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Neuroscience as a Component in Educational Setting. An Interpretive Overview

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Abstract

In recent years, considerable advancements have been made in the field of educational neuroscience research. Researchers commend its existence and influence on educational procedures. This effort was intended to illustrate the educational applications of Neuroscience. In particular, research articles, quantitative and qualitative analyses, meta-analyses, and articles of critical inquiry on Neuroscience in Education were examined. In addition, a review of recent literature was attempted. From these studies, conclusions can be derived that can prove useful in the fields of research and teaching. Thus, best practices, methodologies, perspectives, attitudes, and perceptions that support the significance and value of Neuroscience in the field of education are offered.

Keywords: *Neuroeducation, Neuroscience, Educational Setting, Neurocognition*

1. Introduction

Educational Neuroscience is a new discipline that, according to academics, shows considerable promise for the future (Thomas, 2013). According to Willingham (2009), numerous attempts have been undertaken since the mid-1960s to discover the similarities between Neuroscience and Education. For instance, the term "neuro-educators" was coined in light of brain research, which focuses on enhancing and altering educational practice (Cruickshank, 1981). In addition, numerous initiatives have been made to investigate the function of Neuroscience in teaching (Fischer, Goswami & Geake, 2010; Samuels, 2009; Rato, Abreu & Castro-Caldas, 2011). Therefore, this paper investigates how Neuroscience operates in education. Specifically, an attempt is made to research a significant number of articles connected to the topic, and their content, methodology, results, and conclusions are analyzed in depth.

2. Literature Review

Numerous experts have made parallels between Neuroscience's historical contributions to health and its potential future contributions to education. In 2011, a study titled "Neuroscience: Implications for Education and Lifelong Learning" was released in the United Kingdom, arguing that Neuroscience and education have common ground (Royal Society, 2011). Similar connections are drawn by other experts between Education and Neuroscience. Education and medicine are types of applied science, per Thomas (2013). As Piaget (1952) did, general education has attempted for many years to approach behavior within the framework of Cognitive Psychology. However, the brain alone is capable of learning. Consequently, a link between education and Neuroscience develops from study on learning processes

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(Goswami, 2004). Educators are now faced with a new challenge: how to connect Neuroscience and Educational theory and practice.

There are numerous causes for the two-way connections between Neuroscience and Education. The most important cause was the widespread availability of non-invasive techniques, such as functional magnetic resonance imaging, for seeing brain activities. Brain regions engaged in school-taught skills, such as reading and mathematics, are measured using a variety of imaging methods for brain functions. It also evaluates the alteration of brain connections throughout learning and development (Gkintoni & Dimakos, 2022). Imaging the neural consequences of learning permits us to comprehend typical and atypical developmental trajectories and to better characterize the plasticity limitations of brain circuits based on the cognitive functions modified by training. In addition, the application of neuroimaging methods gives the prospect of gradually delivering more precise information than behavioral methods into the cognitive subprocesses related to learning (Grabner & Ansari, 2010). In this approach, a greater understanding of the neurological and cognitive roots of academic abilities will aid in the design of learning settings that are more favorable to the acquisition of the skills important to our contemporary Western society (Ansari et al., 2012).

Brain-based learning has arisen during the past three decades, with teachers extrapolating neuroscience results for classroom application (Zadina, 2015). Bruer (1997) referred to this action as "Bridge too far" (bridge too far) since the professionals lacked scientific understanding and took baseless action. Scientists joined the push to educate professionals on the process, but they lacked classroom teaching skills. Educational psychologists, cognitive psychologists, neurologists, and neuroscientists viewed this endeavor with skepticism since they did not know who should provide guidance to educators. They engaged in numerous conversations and negotiations (Blakemore, 2005; Byrnes, 2001; Della Sala & Anderson, 2012; Fischer, 2009; Howard-Jones, 2010; Royal Society, 2007; Tokuhama-Espinosa, 2010; Zadina, 2015).

3. Methodology

At this phase, we will present and evaluate the research topics, materials, and methodologies associated with Neuroscience in the field of Education. We searched the databases PsycINFO, PubMed, and SCOPUS for relevant papers (2022). In addition, we incorporated the terms Neurosciences, Educational practice, Neuroeducation, and Neurocognition. Finally, we utilized broad search criteria to guarantee that relevant information was identified.

