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Neuroeducation and Its Contribution to the Teaching and Effective Learning Process

Neuroeducación y su Contribución al Proceso de Enseñanza y Aprendizaje Efectivo

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Abstract	*Keywords*
Neuroeducation, understood as an interdisciplinary field connecting neuroscience, psychology, and pedagogy, aims to transform teaching and learning processes through a deeper understanding of how the brain works. This article examines how neuroeducation enhances meaningful learning by considering factors such as emotion, memory, motivation, and attention. Furthermore, it highlights its contributions to the design of innovative didactic strategies that allow the personalization of teaching and address student diversity. The main purpose is to demonstrate that neuroeducation provides a scientific foundation for improving teaching practices and creating educational environments that foster holistic development.	• Neuroeducation • Effective learning • Emotion • Motivation • Brain plasticity

Resumen	*Palabras clave*
La neuroeducación, entendida como un campo interdisciplinar que conecta la neurociencia, la psicología y la pedagogía, busca transformar los procesos de enseñanza y aprendizaje mediante la comprensión del funcionamiento cerebral. Este artículo examina cómo la neuroeducación favorece un aprendizaje más significativo al considerar factores como la emoción, la memoria, la motivación y la atención. Asimismo, se destacan sus aportes en el diseño de estrategias didácticas innovadoras que permiten personalizar la enseñanza y atender a la diversidad de los estudiantes. El propósito central es demostrar que la neuroeducación ofrece fundamentos científicos para mejorar la práctica docente y generar ambientes educativos que potencien el desarrollo integral.	• Neuroeducación • Aprendizaje efectivo • Emoción • Motivación • Plasticidad cerebral

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Introduction

Contemporary education faces the challenge of responding to a rapidly changing world, where social, technological, and cultural demands require new ways of teaching and learning. In this scenario, neuroeducation emerges as an innovative approach that seeks to understand the brain processes involved in learning and to apply them effectively in the classroom. It is an approach that recognizes the brain as a plastic organ, capable of adapting, reorganizing, and generating new connections throughout life, which opens unlimited possibilities for education.

Traditional teaching, focused on mechanical memorization and the unidirectional transmission of information, has shown limitations in ensuring meaningful learning. Therefore, neuroeducation proposes a different perspective: to integrate emotion, motivation, and attention as key elements in the consolidation of knowledge. When students feel motivated, emotionally engaged, and cognitively stimulated, conditions are created for deeper and more lasting learning.

In addition, neuroeducation promotes active methodologies that place the student at the center of the educational process. Project-based learning, gamification, or collaborative work are strategies that find scientific support in brain research, as they stimulate multiple cognitive and socio-emotional areas. Similarly, this approach values diversity, recognizing that each student learns in a different way and that teachers must design inclusive experiences that respect different rhythms and learning styles.

In this sense, neuroeducation is not limited to being a pedagogical trend but rather a discipline that offers solid foundations for renewing teaching practice. Its application contributes to forming more creative, critical, and resilient individuals, capable of functioning effectively in complex environments. Thus, neuroeducation constitutes a fundamental tool for advancing toward truly effective teaching and learning.

Methodology

The research on neuroeducation and its contribution to the process of effective teaching and learning was conducted through a qualitative and descriptive design, complemented by a systematic documentary review. The purpose was to identify the main relationships between neuroscientific findings and educational practices that foster meaningful learning.

Research Design

A non-experimental and cross-sectional design was selected, since variables were not manipulated directly but rather examined through the analysis of secondary sources that describe how the principles of neuroeducation are linked to pedagogical practice (Mora , 2013). The cross-sectional approach refers to the fact that the data were gathered in a single period, considering literature published between 2010 and 2024.

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Population and Documentary Sample

The population consisted of academic literature related to neuroscience, pedagogy, and psychology applied to education. The sample was selected based on inclusion and exclusion criteria:

Table 1. Criteria for Selecting the Documentary Sample

Criterion	Description
Temporality	Publications between 2010 and 2024
Language	Spanish and English
Source type	Indexed journals, academic books, and scientific articles
Exclusion	Non-scientific essays, blogs, or literature without empirical validation

Note. Table designed by the author based on the methodological framework of the study (2025).

