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NEUROPHYSIOLOGICAL FEATURES OF PRESCHOOL CHILDREN'S DEVELOPMENT AS A PSYCHOLOGICAL AND PEDAGOGICAL PROBLEM

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Abstract

This article presents an analytical review of neurophysiological mechanisms underlying preschool children's development in the context of psychological and pedagogical science. Preschool age is defined as a sensitive period of intensive maturation of the central nervous system (CNS) and higher mental functions. The study examines morphofunctional brain development, synaptogenesis, myelination, neuroplasticity, and interhemispheric integration, emphasizing their role in cognitive, emotional-volitional, and behavioral regulation. The integration of neurophysiological knowledge into preschool education practice is substantiated as a scientific foundation for optimizing educational environments and preventing developmental dysfunctions.

Keywords

neurophysiology, preschool development, neuroplasticity, central nervous system, cognitive development, pedagogy.

1. Introduction

The growing integration of neuroscience and education has significantly transformed modern pedagogical paradigms. Preschool age (3–7 years) represents a critical developmental stage characterized by rapid structural and functional maturation of the brain. Contemporary developmental neuroscience emphasizes that neural circuit refinement, cortical specialization, and executive system formation during this period determine future academic and socio-emotional outcomes. In the context of educational reforms, understanding age-related neurophysiological patterns becomes essential for evidence-based pedagogical design.

2. Aim of the Study

The study aims to analyze neurophysiological mechanisms of preschool development as a biological foundation for cognitive, emotional-volitional, and behavioral formation within pedagogical environments.

3. Materials and Methods

The research is theoretical-analytical. Scientific sources from developmental neurobiology, cognitive neuroscience, educational psychology, and neuropsychology (2019–2025) were systematically reviewed. Comparative and integrative analysis methods were applied to synthesize interdisciplinary findings.

4. Results and Discussion

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Neurodevelopment during preschool age is characterized by intensified synaptogenesis, dendritic arborization, and progressive myelination. Frontal cortical regions responsible for executive control and voluntary regulation undergo significant maturation. However, incomplete prefrontal integration explains the predominance of impulsive and emotionally driven behavior. Neuroplasticity during this stage ensures high sensitivity to environmental stimuli, learning experiences, and emotional climate.

Interhemispheric connectivity, mediated by corpus callosum development, supports the integration of logical and figurative thinking. Emotional regulation mechanisms gradually stabilize as cortical-subcortical interactions mature. Educational strategies that combine cognitive stimulation, motor activity, and positive emotional reinforcement optimize neural network consolidation.

5. Practical Implications

• Alternation of cognitive and motor tasks;

• Play-based neurodevelopmental methods;

• Emotionally supportive educational climate;

• Individualization according to neurodevelopmental maturity;

• Prevention of psycho-emotional overload.

6. Conclusion

Preschool neurodevelopment forms the biological foundation for personality formation and learning readiness. Educational systems must incorporate neurophysiological principles to enhance cognitive outcomes and safeguard mental health. Future interdisciplinary research should focus on evidence-based neuroeducation models adapted to regional educational systems.

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