4. Results

Rueda (2020) aimed to promote neuroimaging in order to comprehend the characteristics of the human brain and how this connects to the human desire to share information. Two essential questions regarding the topic of Neuroeducation are introduced. How Neuroeducation can strengthen the functioning of the brain through education, and whether understanding of the brain can improve teaching and learning. As suggested by Rueda's (2020) paper, a literature review was conducted to answer the questions highlighted. It argues that brain measures have revealed several anatomical and functional changes in the brain as a result of cognitive intervention or practice. Neuroimaging advancements have enabled researchers to comprehend the quirks of the human brain and how they connect to people's desire to share information. The evolution of the human brain enabled the activation of cognitive processes that facilitate social learning. Education and experience have a substantial impact on the maturation of the human brain. The burgeoning area of Neuroeducation seeks to integrate research about brain processes

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related to cognitive skills involved in learning with the educational community's efforts to maximize knowledge transmission and assimilation.

Thomas (2013) seeks an analogy between educational Neuroscience and medicine in order to determine the potential educational implications of the discipline. It also examines how education can function following the use of Neuroscience. In order to develop these positions, offers forecasts and educated estimates about what educational Neuroscience may hold in the future to assist educators of today. It employs three predictive elements that will soon influence neuroscience education. The first predictor is that the majority of Neuroscience's original contributions to education are related to the realization that effective teaching approaches exist. The second prediction is that Neuroscience may provide new educational methods in the future. The third prediction refers to the possibility that the initial neuroscience results that will have an impact on education will be more general than curriculum-specific.

Ansari, De Smedt, and Grabner (2012) attempt to conduct a critical evaluation of the field of Neuroeducation. They discuss the increasing momentum behind integrating education and neuroscience to enhance learning. In addition, they investigate why multidisciplinary research takes such steps and examine significant developments in neuroscientific research. In addition, they discuss the recent evidence regarding the brain circuits underlying reading and mathematical skills, as well as the possibilities of using neuroscience to design training programs for neurocognitive functions, such as working memory, which are anticipated to have an effect on overall brain function. They strive to expand comprehension of academic skill acquisition (Antonopoulou et al., 2019; 2020; 2021a; 2021b; 2021c). Simultaneously, they explore the potential of new brain imaging techniques, which serve as diagnostic tools and evaluations of the efficacy of educational interventions. In addition, they emphasize realistic expectations for the immediate influence of neuroscience on education, methodological challenges, and deficiencies in interdisciplinary education, all of which contribute to miscommunication between educators and neuroscientists (Antonopoulou et al., 2022).

The research by Zadina (2015) aims to investigate suggestions for finding the appropriate Educational Neuroscientist training, broad interventions based on Educational Neuroscience that could contribute to curriculum reform, and emerging ways Educational Neuroscientists can inform practitioners of effective teaching. The article by Jamaludin, Henik, and Hale (2019) examines the learners' perspectives on Educational Neuroscience. Therefore, the impact of neuroscientific research on education was researched, and where necessary, student and teacher outcomes were examined to facilitate educational improvement (Antonopoulou et al., 2021d). The significance of early life cues on the infant brain's ability to develop in a manner consistent with its future demands was therefore explored. In addition, we examined the outcomes of a neuroimaging and behavioral study designed to mitigate 9 to 16-year-old children' underlying cognitive processing deficits. Implemented was an intervention program comprising numerous exercises focusing on distinct cognitive processes. A one-year examination of the cognitive and academic growth of the program's students revealed that it was highly beneficial. Therefore, it was explored whether the cognitive performance of the students correlates with the outcomes of the intervention. According to the relevant research, it is crucial to focus early intervention programs in order to bridge the gaps between the community, the home, and the school environment for the development of the child.

