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Neuroeducation And Meaningful Learning: Contributions Of Neuroscience To Teaching Practice

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Abstract
Background*: Neuroeducation has emerged as an interdisciplinary field that integrates findings from neuroscience, psychology, and education to improve teaching and learning. Grounded in the theory of meaningful learning, this approach emphasizes how brain-based principles can inform pedagogical strategies, enabling deeper cognitive engagement and knowledge retention.*
Materials and Methods*: This study is a qualitative bibliographic review that analyzed scientific literature published between 2014 and 2024. Peer-reviewed sources were selected from databases such as SciELO, ERIC, PubMed, and Scopus, using descriptors in Portuguese, Spanish, and English related to neuroeducation, meaningful learning, and evidence-based teaching practices.*
Results*: The findings demonstrate that teaching strategies supported by neuroeducational principles—such as personalized instruction, active methodologies, emotional engagement, and stimulating learning environments—enhance knowledge consolidation, increase student motivation, and support long-term retention. The study also highlights the importance of combating neuromyths through neuroscientific literacy among educators.*
Conclusion*: Integrating neuroscience with education offers a scientifically grounded foundation for transforming teaching practices. This convergence allows educators to assume the role of mediators of cognitively and emotionally enriched learning, fostering a more effective, inclusive, and humanized educational process.*
Keywords: *Neuroeducation; Meaningful learning; Teaching practice; Neuroscience; Education.*

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I. Introduction

Neuroeducation, an interdisciplinary field that bridges neuroscience, psychology, and education, has emerged as a transformative strategy for teaching practices by offering scientific evidence on the brain mechanisms involved in meaningful learning (Cosenza & Guerra, 2011; Silva & Azevêdo, 2023). This approach seeks to understand how processes such as neuroplasticity, attention, memory, emotions, and executive functions interact to support students' construction of meaning (Rotta, 2023; Cosenza & Guerra, 2011).

Particularly, the concept of meaningful learning, as defined by Marco Antônio Moreira (1999; 2009), emphasizes that new knowledge must relate in a non-arbitrary and non-literal way to existing relevant concepts in the learner's cognitive structure known as subsumers promoting logical and comprehensive integration (Moreira, 1999). When Ausubel's theory is combined with recent neuroscientific findings which demonstrate that pedagogical contexts stimulating meaningful synaptic connections enhance retention and engagement the teacher's role shifts toward mediating enriched cognitive experiences (Silva & Azevêdo, 2023; Rotta, 2023).

Recent studies highlight the use of neuroimaging as a resource for identifying, in real time, which teaching methodologies optimize student retention and engagement, thereby enhancing pedagogical planning based on scientific evidence. This precision allows educators to adapt strategies to both individual and collective neurocognitive needs, strengthening the personalization of learning (Pradeep. et al, 2024).

Nevertheless, despite the growing attention to Neuroeducation, challenges persist, such as the widespread dissemination of neuromyths among educators, which may hinder the effective application of evidence-based practices (Amorim & Rato, 2021; Scheineder et al., 2024). Overcoming these misconceptions requires continuous professional development and critical reflection on how neuroscientific knowledge is translated into curriculum and teaching practice (Silva et al., 2023; Scheineder et al., 2024).

Thus, the integration of neuroscience and meaningful learning provides a solid foundation for innovative and effective teaching practices, capable of fostering deep and lasting cognitive connections (Cosenza & Guerra, 2011; Pradeep. et al, 2024). This articulation represents a promising path for transforming education through a scientifically grounded understanding of how students truly learn.

Given the growing body of evidence on the brain's role in learning and the urgent need to reframe teaching practices in response to contemporary educational challenges, the following guiding question arises: *How can the contributions of neuroeducation support the development of meaningful learning in the school context?* This inquiry aims to reflect on how neuroscience not only explains the cognitive and emotional processes involved in learning but also provides theoretical foundations for more effective, personalized, and student-centered pedagogical practices.

The objective of this article is to analyze the contributions of neuroeducation to the development of meaningful learning, highlighting the main neuroscientific principles that support innovative educational practices. It also seeks to discuss how knowledge of brain functioning can enhance the teacher's role as a mediator of the learning process, promoting more contextualized, engaging, and effective experiences for students.