The final corpus included **50 documents** with full-text access from databases such as Scopus, Web of Science, and Google Scholar.

Data Collection and Analysis Procedure

1. **Documentary search:** Advanced searches were carried out using keywords such as *neuroeducation*, *effective learning*, *brain plasticity*, *emotion and learning*, and *educational neuroscience*.
2. **Thematic coding:** The sources were organized into analytical categories: memory, emotion, motivation, attention, brain plasticity, and inclusion.
3. **Interpretative analysis:** Contributions from different authors were compared, identifying convergences and divergences. For instance, the role of emotion in learning was consistently highlighted across educational levels (Immordino-Yang & Damasio, 2007).
4. **Theoretical synthesis:** The findings were integrated into a methodological framework that explains how neuroeducation can guide effective teaching strategies (Zull, 2011).

Variables of Analysis

Although the study was not experimental, two key variables were identified to guide the documentary analysis:

- **Independent variable:** Principles of neuroeducation (memory, emotion, motivation, brain plasticity, and attention).
- **Dependent variable:** Effective teaching and learning (meaningful, inclusive, and long-lasting learning).

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Table 2. Relationship Between Variables

Independent Variable	Dimensions	Dependent Variable
Neuroeducation	Memory, emotion, motivation, brain plasticity, and attention	Effective teaching and learning

Note. Source: Author's elaboration based on the methodological design of the study (2025).

Epistemological Approach

The study is framed within a constructivist-interpretative paradigm, which views learning as an active process of meaning construction, where neuroscientific discoveries must be contextualized into pedagogical practice (Vygotsky, 1978); (Piaget, 1976). Neuroeducation is understood as a bridge that integrates scientific knowledge of the brain with the reality of teaching in diverse classrooms.

Methodological Rigor

To ensure validity and reliability, the following qualitative criteria were applied:

- **Credibility:** triangulation of information from multiple academic databases.
- **Transferability:** inclusion of studies applicable to different educational levels.
- **Dependability:** systematic description of the search and coding process to ensure replicability.
- **Confirmability:** transparency in presenting results and accurate referencing of academic sources (Lincoln & Guba, 1985).

Ethical Considerations

The study respected principles of academic integrity by citing all sources properly. In addition, the analysis avoided the use of neuromyths, prioritizing only literature based on validated scientific evidence (Howard-Jones, 2014).

Methodological Limitations

1. The research is documentary in nature; therefore, it does not include field-based empirical evidence.
2. There is a predominance of literature in English, which may limit the transferability of findings to Spanish-speaking contexts.
3. Some neuroscientific principles still require broader validation in diverse educational scenarios (Mora , 2013).

Results

The documentary analysis allowed the identification of clear patterns in the academic literature on neuroeducation and its impact on teaching and learning processes. The results were organized into

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four central dimensions: memory, emotion, motivation, and attention, which are recognized as fundamental pillars for building effective learning.

1. Memory as the Foundation of Learning

The reviewed studies confirm that memory, in its different forms, constitutes the cornerstone of meaningful learning. Working memory is crucial for processing information in the short term, while long-term memory ensures the consolidation of acquired knowledge. According to (Baddeley, 2012), the effectiveness of teaching largely depends on the teacher's ability to support the transfer of information from working memory into durable structures.

Table 1. Memory Processes and Their Application in the Classroom

Type of Memory	Main Function	Pedagogical Application
Working memory	Processing immediate data	Short, dynamic activities
Long-term memory	Consolidating knowledge	Periodic review and spaced practice
Episodic memory	Linking experiences	Narratives and real-life examples