According to Thomas (2013), about the predictive factor that Neuroscience-related educational approaches function, these methods are likely to improve educational outcomes in the distant future, just as medical advances has improved public health. This cannot be proven, however. However, if the conclusion is right, educators should be courageous and interact with educational neuroscience. Simultaneously, the revolutionary methods of Neuroscience that can improve education can emerge through the benefits of training working memory or executive function of education, the benefits of

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distance learning or reward-based learning, the significance of sleep in consolidating memories, diet, or aerobic exercise. Nonetheless, according to Thomas (2013), only a few of these strategies have the potential to be truly revolutionary in lifelong education, with the exception of providing minor benefits to optimize learning.

In addition, several results regarding the value of "Neuro training" are gathered from other study articles. They say that Neuroscience is a discipline of tremendous advancement and that the accessible non-invasive imaging methods for the human brain have enabled researchers to examine how the brain changes during development and learning (Gkintoni et al., 2021c). In addition, the techniques allowed for the investigation of the brain circuits involved in fundamental academic skills, such as reading and mathematics, and more general cognitive skills, such as working memory. This advancement has pushed for stronger links between neuroscientists and educators in the effort to enhance learning. Reading, mathematics, and "Brain Training" are the three subfields that have been reviewed. This article has demonstrated numerous reasons to be excited about Neuroscience's new concepts. There have been advances in the knowledge of how the brain functions and reading as a function of learning due to studies in this area.

5. Discussion

Based on the above, it is evident that the human brain is uniquely able to include a window that influences its formative experience. As evidenced by the research, the human brain is an organ designed for learning and places a premium on determining the optimal method of educating infants. Therefore, it is appropriate for educators to analyze the functioning of the brain and have a better understanding of how teaching and learning should be arranged. Understanding the brain is an important tool for educators. After studying the operations of the brain, a vital tool for educators, it is next determined how well educators comprehend the notion of Neuroscience of Education. In addition, the function of Neuroscience in Education as perceived by teachers was explored, and it was discovered that teachers realize the need for additional training in this specific subject in order for it to fulfill its goals more effectively. In addition, based on the high acceptance of the need for additional training in the field of Neuroscience, it was determined that while instructors are interested in how the brain functions, they find it difficult to apply the relevant discoveries to educational practice. It is important for them to know that they must be in close contact with the field of science in order to stay updated, consult with, and work with experts from other fields.

Neuroscience can contribute numerous benefits to education, enhancing it and improving learning. Scientists recommend the development of interdisciplinary training programs to meet any issues in this field. Thus, neuroscientists will learn about educational research and pedagogy, while educators and educational researchers will be exposed to the most recent neuroscientific findings, findings, ideas, and methodologies. Thus, two-way and reciprocal interactions between the two sectors will ensue. In addition, they will have superior communication skills, and their objective will be to develop a common language for generating future research topics and translating the findings into specific instructional applications.

In addition to incorporating Neuroscience into education, it is necessary that research be conducted to determine the most effective approaches for teachers who will be asked to implement them in the classroom. A positive environmental framework for brain development is offered in relation to early intervention programs that are deemed crucial for students' exposure to the subject of Neuroscience (Gkintoni et al., 2022a). However, it is also proposed to examine the development of preschoolers' talents in order to improve their success in the classroom. Therefore, progress in education is best served

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and increased when an integrated learning perspective is taken into account to thoroughly comprehend the principles of learning and how to design learning to maximize each student's ability to reach optimal outcomes.

6. Conclusion

Consequently, based on the review we have conducted, Neuroscience is a crucial component of education and should be addressed as such by educators. The most essential point from what we have discussed in this study is the various advantages of applying neuroscience to educational practice. It is regarded as fundamental to train teachers in neuroeducation in order to improve the educational process and learning environments. The field of Neuroscience in education can assist educators in comprehending the structure and function of the human brain, as well as the skills of learners by age, and uncovering some of the causes for students' strengths and limitations. Particularly, by integrating their knowledge of the brain to their teaching, teachers will become drivers of educational transformation and help their students comprehend and improve core academic skills – and not only – to the greatest extent possible. In light of the information presented in this review article, we conclude that it is of the utmost priority for (future) educators to acquire the necessary knowledge about how the human brain "learns," but it is of even greater significance for educational decision makers and universities to include neuroeducation courses in teacher training programs and to conduct research in this area.

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