This study is relevant as it fosters dialogue between neuroscience and education at a time when schools are undergoing significant methodological shifts and facing new learner profiles. By considering the advances of neuroeducation as a tool for enhancing pedagogical quality, this article contributes to broadening educators' understanding of the mental processes underlying learning and to promoting practices rooted in scientific evidence. This discussion is timely as a strategy to address educational challenges such as school dropout, student disengagement, and instructional standardization, aiming to foster a more inclusive, emotionally supportive, and intellectually stimulating school environment.

II. Material And Methods

This study is characterized as a qualitative bibliographic review, aimed at analyzing recent scientific literature addressing the contributions of neuroeducation to the development of meaningful learning. The qualitative approach was adopted for its ability to provide a more in-depth understanding of the concepts, contexts, and interpretations related to the research topic (Minayo, 2014).

The selection of bibliographic material occurred between May and July 2025, with a temporal scope covering the last ten years (2014–2024). The selection prioritized national and international peer-reviewed open-access publications. The databases consulted included SciELO, ERIC, Google Scholar, PubMed, Redalyc, and Scopus. The following descriptors were used in Portuguese, Spanish, and English: "neuroeducation," "neuroscience and learning," "meaningful learning," "teacher training," and "evidence-based pedagogical interventions."

The inclusion criteria were as follows: (a) scientific articles published in qualified journals; (b) studies with a direct focus on the relationship between neuroeducation and meaningful learning; and (c) systematic or narrative reviews and empirical studies related to the educational field. Studies were excluded if they were duplicated, lacked full-text access, or presented opinion-based content without theoretical-scientific rigor.

The analysis process involved an exploratory reading followed by thematic content analysis, aimed at identifying conceptual recurrences, reported pedagogical practices, and relevant empirical evidence. The extracted data were organized into interpretative categories that aligned with the study's objectives, in accordance with the content analysis technique proposed by Bardin (2011).

This methodological framework ensured scientific rigor while also respecting the interdisciplinary and complex nature of the investigated theme.

III. Theoretical Framowork

Neuroeducation: Origins and Foundations

Neuroeducation emerged as a consolidated interdisciplinary field during the 1990s and 2000s, aiming to integrate theories and methods from cognitive neuroscience, psychology, and education (Pradeep et al., 2024, p. 1). Its incorporation of findings related to neuroplasticity, memory, and attention has introduced a new perspective on how to design learning environments that align with brain functioning.

The following extended quote reflects this foundation:

Neuroeducation, an emerging interdisciplinary field at the intersection of neuroscience and education, investigates the complex processes underpinning learning, offering novel insights and methodologies. This article examines the foundational principles of neuroeducation and describes the dynamic interplay between neuronal mechanisms and pedagogical strategies. Central to this exploration is an appreciation for the brain's remarkable capacity to adapt and reorganize in response to meaningful learning experiences (Pradeep et al., 2024, p. 1).

This excerpt underscores that neuroeducation extends beyond debunking neuromyths. It establishes a robust theoretical foundation grounded in the biological principles of learning.

In indirect citation, Pradeep et al. (2024, p. 1) observe that "utilizing advanced imaging techniques and rigorous neuroscientific research" allows for the mapping of cognitive processes such as attention, memory, and learning, thereby reinforcing the empirical nature of the field.

Furthermore, the authors emphasize that this interdisciplinary integration fosters pedagogical innovation by advocating for educational strategies grounded in solid scientific evidence and tailored to the unique neural dynamics of each learner (Pradeep et al., 2024, p. 2).

Finally, with a focus on classroom applicability, the field highlights the teacher's role as a facilitator of meaningful learning. Educators can apply knowledge about synaptic plasticity, emotional regulation, and motivation to design more effective and inclusive learning experiences (Pradeep et al., 2024, p. 3).

Neuroscientific Bases of Learning

Recent advances in neuroscience have unveiled fundamental cognitive mechanisms such as neuroplasticity, memory, attention, and emotion that underlie the learning process. Understanding how these components operate in synergy provides a crucial foundation for aligning educational practices with the way the brain processes, retains, and constructs meaning from information. In this sense, neuroeducation advocates for pedagogical planning grounded in scientific evidence about brain functioning, particularly through the lens of meaningful learning.

