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Current Trends, Dilemmas and Future Directions in Neuropedagogy in the Field of Early Childhood[4]

During the past 25 years, research on brain structure and function has expanded our understanding of the relationship between brain development and learning. This field of study is referred to with several terms such as neuroeducation, neuropedagogy, and Mind, Brain and Education. Although a strong interest in neuroeducation is present among researchers and teachers, often misleading recommendations from neuroscience research are made for classrooms. This article provides an overview of neuroeducational research studies in early childhood education to demonstrate how this field of study impacts teachers' and parents' understanding of best practices and optimal development. Also, to address the concern of the valid and reliable research in neuroeducation, we outline the principles of neuroeducational research based on Nouri (2016), and propose directions for future research.

Keywords: *Early childhood, neuroeducation, neuromyths, neuropedagogy, neuroeducational research,*

Introduction

During the past 25 years research on brain structure and function has expanded our understanding of the relationship between brain development and learning. Educators, parents and scientists recognized the importance of this knowledge for supporting children's optimal development. This new paradigm of learning has been referred with different terms. For example Nouri (2016) uses the term of *neuroeducational studies* which is "defined as a growing interdisciplinary field based on synergetic connection between neuroscience, cognitive science, psychology, and education in an effort to improve our theoretical and practical understanding of learning and education" (p.59). Other theorists call this field of studies as, for example, *educational neuroscience*, *neuroeducation* (Smeyers, 2016), *Mind and Brain and Education*

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(Howard-Jones, 2011) *neuropedagogy* and *neurodidactics* (Kraft, 2012). Similar to Nouri's definition Patten and Campbell (2011) delineates *educational neuroscience* as a field of study that "produce{s} results that ultimately improve teaching and learning, in theory and practice" (p. 6). Though different names are used synonymously for the disciple; all seem to convey the idea that instead of being a single discipline, it is an interdisciplinary field that aims to explore a holistic understanding of learning and education.

Nouri (2016) firmly separates neuroeducational studies from the so called "brain-based learning" due to the recent criticism about brain-based learning for its overgeneralizing and oversimplifying neuroscientific findings for the use of education. Zambo (2013) also expressed her concern about misusing ideas related to neuroscience and applying neuromyths, as she refers to these simplified and misinterpreted ideas of neurological studies in education. Similarly, Howard-Jones (2010) warns about neuromyths that play a significant role in molding teachers' views and understanding of the relationship between brain and education. These neuromyths often misguide teachers; for example when teachers advocate for so called hemisphere strategies to remedy learning disabilities based on the notion that people are rather right or left-brained, though none of these "myths" are substantiated with data in the field of neuroscience. To eliminate the problem of oversimplification, overgeneralization and misuse of information in neuroscience, researchers calls for merging several disciplines such as cognitive psychology, neurosciences, psychology, cultural anthropology and education, so that with a multidisciplinary approach, neuroscientists can assist teachers in better understanding the brain structures and functions (Hruby and Goswami, 2011).

In this paper, we will provide an overview of neuroeducational research studies in early childhood education to demonstrate how this field of study impacts teachers' and parents' understanding of best practices and optimal development. In addition, to address the concern of obtaining and using the valid and reliable research in neuroeducation, we also outline of principles of neuroeducational research based on Nouri (2016), and propose directions for future research.

Trends, Topics and Issues Related to Early Childhood in Neuroeducation

The expectations and pedagogical practices in early childhood are rapidly changing to respond to the changing societies worldwide. Although with the help of technology, specifically with brain imaging, we understand more about child development; in many countries the over-emphasis on academic skills such as reading and math skills, and the neglect of social emotional

development seem to trigger pedagogical practices that are developmentally inappropriate for young children, and hinder the implementation of balanced approaches to child development (National Association for the Education of Young Children, 2015). Tobin (2013) warns about the disappearance of play and appropriate physical movement in young children's every day activities as a result of the restricted learning outcomes and inadequate teaching methods with which teachers erroneously prioritize academic skills and disregard children's physical and social emotional needs. To ensure that young children are engaged in developmentally appropriate activities and interaction, Haslip and Gullo (2018) urge the support for conducting research and distributing the findings to educators, parents, and policy makers. This need for research-based practices in early childhood classrooms is targeted in the field of neuroeducation which uses the theories and techniques of neurosciences to inform pedagogical practices and further educational research. Without the intention to provide a comprehensive overview of topics in which neuroeducational research offered pedagogical implications for early childhood educations, we include intentionally selected topics of research that targeted essential skills and activities for young children.

Self-regulation, which children develop during the first five years, is a fundamental skill for life-long learning. Self-regulation includes skills to maintain attention, to be resistant to distractions and to avoid conflicting behavior. Early childhood teachers have a main role in helping children regulate their behaviors, emotions and reactions (Blair and Raver, 2015). Based on the research studies addressing the neurological processes for this effect of music implementing music, rhythm and movement to promote self-regulation is proposed (Williams, 2015). Although the impact of formal music training on neurological development is well-known (George and Coch, 2011), Williams (2015) argues that the infusion of coordinated rhythmic activities could serve as effective pedagogical approaches to address the neurological foundations of self-regulation. Similarly, Neville et al. (2008) found that children who participated in regular music training demonstrated higher level of auditory selective attention. Thus, research findings regarding the neurological base for improved self-regulation can guide teachers in applying music, movement and rhythm in the everyday classroom activities.

Social competence and mental health are vital emerging capacity during the early years; therefore, there is increased interest in research related to the neurobiological base of these skills. Neuroscience can identify leverage points for advancing brain development. In particular, parents' and caregivers' presence, and the frequency and quality of interaction with young child have an impact on the neurodevelopment of the brain, and ultimately influence the

child's emotional regulations and social cognition (Szalavitz & Perry, 2011). Therefore, the parents' and educators' responsive interaction with children can facilitate the social emotional well-being of children.

