PRACTICAL STRATEGIES FOR ENHANCING INTERDISCIPLINARY COLLABORATION IN NEUROEDUCATIONAL STUDIES

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Abstract: The need to overcome artificial obstructions and limitations in our scientific understanding of the complexity of educational issues is the major driver of interdisciplinary collaboration in the field of Neuroeducational Studies. To get full advantage of interdisciplinary collaboration therefore, it would be necessary to identify and develop a number of practical strategies that facilitate such endeavor. The relevance literature suggests that making effective interdisciplinary collaboration in the field is dependent on a number of factors, including: creating a common language and conceptual vocabulary; developing graduate educational programs; providing training programs for neuroscientists and educators; and developing neuroeducational research organizations. It is concluded that, interdisciplinary collaboration is a potential key that ensures a more prosperous future for the field and it will be best realized based on authentic dialogue among scientists and educators.

Keywords: Neuroeducational Studies, Interdisciplinary Collaboration, Neuroscience, Psychology, Cognitive Science, Education

1. INTRODUCTION

The explosion of new ideas and findings throughout the 20th century launched many new disciplines, and promising associations between these disciplines in turn gave birth to innovative fields of study. The efforts in this direction, continues into the 21st century as new insights in human behavior and the brain portend new strategies to improve the learning sciences (Schwartz & Gerlach, 2011). The rapid development of neurosciences, the advances in psychology and education research, and interdisciplinary cooperation between these fields of investigation lead to a better understanding of learning, cognition, emotions and consciousness (Battro, Fischer & Le´na, 2008). Consequently, an interdisciplinary field of study built on the steadily growing interest in the potential of a connection between neuroscience, cognitive science, psychology, and education in order to improve our understanding of learning and education. This emerging field sometimes referred to as 'Neuroeducation' e.g. (e.g. Howard-Jones, 2011; Ansari, De Smedt & Grabner, 2012), sometimes as 'Mind, Brain and Education' (e.g. Fischer et al, 2007; Stein & Fischer, 2011; Schwartz and Gerlach, 2011) and sometimes as 'Educational Neuroscience' (e.g. Geake, 2009 & Patten & Campbell, 2011).

Although there are some differences in the approach of these initiatives, the common goal of all these initiatives is to combine our educational understanding with our biological and psychological understanding of brain function and learning (Howard-Jones, 2008, p. 361). However, some experts in the field prefer the term Mind, Brain and Education, which they see it as being more pedagogically focused (Schwartz and Gerlach, 2011). Some others prefer the term 'neuroeducation', as see it more akin to an education science (Campbell, 2011; Howard-Jones, 2011). They believe this better reflects a field with education at its core, uniquely characterized by its own methods and techniques, and which constructs know-ledge based on expe-

riential, social and biological evidence (Howard-Jones, 2011; 2008).

Following Campbell (2011), I believe that the term 'neuroeducation' encapsulates anything that involves some kind of rigorous synthesis concerning matters pertaining to mind, brain, and education quite well. In this view, "educational neuroscience" can be considered "as a new area of *educational* research, and one that naturally draws on the neurosciences (especially cognitive neuroscience, including psychophysiology), and yet one that falls within the broader emerging *field* of neuroeducation" (Campbell, 2011, p. 8). Neuroeducation in this sense can be described as growing energy behind linking education, psychology, cognitive science and neuroscience in an effort to improve learning theory and educational practice.

Here, I use the term "Neuroeducational Studies" to pretty well describe it as "a growing interdisciplinary field based on a synergetic connection between neuroscience, cognitive science, psychology, and education in an effort to improve our theoretical and practical understanding of learning and education". The suffix "studies" added to best feature its *interdisciplinarity* nature and distinguish it from single disciplines; as such it has been recruited by other interdisciplinary fields such as "Curriculum Studies", Cultural Studies", "Environmental Studies", "Law studies" and so on.

