The dialogue between pedagogy and neuroscience as a new frontier in education

Il dialogo tra pedagogia e neuroscienze come nuova frontiera dell'educazione

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ABSTRACT

Our work tries to demonstrate how neuroscience is gaining increasing spaces in pedagogy as biology of human mental processes; at the same time pedagogy can help neuroscience to define and clarify the processes that need to be studied to arrive at a deep understanding of biology of the human mind in educational processes.

The attempt to achieve common epistemological basis in order to study and refine educational practices, urged by the availability of many neuroscientists to take charge organic layers of complex social behaviors, allows to predict the implications of this combination applied to educational processes, converging pedagogical, psychological, biological studies and correlating their scientific languages from theoretical to applied research.

Our work is aimed at creating a new way of thinking in pedagogical sciences, without distinctions between mind and brain, biology and experience, nature and culture: it is is based on the idea that, despite the genetical and constitutional factors play an important role in the development of the human mind, human relations and cultural and social factors implicated in education, through neuroplasticity, can shape the development of the brain and mind and promote a good quality of cognitive, social, emotional functioning. We base our reflections on personalistic anthropology, which connects causality, physiology and phenomenology considering the brain not as a mechanism but as organism with its own teleology, in mutual relationship with the environment, where the human being is a symphony of physical, psychological, social self.

Il nostro lavoro cerca di dimostrare come le neuroscienze, in quanto studi sulla biologia dei processi mentali umani, debbano guadagnare sempre più spazio negli studi pedagogici; allo stesso tempo, la pedagogia può indicare alle neuroscienze quali processi sia opportuno definire e studiare per arrivare a una profonda comprensione dei correlati neurali dei processi educativi.

Il tentativo di costruire basi epistemologiche comuni al fine di studiare e perfezionare le pratiche educative, è stato incoraggiato dalla disponibilità di molti neuroscienziati di farsi carico delle basi neuroanatomofisiologiche dei comportamenti sociali complessi. Ciò ha permesso di prevedere le implicazioni della combinazione di studi nei quali convergono aspetti pedagogici, psicologici, biologici che correlano i propri linguaggi scientifici dalla teoria alla ricerca applicata.

Il nostro lavoro è finalizzato alla creazione di un nuovo modo di pensare l'educazione all'interno delle scienze pedagogiche, che abbandoni controproducenti distinzioni tra mente e cervello, biologia ed esperienza, natura e cultura, basandosi sul concetto che, nonostante i fattori genetici e costituzionali svolgano un ruolo importante nello sviluppo della mente umana, i rapporti umani e i fattori culturali e sociali implicati nella formazione, attraverso la neuroplasticità, possono plasmare lo sviluppo del cervello e della mente e promuovere una buona qualità del funzionamento cognitivo, sociale, emotivo.

La nostra proposta si situa nel quadro di un'antropologia personalista, che collega causalità, fisiologia e fenomenologia considerando il cervello non come meccanismo, ma come organismo con una propria teleologia ed in reciproco rapporto con l'ambiente e che rende possibile all'essere umano di manifestarsi come un "sé sinaptico" risultante dalla sinfonia dei suoi molti sé (fisico, psicologico, sociale).

KEYWORDS

Inclusion, Support Teachers, Video-Analysis, Attitudes, Beliefs, Reflexivity.
Inclusione, Insegnanti di Sostegno, Videoanalisi, Atteggiamenti, Convinzioni, Riflessività.

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If we give people, children, adolescents, or adults, information on the correlation between the operation and the structure of the brain, neural development and the impact of the experience and the development of their mental life, we help them to develop a capacity of discernment that allows them to see their minds in a new light (...) Reflecting on the neural correlates allows us to understand the experience, rather than elaborate rationalizations aimed at explaining our inappropriate behavior in order to get rid of it; neural insights seem to really help us to have more compassion and insight for ourselves and for other people (Siegel, 2009, p. 258).

1. Epistemological background

Part of the pedagogical world still underestimates the actual role of neurosciences in studying the relationship between brain, body and behavior and applying the results of research to education, considering neurosciences as disciplines far from traditional approaches in pedagogy.

In reality, the conflict is only apparent and is a characteristic of the interaction between related scientific disciplines, which often has stimulated the advancement of knowledge.

As noted by several historians of science, for every discipline there is generally an antidiscipline that generates a creative tension within the mother discipline, putting into question the thesis and accuracy of the methods. In this case, neurosciences can represent new antidisciplines with respect to which pedagogical disciplines are mothers (D'Alessio, 2014a).

Our work tries to demonstrate how neuroscience will gain increasing importance and space in pedagogy as biology of human mental processes; at the same time pedagogy can help to define and clarify the processes that need to be studied if you want to arrive at a deep and multifaceted understanding biology of the human mind in educational processes.