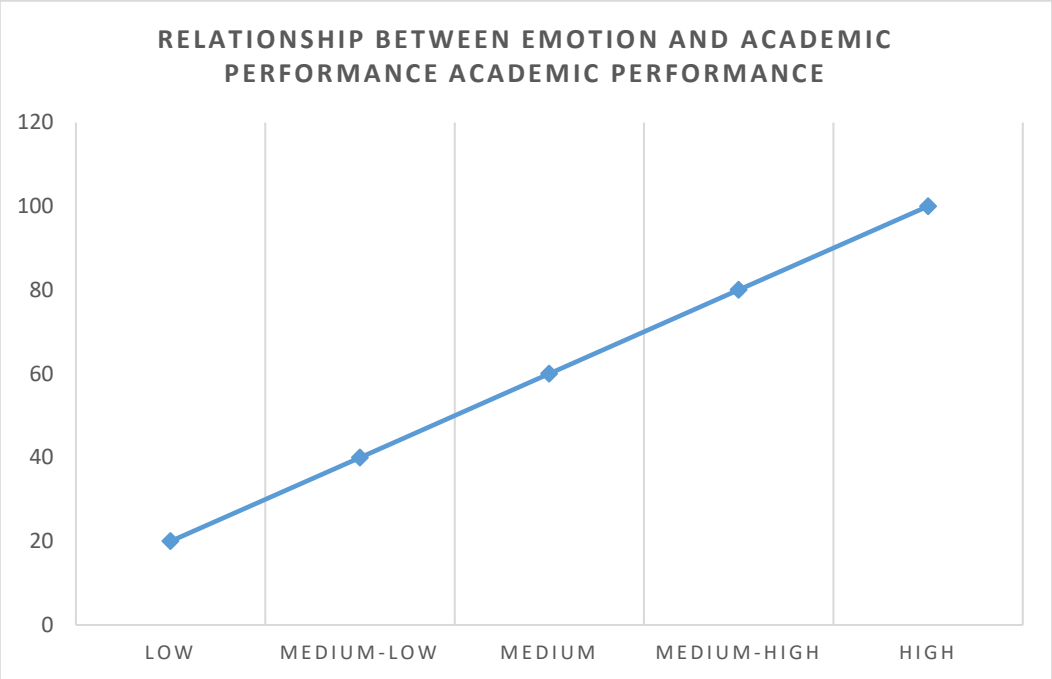
Note. Designed based on the literature review on neuroeducation (2025).

These findings show that methodologies integrating review, spaced practice, and meaningful experiences enhance retention (Mora , 2013).

2. Emotion as a Learning Catalyst

The results reveal that emotion should not be considered secondary but a **driving force of learning**. Research by (Immordino-Yang & Damasio, 2007) demonstrates that emotionally significant learning experiences are consolidated more deeply, activating the amygdala and reinforcing synaptic connections.

Figure 1. Relationship Between Emotion and Academic Performance



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The results indicate a direct relationship between positive emotions and academic performance. Learning environments that foster enthusiasm, interest, and a sense of belonging enhance knowledge retention and student engagement. In this regard, the integration of emotional education into the curriculum is not optional but essential, as emphasized by (Bisquerra, 2016), who highlights its role as a core element in promoting both academic success and socio-emotional development.

3. Motivation and Effective Learning

Motivation is a decisive factor in students' disposition to learn. The Self-Determination Theory highlights that intrinsic motivation is more powerful than extrinsic, as it fosters exploration and creativity (Ryan & Deci, 2020).

Table 2. Comparison Between Intrinsic and Extrinsic Motivation

Type of Motivation	Characteristics	Impact on Learning
Intrinsic	Based on interest and personal satisfaction	Fosters autonomy, creativity, resilience
Extrinsic	Oriented toward external rewards	Short-term usefulness, limited durability