According to Alkhasawneh and Al Sharif (2025, p. 1):

The principle of neuroplasticity refers to the brain's ability to reorganize and form new neural connections throughout life. This capacity is critical to the learning process, enabling individuals to adapt to new experiences and information. When applied in educational settings, this understanding allows for the design of more effective instructional strategies tailored to cognitive variability.

This perspective reinforces the notion that brain adaptability must be considered when planning learning environments. By leveraging the brain's natural ability to restructure in response to stimulation, teachers can foster more personalized, engaging, and cognitively sustainable learning.

Additionally, neuroscientific studies such as those by Jolles and Jolles (2021, cited in Pradeep et al., 2024, p. 2) demonstrate that the use of neuroimaging techniques has enabled researchers to monitor, in real time, how attention and memory are modulated during learning activities. These insights support the design of targeted interventions that optimize student engagement and knowledge retention.

In summary, neuroscience offers a powerful lens through which educators can better understand and enhance learning. Strategies that stimulate attentional focus, reinforce memory consolidation, and integrate

emotional dynamics have proven effective in creating learning environments where meaning is constructed and retained with greater depth and authenticity.

Ausubel's Theory of Meaningful Learning

The theory developed by David P. Ausubel in the 1960s was consolidated in his seminal work *The Psychology of Meaningful Verbal Learning* (1963), where he proposed that meaningful learning occurs when new content is anchored to existing concepts within the learner's cognitive structure, known as *subsumers*. This process involves substantive and non-arbitrary relationships between prior knowledge and new information (Moreira & Masini, 1982, p. 112).

As highlighted in the following extended quote:

It is important to reiterate that meaningful learning is characterized by the interaction between prior knowledge and new knowledge, and that this interaction is non-literal and non-arbitrary. In this process, new knowledge acquires meaning for the learner, and prior knowledge gains new meanings or greater cognitive stability. (Moreira & Masini, 1982, p. 112).

This passage captures the essence of Ausubel's theory: it is not enough to simply present content; it is necessary to connect new ideas to students' existing knowledge in such a way that authentic integration and cognitive reorganization occur.

According to Moreira and Masini (1982, p. 112), "this interaction is non-literal and non-arbitrary," emphasizing that only relevant prior knowledge should act as a *subsumer* in the process of meaningful learning.

In addition, Ausubel introduced the concept of **advance organizers** as a pedagogical strategy—introductory content presented prior to formal instruction that activates subsumers and facilitates the assimilation of more complex information (Bryce & Blown, 2023, p. 1). These tools reflect a clear concern with the mental structure of the learner and the need to align it with new content in a coherent and progressive manner.

Ultimately, the significance of this theory lies in its practical applicability to educational contexts. When implemented according to its principles, meaningful learning promotes long-term retention, encourages critical thinking, and reduces reliance on rote memorization. As such, it offers a solid foundation for scientifically informed pedagogical practices.

Implications for Teaching Practice

The literature reviewed reveals that neuroeducation not only enhances the theoretical understanding of how learning occurs but also offers practical applications capable of transforming teaching practices (Costa, 2023, p. 1). By understanding how neuroplasticity, attention, memory, and emotions affect learning, educators can plan instructional strategies that foster more inclusive and effective learning environments.

As emphasized by Costa (2023, p. 1):

From a theoretical perspective, this article presents concepts from neuroscience such as neuroplasticity and higher nervous functions (attention, memory, motivation, emotions, and executive functions) establishing connections between them and the learning process. Thus, through a literature review and synthesis of information, our main objective is to articulate the contributions of neuroscience to pedagogical practices.

This passage clearly demonstrates the effort to connect neuroscientific principles to teaching strategies, offering a grounded framework for understanding how cognitive mechanisms can guide more effective pedagogical decisions.

In indirect citation, Brandão (2025, p. 3) points out that "brain-based teaching strategies enhance student learning and cognitive development" by strengthening processes such as attention, memory, and motivation, while also creating emotionally safe environments (Brandão, 2025, p. 3).

Moreover, the implementation of personalized pedagogical approaches informed by neuroeducation has shown positive impacts on student engagement and performance across diverse educational settings (Brandão, 2025, p. 5). These findings reinforce the importance of ongoing teacher training and professional development to ensure the faithful and effective application of evidence-based strategies.