The attempt to achieve common epistemological basis in order to study and refine educational practices, urged by the availability of many neuroscientists to take charge organic layers of complex social behaviors, allows to predict the implications of this combination applied to educational processes, with the objective to converge pedagogical, psychological, biological studies and correlate their scientific languages from theoretical to applied research (ib.).

2. Neuroscience and Pedagogy: toward an Interdisciplinary Dialogue

Studies on brain functioning in interpersonal relationships (within psicophysiology, neuropsychiatry, psychoneuroendocrinology, psychosomatic, biogenetic) are now numerous.

Here we name just a few of them: Grafman's (1999), Kempermann's (2000), Battro's, Neville's (2011) studies on neuroplasticity, Turnbull and Solm's (2005) studies on neuropsychoanalysis, those on the relationship between self-construction and brain anatomofisiology brain of LeDoux (2003), psychobiological studies of empathy of Trevarthen (1997), studies on memory and the relationship between psychoanalysis, psychiatry and biology of the mind of Kandel (2007), studies on mirror neurons of Rizzolatti (2006), those on the conscience of Damasio (1998) and Edelmann (2000), psychogenetic studies of Ridley (2006) and Plomin (2002), Siegel's (2001) studies on neurobiology of interpersonal experience and many others.

These studies highlight the role of experience in determining the structure and function of the biological organism. Taking into consideration a lot of research on early negative experiences that may result from deprivation, they show how the quality of interpersonal experiences can be decisive for a normal neurobiological and psychological development (D'Alessio, Minchillo, 2010). It seems that human relations produce changes on the molecular level, with broad implications on learning and memory (D'Alessio, Leone, 2011).

Today many neuroscientific researches are based on a combination of epidemiological studies, genetic studies, molecular and brain imaging techniques: to encourage this course it would be appropriate to combine the resources available for research in the different sectors (educational, neurological, psychological, biological, pharmacological, etc.).

Much of the current educational practices today shows a strong dualism that makes it difficult and problematic to integrate the work done by the education professionals with the understanding and the technological resources provided by neuroscience (D'Alessio, Minchillo, op.cit.).

Trial of changes in brain circuits induced by psychotheraphy already exist in clinical psychology, which suggests a similar possible action induced by educational process, but the impact of the neuroscientific studies on these subjects is still limited. Now it is the time that researchs and studies on the structure and functioning of human brain constitute an indispensable part of the corpus of knowledge and training programs of present and future educators, favouring the construction of appropriate tools and methods of working.

Our contribution, in an epistemological sense, is aimed at creating a new way of thinking in pedagogical sciences, abandoning counterproductive distinctions between mind and brain, biology and experience, nature and culture: it is is based on the idea that, despite the genetical and constitutional factors play an important role in the development of the human mind, human relations and cultural and social factors implicated in education can shape the development of the brain and mind and promote a good quality of cognitive, social, emotional functioning (ib.).

The integration of biological, neurological, psychological, philosophical and pedagogical perspectives can bridge the gaps between definitions of behaviors that are based on pedagogical constructs and their neural correlates, to understand, for example, the biological basis of emotive communication or emotional effects of traumatic experiences on brain development.

We base our reflections on mind-brain relation on personalistic anthropology, which, in the light of neuroscientific theories, try to connect causality, physiology and phenomenology to consider the brain not as a mechanism but as organism with its own teleology, in fruitful mutual relationship with the environment, where the human being is viewed as a symphony of physical, psychological, social self (D'Alessio, 2014a).

The reason why this convergence has not been achieved before is probably because neuroscience did not seem mature enough from a technical point of view to deal with the issues concerning the mental processes in all their complexity; now, as a consequence of advances in neuroimaging is possible to wide and refine our understanding of education to obtain higher level of understanding of the mechanisms involved in it (ib.).

This is not to undermine a discipline in favor of another: on the contrary, when pedagogy suggesting fundamental ideas about human education has a better potential than neuroscience, much less able to consider the existential aspects of education (ib.).

The dichotomy between mother discipline and anti-discipline indicates how the two disciplines can interact with profit (Kandel, 2007); in this pedagogy has a dual role: on the one hand should try to answer questions within its competence in education, from another side can propose meaningful tasks to neuroscience research: the potential of pedagogy and neuroscience resides in their visions of the world and their potential to generate specific theories on interrelated variables (ib.).

The synergistic interaction between pedagogy and neuroscience has been described in two paradigms: the consequences on the development of some forms of social deprivation (Siegel, 2001) experienced at an early age and the mechanisms of learning (D'Alessio, Minchillo, 2010).

These two lines of research are paradigmatic in different directions: they exemplify the kind of problems that the sciences of education are required to synthesize and to bring to the attention of neuroscience and are interesting from a methodological point of view because they illustrate the ability to simplify and refine behavioral models (Kandel, 2007).

