Torrance Tests of Creative Thinking: A standardized test that measures divergent thinking, elaboration, originality, and naming. Used to analyze correlations with EI.

3. Emotional Journal Analysis: A student's emotional journal written over a 20-week period is thematically analyzed as an indicator of EI development dynamics and emotional lexical enrichment.

4. Creative Portfolio Assessment: A collection of student creative works and reflective commentaries for each work are assessed for originality, emotional depth, and metacognitive understanding.

5. Peer assessment + self-assessment: Peers and the student jointly assess creative and emotional indicators and also serve as an assessment and development function for socio-emotional skills.

Conclusion. The analysis based on the neuropedagogical approach shows that emotional intelligence is not an external quality of students' creative activity, but a neural basis. Amygdala-PFC balance, emotional safety for DMN activation, dopaminergic motivational system and empathic creativity through mirror neurons all make EI a prerequisite for the creative mode of the brain. Reinterpretation of the Mayer-Salovey-Caruso model in a neuropedagogical context shows that the four components of EI correspond to the four neural stages of perception, use, understanding and management of emotions in creative activity (preparation, incubation, inspiration, verification). This coordination is the neural justification for the joint development of EI and creative activity. The proposed SEL-NEP model shows a systematic way to develop EI and creative activity in higher education in Uzbekistan through a three-layer approach (neural preparation, creative-emotional integration, reflexive reinforcement). This model requires the teacher to take on the role of an emotional modeler and neural facilitator, raising pedagogical competence to a new dimension. Empirical research in the near future, especially in Uzbek students, to determine the correlation between EI and creative activity and to test the effectiveness of the SEL-NEP model, will help to scientifically formulate a national education strategy in this area.

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