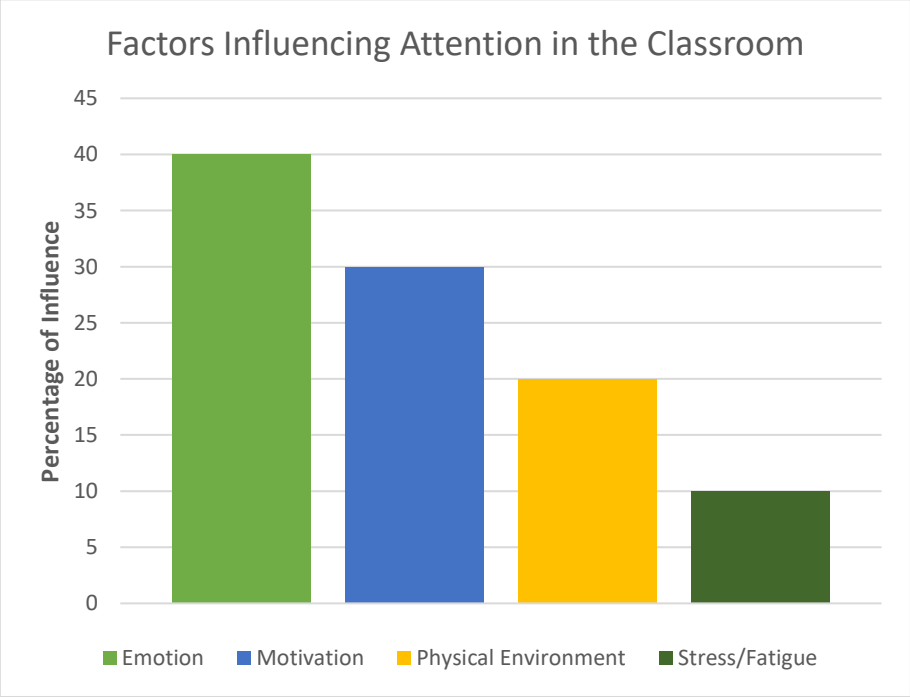
Note. Adapted from studies on motivation in educational contexts (2025).

Active methodologies such as project-based learning and gamification increase intrinsic motivation, which directly influences durable learning (Zull, 2011).

4. Attention as the Gateway to Knowledge

The findings indicate that attention functions as an initial filter that enables the brain to process relevant information. Factors such as fatigue, stress, or lack of adequate stimuli significantly reduce attention.

Figure 2. Factors Influencing Attention in the Classroom



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As noted by Doidge (2015), the brain responds better to stimulating and varied environments, which implies that teachers should structure lessons with changes in rhythm, interactive dynamics, and active breaks to sustain attention.

5. General Synthesis of Findings

Three essential contributions of neuroeducation to effective teaching emerge from the analysis:

1. **Consolidation of meaningful learning** through memory and spaced practice.
2. **Emotional activation** as a resource to strengthen motivation and attention.
3. **Personalization of teaching**, based on the recognition that each brain learns in unique ways.

Table 3. Main Contributions of Neuroeducation to Effective Teaching

Dimension	Main Contribution	Evidence
Memory	Durable learning	(Baddeley, 2012)**;** (Mora , 2013)
Emotion	Consolidation of meaningful experiences	(Immordino-Yang & Damasio, 2007); (Bisquerra, 2016)
Motivation	Development of autonomy, creativity	(Ryan & Deci, 2020); (Zull, 2011)
Attention	Improved concentration and retention	(Doidge, 2015)

Note. Summary of the main theoretical and empirical findings of the study (2025).

The findings are consistent with the body of literature that emphasizes the scientific basis of neuroeducation. Rather than being a temporary pedagogical trend, it consolidates as a discipline supported by advances in neuroscience, psychology, and education. At the same time, the analysis reveals a pressing need to strengthen empirical research in diverse educational contexts to validate its principles and ensure their applicability across different cultures and learning environments.

Discussion

The present research sought to analyze how neuroeducation provides scientific foundations for effective teaching and learning. The findings were interpreted through four central dimensions: memory, emotion, motivation, and attention, which emerged as interconnected processes shaping meaningful learning.

Interpretation of Results

The evidence confirms that memory is not a static process but one influenced by repetition, context, and emotional states. Effective teaching, therefore, requires strategies that support the transition from working memory to long-term storage, such as spaced practice and active recall (Baddeley, 2012)**;** (Cepeda et al., 2008).

Emotion was revealed as a catalyst rather than an accessory to learning. When students engage in emotionally relevant experiences, retention and transfer of knowledge are enhanced. This reinforces the idea that pedagogical practices should intentionally integrate emotional engagement to foster deeper connections (Immordino-Yang & Damasio, 2007).