Finally, the adoption of neuroeducational practices requires institutional support, investment in teacher education, and curricular adjustments tailored to learners' neurocognitive profiles. When properly mediated by informed educators, such practices have the potential to significantly enhance the quality and depth of meaningful learning.

Synthesis and Implications for Meaningful Learning

The combination of neuroscientific foundations such as neuroplasticity, attention, memory, and emotion with Ausubel's theory of meaningful learning suggests that education must move beyond the mere transmission of content. Teaching should promote the active and contextualized construction of meaning (Thomas et al., 2019,

p. 477). Thus, both Ausubel's notion of subsumers and the neural processes that underlie learning must be integrated into pedagogical planning (Pradeep et al., 2024, p. 1).

Neuroplasticity, in particular, is recognized as a central element in the consolidation and retention of knowledge. It enables synaptic connections to be strengthened through meaningful learning experiences, activating pre-existing cognitive schemas (Gkintoni et al., 2025, p. 397). This biological condition reinforces the importance of organizing content clearly and meaningfully, triggering relevant subsumers so that learning becomes durable and adaptable (Marzola et al., 2023, p. 125).

In this synthesis, the teacher's role becomes crucial. Educators who employ strategies such as advance organizers, spaced repetition, and emotional engagement are, in effect, aligning their practice with neural mechanisms that support effective learning (Dubinsky et al., 2024; Jolles & Jolles, 2021). These approaches not only stimulate attention and memory but also promote cognitive and emotional well-being during the learning process (Jolles & Jolles., 2021).

Furthermore, studies indicate that enhancing neuroscientific literacy within schools defined as the ability to understand and apply brain-based knowledge in educational contexts is essential for educators to base their teaching on scientific evidence rather than neuromyths (Jolles & Jolles., 2021; Ansari et al., 2017). This critical foundation empowers teachers to distinguish between validated practices and misconceptions, thereby strengthening the quality of pedagogical mediation.

In conclusion, the synthesis of the reviewed contributions demonstrates that meaningful learning, when permeated by neuroeducational principles, requires not only innovative instructional tools but also a school culture grounded in scientific understanding of the brain. This approach has the potential to transform educational environments into more inclusive, equitable, and cognitively attuned spaces, aligning theory, evidence, and practice in meaningful and sustainable ways (Thomas et al., 2019, p. 481).

Neuroeducational Convergence: Final Synthesis for Teaching Practice

The convergence between neuroeducation and the theory of meaningful learning reveals a new pedagogical paradigm in which the learning process is understood as an active construction based on significant relationships with prior knowledge, supported by neural mechanisms such as neuroplasticity, attention, and memory (Thomas et al., 2019; Pradeep et al., 2024). This understanding redefines the role of the teacher from a transmitter of information to a mediator of cognitively rich and emotionally engaging experiences (Dubinsky et al., 2024).

Studies demonstrate that when teachers take into account the neurobiological aspects of learning, their practices become more effective in promoting both retention and student engagement (Jolles & Jolles, 2021). According to Ausubel, as updated by Moreira (2006), meaningful learning depends on the activation of subsumers in the learner's cognitive structure structures that are potentiated when content is presented clearly, contextually, and with relevance to students' existing knowledge.

Neuroeducation also highlights the critical role of emotions in the learning process an aspect often neglected in traditional models. Recent research shows that emotionally safe environments and pedagogical methodologies that foster emotional bonds between students and the learning content enhance both knowledge retention and the development of higher-order cognitive abilities (Gkintoni et al., 2025; Marzola et al., 2023). These findings reinforce the notion that evidence-based, brain-informed teaching practices can significantly improve academic performance.

Another key implication is the need for personalized learning. Recognizing that every brain learns in a unique way demands that teaching strategies be adapted to the neurocognitive needs of each learner (Alkhasawneh & Al Sharif, 2025; Dubinsky et al., 2024). This approach not only respects cognitive diversity but also contributes to a more equitable and inclusive education an essential principle in contemporary pedagogical frameworks.

Thus, incorporating neuroeducational principles into teaching practice represents a significant advancement in the pursuit of meaningful learning. By integrating scientific knowledge of brain function with classical educational theories, teachers can design interventions that are more efficient, intentional, and sensitive to the realities of their students (Jolles & Jolles., 2021; Pradeep et al., 2024). This convergence of theory and practice has the potential to transform schools into more humanized, critical, and innovative learning environments.