The great opportunity that is presented today to pedagogy is the following: when they comes to studying educational processes, neuroscientists need a guide, therefore pedagogy can provide an important contribution to neuroscience. Its power resides in the peculiarity of its perspectives, which may indicate the mental functions and the relationships that need to be studied to arrive at an understanding of more complex and profound study of the human mind in the dynamic process of education. As stated in the introductory part of this work, pedagogy can play a dual role in trying to answer questions pertaining educational processes; on the other side, it can asks questions about education that neuroscience is called to respond, with the objective to obtain an advanced vision of educational processes (D'Alessio, Minchillo, op.cit.).

As a consequence of the progress of neurosciences and pedagogy in recent years, both disciplines have a new and better position to unify pedagogical insights and the search for a deeper understanding of biological basis of education.

We want to propose a conceptual model designated to put together pedagogical theories and practices with the latest discoveries in neuroscience in the training of educators.

The current thinking of neuroscientists about the relationship between mind and brain can be summarized in five principles (Kandel, op.cit): 1) all mental processes, even the most complex derive from brain processes; the assumption is that what we call mind is a set of functions performed by the brain; the action of the brain is not limited to simple motor behaviors but extends to all complex cognitive, conscious and unconscious acts that we associate to the human behavior: thought, language and the creation of literary, musical and artistic production. A related principle is that cognitive and emotional problems are also disorders of brain function, even when their causes are environmental in origin; 2) the combination of genes exerts a strong control over behavior; 3) a modification of genes alone can not explain all the variability observed in a given personality trait: a remarkable contribute is given by social and developmental factors; just as the combinations of genes contribute to determine the behavior, also the behavior and social factors may exert a retroactive effect on the brain by modifying gene expression and functioning of nerve cells; learning results in alteration of gene expression: therefore the whole "culture" is expressed in the form of "nature"; 4) genetic changes induced by learning produce patterns of neuronal connection which contribute to forming the biological basis of individuality and

are probably responsible of behavioral differences induced by social circumstances; 5) if education is effective, we presume that this is done through the process of learning that change genetic expression by acting on the effectiveness of synaptic connections and rewrites the paths of anatomical connections between the neurons of the brain; so the brain imaging techniques may eventually allow a quantitative assessment of the outcome of educational processes.

The basic assumption of neuroscience is that all the functions of the mind reflect functions of the brain: specific brain lesions produce behavioral changes and specific alterations of behavior are reflected in the typical changes of brain functioning (ib.).

But we must say we only have a partial knowledge of the way in which the brain generates mental processes. The great challenge for neurobiologists and for pedagogist is to delineate this relationship in terms that are satisfactory to the neurobiologist who studies the brain and for the pedagogist who studies education. Kandel 's (op.cit.) research shows that when we learn the mind influences gene transcription in neurons: then we can shape our genes, which in turn affects brain anatomy even at the microscopic level.

3. Neuroplasticity and Education

Nowadays it's possible to objectively monitor the developmental path of child's brain and document how this is being shaped by parenting, education and other environmental influences (Battro et alii, 2010).

The layout of the connection architecture, genetically determined, provides a universal neural platform, shared by all humans, but specific cultural experiences will shape this: schooling, in particular, is an important event in children's lives; brain changes induced by education are made possible by the remarkable adaptivity that features the developing brain (ib.).

Early intervention programs that teach both children and parents the elements of attention focusing can be extremely effective. For children who are socially and economically lacking these interventions appear to be particularly successful and moreover have the capability to bring more equality and justice to the education system (ib.).

Neuroplasticity begins before birth,when the brain is at the beginning of its formation, and genetic variations or mutations, as well as early environmental influences, can cause brain changes that may lead develop learning disabilities in some children: neuroplasticity is the fundamental transition process, and it would be advisable investigating more carefully its molecular, neuronal and brain-wide mechanisms in the future (ib.).

According to the state of scientific knowledge, investment in early education can have a deep impact on brain's structure throughout life and therefore on health, economy, and social justice: these insights concern mainly the development and acquisition of instrumental abilities, but we have to understand much more about how education insert moral values, rules of social conduct and dispositions for ethical behaviour (D'Alessio, 2014b). These properties and skills are of paramount importance for the future of mankind, and we need to intensify researches in this purview.

Conclusions

It seems that education can change people through learning by producing changes in genetic expression that modifies the intensity of synaptic connections and through structural changes that alter the anatomical pattern of interconnections between nerve cells and the brain.

In this way, education works deeply in the brain modifying its structure and activating genes: it acts "talking to neurons" (Doidge, 2008). An effective educator is therefore a real *microsurgeon* of mind, a *neurosculptor* of neuronal networks.

We think that is a great, wonderful responsibility!

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