Regardless of its name, this new academic field holds many attributes of a growing interdisciplinary field, even though it is still in its early stages. There are peer-reviewed scientific journals, academic societies, graduate programs, conference series, forums and special interest groups that all exemplify the vitality and dynamic advancements of the field. In addition, there also exist an increasing interest and emphasis on the role of this new filed in better understandings of education, development and learning (e.g. Spitzer, 2012; Blakemore & Frith, 2005; Gardner, 2009; Ansari, De Smedt & Grabner, 2012; Campbell, 2011; Goswami, 2004, 2006; 2008; Ansari & Coch, 2006). In that light, neuroeducational studies as an emerging field that concerned with the interaction between mind, brain, and education, has proved revolutionary in educational research, introducing concepts, methods, and technologies into many advanced institutions around the world (Battro, Fischer & Le´na, 2008).

While the interdiscipline of neuroeducational studies currently is growing fast, it is also being faced with a number of practical challenges some of which are endemic to the emergence of any new discipline (Patten & Campbell; 2011; Schwartz & Gerlach, 2011). Patten & Campbell (2011) recount some of these challenges including: a need for more coherent terminology, a struggle to identify and establish theoretical and philosophical foundations, a quest for practical empirically-based models, and a requirement for standards of ethical practice. They truly ascribe these challenges onto the "cross-disciplinary" nature of the field and its consequential need to combine a variety of resources, methodologies, and results (see Patten & Campbell, 2011). This specific structure of the field augment the need to build an infrastructure that supports sustainable collaboration between researchers and teachers and creates a strong research foundation for education (Hinton & Fischer, 2008). Overall, the need to overcome artificial obstructions and limitations in our scientific understanding of the complexity of educational issues is the major driver of interdisciplinary collaboration in neuroeducational studies.

2. INTERDISCIPLINARY COLLABORATION IN NEUROEDUCATIONAL STUDIES: A PRACTICAL FRAMEWORK

Interdisciplinary thinking is at the heart of a holistic understanding of complex problems. In his landmark book, Pop-

per (1963) stated that "we are not students of some subject matter, but students of problems; and problems may cut right across the borders of any subject matter or discipline" (p. 88). This point is particularly clear in neuroducational studies, a field which has been built as an interdisciplinary field of study to investigate educational issues that their solution is of beyond a single disciplinary perspective. This demands educators and scientists to work collaboratively in a manner that the gap between research and practice could be lessened and neuroeducation could inform educational theory and practice. Based on this understanding, numerous studies have emphasized on the importance of interdisciplinary collaboration in the field (e.g. Goswami, 2008; 2006; 2004; Howard-Jones, 2008; Geake, 2009; Ansari & Coch, 2006; Fischer et al, 2007; Hardiman, 2009; Willingham & Lloyd, 2007; Gardner, 2009; and Ansari, De Smedt & Grabner, 2012). The feasibility of interdisciplinary collaboration however has not been well represented and introduced in a systematic fashion.

To get full advantage of interdisciplinary collaboration therefore, it would be necessary to identify and develop a number of practical strategies that facilitate such endeavor. Toward this end, the principal problem being investigated here is to review and synthesize the relevant literature in order to provide a conceptual overview of interdisciplinary collaboration in the field and to initiate a serious debate on the potential levels of collaboration between the contributing disciplines. The relevance literature suggests that making effective interdisciplinary collaboration in neuroeducational studies is dependent on a number of factors which can be categorized into the following strategies:

2.1. Creating a common language and conceptual vocabulary

One of the truisms in regard to difficulties associated with establishing interdisciplinary research and collaboration is the necessity of creating a common language and conceptual vocabulary (Gilbert, 1998). Concepts and language, even with respect to the meaning of fundamental terms such as "learning" and "education" can mean completely different things to educators and scientists (Devonshire, & Dommett, 2010; Howard-Jones, 2011). For instance, from a biological perspective, learning is the process of making neuronal connections in response to external environmental stimuli, and education is the process of controlling or adding stimuli, and of inspiring the will to learn (Koizumi, 2004). On the other hand, educators go on to significantly distinguish learning from education. They do not necessarily include any learning as educational experience. From an educational perspective, it is the dominant educational ideology (normative theory) which determines what kind of learning is educational experience and what is noneducational or even miseducational (see Eisner, 1995, p. 37).