IV. Final Considerations And Implications

This review highlighted that the articulation between the foundations of neuroeducation and the principles of meaningful learning represents both a theoretical and practical advancement in the educational field. The findings suggest that learning can no longer be understood merely as the assimilation of content but rather as a biological and emotional process deeply influenced by the brain's organization.

The implications for teaching practice are significant: teachers must understand how the brain learns in order to mediate knowledge more effectively, adopting strategies that align with neuroplasticity, attention, and

memory. The use of active methodologies, advance organizers, emotionally positive environments, and personalized instruction must move beyond theoretical recommendation and become part of the educator's everyday practice.

From an academic perspective, this review reinforces the importance of ongoing teacher training grounded in scientific evidence, especially in combating the persistence of neuromyths within school culture. The studies analyzed indicate that when educators grasp the neuroscientific principles underlying learning, their actions become more intentional, reflective, and responsive to students' individual needs.

Ultimately, this study contributes by synthesizing the relevance of brain-informed teaching, expanding the discussion on the role of neuroeducation in transforming pedagogical practices. It is hoped that the findings discussed here will inspire further research and support the development of educational policies more aligned with contemporary scientific discoveries.

References

[1] Alkhassawneh, S; Al Sharif, H. Perspectives Of Brain Research (Educational Neuroscience) On The Design And Implementation Of Teaching Strategies In Educational Technology. Journal Of Neuroeducation, V. 5, N. 2, P. 14-24, 2025.

[2] Amorim, J; Rato, J. R. O Mito Do Ensino Por Estilos De Aprendizagem: Qual A Perceção De Diferentes Profissionais Em Contexto Escolar? Revistamultidisciplinar, V. 3, N. 2, P. 41–47, 2021. Doi: 10.23882/Ne2143. Disponível Em: Https://Revistamultidisciplinar.Com/Index.Php/Oj/Article/View/63. Acesso Em: 04 Ago. 2025.

[3] Amorim, M.; Rato, S. O Neuromito Dos Estilos De Aprendizagem: Percepção Dos Professores Em Formação De Ciências Biológicas. Doi: Https://Doi.Org/10.21723/Riaee.V19i00.18213 . Riaee, 2024.

[4] Ausubel, D. P. The Acquisition And Retention Of Knowledge: A Cognitive View.. Isbn 978-90-481-5536-1 Isbn 978-94-015-9454-7 (Ebook) Doi 10.1007/978-94-015-9454-7 Springer Science+Business Media Dordrecht Originally Published By Kluwer Academic Publishers In 2000

[5] Bardin, L. Análise De Conteúdo. São Paulo: Edições 70, 2011.

[6] Brandão, D. N. Neuroeducação E Aprendizagem: O Impacto Das Estratégias Baseadas No Cérebro No Desempenho Escolar. Recc (Revista De Educação E Cognição Científica), V. 30, N. 1, P. 1–18, Abr. 2025. Revistas.Unilasalle.Edu.Br

[7] Bryce, T. G. K.; Blown, E. J. Ausubel's Meaningful Learning Re-Visited: Challenges And Advances In Cognitive And Neuroscientific Perspectives. Current Psychology, 2023. Disponível Em: Https://Pubmed.Ncbi.Nlm.Nih.Gov/37359615/. Acesso Em: 08 Jul. 2025.

[8] Costa, R. L. S. Neurociência E Aprendizagem: Noções Das Neurociências E Implicações Pedagógicas. Revista Brasileira De Educação Em Neurociência, 2023. Disponível Em: Https://Www.Scielo.Br/J/Rbedu/A/Zpmwbm6n7jn5vbfj8hfbyfk/. Acesso Em: 10 Jul. 2025. Periodicorease.Pro.Br+2scielo.Br+2revistas.Unilasalle.Edu.Br+2revistas.Unilasalle.Edu.Br

[9] Cosenza, R. M.; Guerra, L. Neurociência E Educação: Fundamentos E Aplicações. 2011.