Neuroscience offers insights into children's neurological activities during reading or other literacy-related activities. For example, with examining preschoolers' brain wave length, Tan and Molfese (2009) found that children can discriminate between words of different syntactic classes, though not at the same level as adults. Caffara et al (2018) used MEG data about young children's (4-8 years old) reaction to written, and spoken words and visual objects. They found that the process of learning to read not only impacts written word processing but also affects object recognition: "suggesting a non-language specific impact of reading on children's neural mechanism" (p. 21). In addition, Hirsch (2013) points out that emotions are critical in cognitive development, more specifically in literacy development. Ultimately, with healthy emotions, as important building blocks in brain, children are more probable to succeed in literacy-related activities. These findings highlight the interconnection and interdependency between social emotional development and advancement in literacy skills, which teachers should consider when planning literacy activities.

The benefits of play is well-documented in general; though some studies specifically point out the neurological advantages of play during childhood. For example, pretend play promotes brain development through emotions and cognition in executive function; and stimulates synaptic connections (Szalavitz and Perry, 2011). In addition, Fletcher (2011) argues that play settings are the optimal environment for children to develop self-regulations, to exhibit pro-social behavior and to learn to control aggression. Furthermore, Burdette and Whitaker (2005) highlights the positive effect of free play with physical activities that involves gross motor play; children develop vital executive function skills such as attention as well as social skills that ultimately enrich emotional and cognitive development.

Overall, these examples for neuroeducational research related to young children's self-regulation, social competence, literacy skills and play clearly demonstrate the holistic and interdisciplinary nature of investigations of these issues related to child development. Further, in order to offer evidence-based implications for early childhood classrooms and to eliminate neuromyths which misguide teachers and parents, design and conduct quality research in in neuroeducation is imperative.

Research in Neuroeducation

Research in neuroeducation, which is conceptualized as an area within education, is needed in order to provide brain-related evidence-based suggestions and implication for educators. Nouri & Mehrmohammadi (2012) defined the boundaries and nature of neuroeducation and also outlined the principles of neuroeducation research. Specifically, Nouri (2016) identified five principles for scientific inquiry in neuroeducation based on which the conclusions and implications drawn from the research findings can offer relevant, evidence-based and usable outcomes. First, neuroeducation is interdisciplinary in nature because researchers incorporate the knowledge from diverse fields which include psychological, neural and pedagogical foundations of learning and development. Because of this interdisciplinary approach to a problem to investigate, there is an increased chance to propose solutions to educational issues from the perspectives of neuroscience and other disciplines (Schwartz & Gerlach, 2011). To the present, few studies have been conducted with a collaboration of researchers in the field of neuroscience, and pedagogy (Nouri, 2016). The second principle of neuroeducational research describes it as *applied* research which ultimately produces findings that improve educational practices. Ultimately, educators and scientists are encouraged to collaborate and identify and examine questions that will advance educational practices (Nouri, 2016). Neuroeducational research has the potential to offer valid and reliable findings with an application for classrooms. Third, neuroeducational research can use a variety of methodological designs; thus both qualitative and quantitative methods could offer a new level of understanding related to learning and development. The fourth principle is an expectations regarding the researchers' ability to adjust neuroeducational research and their own philosophical standpoint. Specifically, a researcher with a certain philosophical orientation determines what questions and issues to investigate (Hendricks, 2017). The final principle is that neuroeducation is value-saturated because of the ethical and moral issues involved (Nouri, 2016). In addition to the evaluation of the impact of research findings, it is essential to consider the ethical issues in the application of neuroscience research in education. Furthermore, Zochi and Pollack (2013) emphasizes the importance of *neuroethics* as a new field which responds to the ethical issues in the context of cultural and social structures. Based on these five principles of neuroeducational research, Nouri (2016) argues for a common definition for neuroeducational research which incorporates these principles:

> *"Neuroeducational research is an interdisciplinary endeavor to develop an insightful understanding and holistic picture of problems related to learning and education. It thus epistemologically is based on an integrated methodological pluralism paradigm. This requires researchers to understand multiple methods and methodologies and employ as they formulate their own research projects. Researchers have a critical role to play in providing systematic evidence and conclusions that are scientifically valid and reliable and educationally relevant and usable."* (p. 64)

Regarding the future directions in neuroeducational research Nouri (2016) suggests the implementation of the four stage approach proposed first by Pincham et al., (2014). First, educators and researchers in collaboration identify educational areas in need for which neuroscience might find solutions. At stage two and three neuroscience researchers design and conduct an investigation of a problem in a laboratory and analyze whether the findings can be employed in an educational setting. At the final stage, teachers and researchers in collaboration reflect on the research findings from the perspective of their discipline. Overall, it is essential to maintain a collaborative relationship between educators and neuroscience researchers to carry out neuroeducational research which advances the pedagogical practices and positively impacts students' learning.

Conclusions

Neuroscience and neuroeducation/neuropedagogy is attractive. Researchers and teachers want to understand brain functions and brain structures so that they can facilitate learning. Especially, early childhood educators and parents are open to and interested in the newest findings of neuroscience so that they can better facilitate child's behavior, motivation and attention for future success. Although there is a need for further research-based guidance in education, caution must be taken. Neuromyths that are misconception about the mind and brain functioning could cover and hide real relationship between brain and education, and might cause unwanted side-effects in education. Because of the wide-spread misconceptions about brain and the applicable recommendations, further research is needed. As Pasquinelly (2012) put"knowledge must be pursued, conveniently disseminated, and taught (p. 93). With this emerging new knowledge, early childhood teachers will be better equipped to implement a developmentally appropriate curriculum.

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