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Motivation, particularly intrinsic motivation, was identified as a decisive factor in promoting autonomy, creativity, and resilience. Theories of self-determination suggest that students thrive when their needs for autonomy, competence, and relatedness are met (Ryan & Deci, 2020). Active methodologies such as gamification and project-based learning contribute to this process by stimulating both cognitive and affective systems (Zull, 2011).

Finally, attention was recognized as the gateway to knowledge. Without effective attention management, learning becomes fragmented. The findings show that fatigue, stress, and monotony reduce attentional capacity, while varied and stimulating environments strengthen it (Doidge, 2015)**;** (Posner & Rothbart, 2014).

Comparison With Previous Studies

These findings align with international literature emphasizing the interdependence of cognitive and emotional processes. For example, the integration of emotional education into curricula has been consistently associated with improved academic performance and socio-emotional skills ((Bisquerra, 2016). Similarly, the recognition of brain plasticity has reinforced the idea that learning is a lifelong process, adaptable to diverse contexts (Mora , 2013).

Nevertheless, some scholars warn against the risk of oversimplification, often referred to as "neuromyths," which misrepresent neuroscientific findings when transferred uncritically into education (Howard-Jones, 2014). This highlights the importance of teacher training to correctly interpret and apply scientific evidence.

Practical Implications

The discussion underscores several implications for educational practice:

1. **Curriculum design must consider brain processes.** Teachers should implement strategies that strengthen memory through repetition, practice, and contextualization.
2. **Emotional education should be integrated systematically.** Learning environments that promote empathy, cooperation, and positive emotions enhance both academic and personal development.
3. **Intrinsic motivation should be fostered through active learning.** Classrooms should move beyond extrinsic rewards to create experiences that engage students meaningfully.
4. **Attention must be managed strategically.** The use of active breaks, multisensory materials, and varied teaching dynamics can sustain concentration and optimize learning outcomes.

Limitations

Although this study provides valuable insights, some limitations must be acknowledged. As a documentary analysis, it relies exclusively on secondary sources. The predominance of English-language literature may also limit cultural applicability to Spanish-speaking contexts. Furthermore, while the principles of neuroeducation are supported by neuroscience, their direct implementation in classrooms still requires broader empirical validation across diverse educational levels (Mora , 2013).

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Future Directions

Future research should focus on empirical studies testing the practical application of neuroeducational principles in real classrooms. Mixed-method approaches could combine neuroscientific evidence with pedagogical experimentation, providing a more holistic understanding of how brain processes translate into effective learning. Additionally, comparative studies across cultures would enrich the field by revealing contextual variables that shape how neuroeducation can be applied worldwide.

Synthesis

The discussion confirms that neuroeducation contributes not only to understanding how the brain learns but also to rethinking teaching practices. By integrating cognitive, emotional, and motivational dimensions, educators can design inclusive and meaningful learning environments that respond to the demands of 21st-century education. However, the field must remain vigilant against misinterpretations and continue to strengthen its scientific basis through empirical validation.

Conclusion

Neuroeducation emerges as a transformative bridge between scientific knowledge of the brain and pedagogical practice. This study highlighted that effective learning is not merely the result of transmitting information but rather the integration of processes such as memory, emotion, motivation, and attention.

Memory provides the foundation for consolidating knowledge, while emotion acts as a catalyst that deepens and strengthens experiences. Motivation, particularly intrinsic motivation, drives autonomy, creativity, and resilience, enabling students to engage meaningfully with their learning. Attention, as the gateway to knowledge, ensures that information is processed efficiently when it is supported by dynamic and stimulating environments.

The overall conclusion is that neuroeducation should not be viewed as a passing trend but as a discipline capable of renewing education in the twenty-first century. By applying its principals, teachers can design inclusive, innovative, and emotionally meaningful learning environments that recognize the uniqueness of each learner.

Furthermore, neuroeducation contributes not only to cognitive development but also to the holistic growth of students, preparing them to face the challenges of an increasingly complex and changing world. It represents an essential tool for building an education system that is more humane, adaptive, and effective, one that responds to the real needs of learners and society.

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