[10] Dubinsky, J. M; Hamid, A. The Neuroscience Of Active Learning And Direct Instruction. Neuroscience And Biobehavioral Reviews 163 (2024) 105737. Www.Elsevier.Com/Locate/Neubiorev

[11] Scheineder, H. S; Et Al. Neuroeducation And Impact On Higher Education: A Systematic Review. International Journal Of Evaluation And Research In Education (Ijere) Vol. 13, No. 6, December 2024, Pp. 3641~3652 Issn: 2252-8822, Doi: 10.11591/Ijere.V13i6.29170 : Http://Ijere.Iaescore.Com

[12] Gkintoni, E.; Vassilopoulos, S. P.; Nikolaou, G. Brain-Inspired Multisensory Learning: A Systematic Review Of Neuroplasticity And Cognitive Outcomes In Adult Multicultural And Second Language Acquisition. Biomimetics 2025, 10, 397. Https://Doi.Org/10.3390/Biomimetics10060397

[13] Jolles, J.; Jolles, D. D. On Neuroeducation: Why And How To Improve Neuroscientific Literacy In Education Professionals. Published: 03 December 2021. Doi: 10.3389/Fpsyg.2021.752151

[14] Jolles, D.; Jolles, I. The Impact Of Neuroscience On Education: A Cognitive Neuroscience Perspective. In: Pradeep, K. Et Al. Neuroeducation: Understanding Neural Dynamics In Learning And Teaching. Frontiers In Education, V. 9, 2024, P. 2–3. Doi: 10.3389/Feduc.2024.1437418.

[15] Marzola, P. Et Al. Exploring The Role Of Neuroplasticity In Development, Learning, And Memory. Brain Sciences, V. 13, N. 12, P. 1–25, Dez. 2023. Doi: 10.3390/Brainsci13121610. Https://Www.Mdpi.Com/2076-3425/13/12/1610.

[16] Moreira, M. A. Aprendizagem Significativa: Um Conceito Subjacente. Revista Da Educação Matemática, V. 7, N. 13, P. 43-50, 1999. Disponível Em: Https://Basenacionalcomum.Mec.Gov.Br/Implementacao/Praticas/Caderno-De-Praticas/Aprofundamentos/191-Aprendizagem-Significativa-Breve-Discussao-Acerca-Do-Conceito. Acesso Em: 01 Jul. 2025.

[17] Moreira, M. A. Teoria Da Aprendizagem Significativa: Contribuições Para A Educação. Campinas: Editora Unicamp, 2009.

[18] Moreira, M. A..; Masini, E. A. S. Aprendizagem Significativa: A Teoria De David Ausubel. São Paulo: Editora Moraes, 1982. 112 P.

[19] Minayo, M. C. S. O Desafio Do Conhecimento: Pesquisa Qualitativa Em Saúde. 14. Ed. São Paulo: Hucitec, 2014.

[20] Pradeep. K. Et Al. Neuroeducation: Understanding Neural Dynamics In Learning And Meaningful Learning. Published 13 December 2024 Doi 10.3389/Feduc.2024.1437418. Www.Frontiersin.Org/Journals/Education

[21] Rotta, N. Neuroplasticidade E Funções Nervosas Superiores Na Aprendizagem. In: Costa, R. L. S. (Org.). Neurociência E Aprendizagem. Revista Brasileira De Educação, Vol. 28, E280010, 2023. P. 469–471. Doi: 10.1590/S1413-24782023280010. Disponível Em: Https://Doi.Org/10.1590/S1413-24782023280010. Acesso Em: 12 Jun. 2025.

[22] Silva, C. G. Da; Azevêdo, B. K. G. Uma Abordagem Neurocientífica Sobre A Importância Das Emoções Para O Processo De Aprendizagem Significativa. Revista Científica Da Uern, V. 4, N. 2, 2023.

[23] Tokuhama-Espinosa, T. The Scientifically Substantiated Art Of Teaching: A Study In The Development Of Standards In The New Academic Field Of Neuroeducation (Mind, Brain And Education Science). 2008. 470 F. Tese (Doutorado Em Educação) – Capella University, Minnesota, 2008.

[24] Thomas, M. S. C. Et Al. Annual Research Review: Educational Neuroscience. Journal Of Child Psychology And Psychiatry, V. 60, N. 5, P. 477–492, 2019. Doi: 10.1111/Jcpp.12973. Disponível Em: Https://Pubmed.Ncbi.Nlm.Nih.Gov/30345518/. Acesso Em: 01 Ago. 2025. Pubmed.Ncbi.Nlm.Nih.Gov