It is clear that, the lack of a common understanding on these fundamental terms, not only increases the risk of misunderstanding and over interpretation of information in translation (Devonshire, & Dommett, 2010; Howard-Jones, 2011), but also undermines the efforts of practitioners and researchers to solve the complexity of educational issues. Therefore, it is generally accepted that developing a common language as the basis of systematic interactions between researchers from different disciplines is a challenging and ultimately necessary part to truly do interdisciplinary research. The first dictionary of MBE science terms (Tokuhama-Espinosa, 2011) is a promising attempt in order to develop a shared terminology for MBE researchers and practitioners. In addition, the establishment of conferences, meetings, journals, workshops and other collaboration channels can also facilitate the building of creating a common language and conceptual vocabulary.

2.2. Developing graduate educational programs

Considering the greatest challenge faces by neuroeducation i.e. diversity in its definition and the lack of a common language, there requires a joint efforts by researchers with different expertise areas of all contributing fields (Ansari & Coch, 2006). Such a vision of cooperation and collaboration requires a context where people can address educational challenges in a supportive environment to develop a framework for defining new goals, roles and responsibilities (Schwartz & Gerlach, 2011).

What is needed more urgently therefore, is training a new generation of neuroeducators who could able to transfer scientific findings from cognitive sciences and neuroscience to educational theory and practice. The good news is that, there is an increasing emphasis on training professionals by the number of highly ranked graduate schools, such as Harvard, Cambridge, and Dartmouth that recently started to present MA and PhD programs in Neuroeducational studies. However, it needs to be replicated by other educational faculties to train a new generation of professionals who will be able to generate new knowledge and critically evaluate concepts, assumptions, underlying theories and limitations in the field.

2.3. Providing training programs for neuroscientists and educators

The fact is that, today teachers and educational sciences students are not trained to become adequately familiar with the potential contribution of neuroscience to educational thought and practice. For this reason, they lack insights into neuroscientific theories and methodological approaches. On the other hand, neuroscientists frequently are largely unaware of the current pedagogical approaches used in schools and, therefore, lack an actual overview of what is being taught in school, how this is taught, and what expectations are being set by curricula (Ansari, De Smedt, & Grabner, 2012). This suggests that it is important to consider strategies to improve the professional development of both neuroscientists and educators working in the field. There is need to provide opportunities for neuroscientists to be trained in educational theory and pedagogy and for educational researchers and educators to equip with a basic understanding about neuroscientific findings, theories and methods (Ansari, Coch & De Smedt, 2011; Ansari, De Smedt, & Grabner, 2012; Ansari & Coch, 2006). It may be realized by integrating courses on cognitive neuroscience into educational studies and teacher education curricula, and integrating cognitive neuroscience methods and findings into their current courses. They need to know what science has discovered about learning and development at multiple levels of analysis, from multiple perspectives (Ansari, Coch & De Smedt, 2011).

Berninger Virginia and Richards Todd (2002) have written a very useful textbook on the brain literacy specifically for teachers and other professionals in the field of education. Likewise, organized opportunities for neuroscientists need to be provided to become more familiar with the nature of educational theory and practice. These opportunities may encourage researchers with different expertise to involve more in action research and to carry out studies in real learning settings. Through such interdisciplinary training, neuroscientists will ask more educationally relevant questions and educators will be able to use know ledge gained through exposure to neuroscience in their educational practice (Ansari & Coch, 2006; Ansari, De Smedt, & Grabner, 2012).

2.4. Developing neuroeducatonal research organizations

The interdisciplinary nature of neuroeducational studies implies conjoining a

variety of perspectives and insights from relevant disciplines into a unified or coherent framework to solve complex problems that their solutions are beyond the scope of a single perspective or discipline. This process of integration may require a multiperspective lens and multimethod approach to research and interdisciplinary collaboration is a useful strategy for tackling complexity nature of issues and problems in the field (Howard-Jones & Fenton, 2012). In this framework, the key goal for neuroeducational research is to bring together all educational stakeholders to share their experiences and collaboratively develop neuroeducational research organizations in which, researchers and practitioners in multidisciplinary, interdisciplinary, and transdisciplinary manners could formulate research questions and methods to investigate the problems coming out of educational policy and practice. Whereas multidisciplinary and interdisciplinary activities are typically project oriented, based on treating traditional problems in new ways, transdisciplinary activity is more oriented toward opening new, potentially revolutionary, sets of problems (Campbell, 2011). Affording new avenues for experimental design and collaboration, be it pursued in a transdisciplinary manner, researchers from different disciplines with a variety of research methods, tools, techniques and processes coming together to create new research methods and procedures in order to answer questions and solve problems which need to be addressed from a multi-perspective approach (Koizumi, 2004). Toward that end, the concept of "Research Schools" (Stein & Fischer, 2011; Hinton & Fischer, 2008) or "Research Schools Network" (Schwartz & Gerlach, 20011) must transform from an idea to a reality. Hinton & Fischer (2008) "As living laboratories that connect the work of researchers and practitioners, research schools will support the bidirectional relationship between research and practice that is needed to ensure fruitful transdisciplinary work" (p. 160). Research Schools Network as an extension of Dewey's laboratory school is a network of researchers, educators, and policy makers working collaboratively to establish conceptual frameworks, identifying educational challenges, developing experimental methodologies and ethics, clarifying research findings, interpreting conclusions, and monitoring suitable applications of results (Schwartz & Gerlach, 2011).

3. CONCLUSION

Although there are many obstacles that lie in the way of a productive field of neuroeducation, but there is much reason to be optimistic and that the groundwork has been laid to advance this field in earnest (Ansari *et al*, 2012). Given this interdisciplinary character of neuroeducation, careful consideration of this issue can make a foundation for a more successful future in the field. The level of interdisciplinary collaboration research has steadily increased over two decades ago. The Organization for Economic Co-operation and Development (OECD) has committed to explore how research in the cognitive and neurosciences has the potential to inform the field of education (OECD, 2007). The International Mind, Brain, and Education society (IMBES) has formed in 2007, to facilitate cross-cultural collaboration in all fields that are relevant to connecting mind, brain, and education in research, theory and practice. The Neuroeducational research network (NEnet) at the University of Bristol has also has played a key role in developing collaboration between the fields of neuroscience and education (see Howard- Jones, 2007; 2011). There are also a number of leading schools have similar programs connecting basic and applied research from the fields of cognitive science, psychology, neuroscience, and education (for example, Mind, Brain, and Education Program: Harvard Graduate School of Education; A Mind, Brain, and Education (MBE) Approach: Department of Education at Dartmouth College; Mind,

Brain, and Teaching Certificate: School of Education at Johns Hopkins University; Centre for Educational Neuroscience: University of London; and the Centre for Neuroscience in Education: University of Cambridge). Such university programs will educate a new generation of professionals who will bridge the division between scientists and educators. In addition, two professional journals ("Mind, Brain, and Education" and "Trends in Neuroscience and Education") devoted to bridge the gap between our increasing basic cognitive and neuroscience understanding of learning and the application of this knowledge in educational settings.

Being a problem-focused interdisciplinary field, neuroecation seeks to bring together biological, psychological, and educational perspectives, with the express intention of improving educational practices (Stein & Fischer, 2011). Given this interdisciplinary character of neuroeducation, careful consideration of this issue can make a foundation for a more successful future in the field. The level of interdisciplinary collaboration research has steadily increased over two decades ago (see box 2). Neuroeducational researchers then, as Howard-Jones (2011) noted "must traverse the boundaries of diverse traditions of knowledge making and establish coherent interdisciplinary dialogue, maintaining sense as it is commonly determined and understood by these very different traditions" (p. 29).

In sum, the potential future of the emerging field of neuroeducational studies should be framed in terms of interactions and based on mutually beneficial dialogue among participants with knowledge of child development, learning, and teaching (Ansari *et al*, 2011). In this framework, whereas cognitive science and neuroscience could inform education by providing additional evidence that may variously corroborate, refine, or refute the validity, reliability, and relevance of the theories of teaching and learning (Campbell, 2010), education could inform cognitive science ad neuroscience by providing a source of complementary behavioral data, as well as posing new worthwhile lines of investigation (Geake, 2009). In light of this, educational researchers and practitioners have a leading role to play in fundamental development of this endeavor.

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