http://doi.org/10.17163/soph.n26.2019.04

On the "neuro" in neuroeducation: from psychologization to the neurologization of school

Sobre lo "neuro" en la neuroeducación: de la psicologización a la neurologización de la escuela

Juan Carlos Ocampo Alvarado[*]
Technological Institute and of Superior Studies of Monterrey, Monterrey / México
juan.ocampo01@cu.ucsg.edu.ec
Orcid Code: https://orcid.org/0000-0002-9353-7581

Abstract

The objective of this article is to analyze the triadic relationship between education, psychology and neuroscience within the framework of neuroeducation. To this end, an exhaustive review of the most relevant literature on the subject was carried out. The historical precedents of neuroeducation can be traced back to the introduction of psychological discourse in education, which later transformed into the psychologization of school. Arguably, the irruption of the neuro in the culture and the advent of the new neurosubjectivities ended up dethroning psychology of its privileged position in the educational context. Under promises of liberation, independence and scientificity, neuroeducation prospered precipitously without addressing the multiplicity of philosophical, methodological and ethical difficulties that still plagues it. However, the structural relationship between psychology and neuroscience reveals the inability of the latter to detach itself from the psi paradigm. Moreover, from the counterpsychology theory and considering its analog behavior, it can be argued that the neuro, rather than an independent stage, is an extension of the psi conditioned to this epoch. Under this approach, neuroeducation is not an alternative to psychological predominance but a return to it which threatens neurologization. Thus, it is imperative that learning is reconnected to culture, educational spaces are reconquered, and the teachers are made aware of their agency so that education can, without ignoring the valuable contributions of the other disciplines, recognize itself as an autonomous knowledge, eminently integrationist and independent.

Keywords

Neuroeducation, education, psychology, culture.

Suggested form of citing: Ocampo Alvarado, Juan Carlos (2019). On the "neuro" in neuroeducation: from psychologization to the neurologization of school *Sophia, Colección de la Educación, 26*(1), pp. 139-166.

[*] Researcher in the Clinical Psychology and Health Career of the Technological Institute and Higher Education of Monterrey of Mexico. He has directed research work in vocational guidance, disability and neurosciences, which have been published in indexed journals. He has collaborated in scientific research projects with the Neurosciences Institute of Guayaquil, the psychological center PSIPRE S.C. and the Academic Vice-Rector of the Catholic University of Santiago de Guayaquil.

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Resumen

El presente artículo tiene por objetivo analizar la relación triádica entre la educación, psicología y neurociencias en el marco de la neuroeducación. Con este fin se llevó a cabo una exhaustiva revisión de la literatura más relevante en torno a la temática. Los precedentes históricos de la neuroeducación se pueden rastrear hasta la introducción del discurso psicológico en la educación, lo que posteriormente se transformó en la psicologización de la escuela. Discutiblemente, la irrupción de lo neuro en la cultura y el advenimiento de las nuevas neurosubjetividades acabaron por destronar a la psicología de su posición privilegiada en el espacio educativo. Bajo promesas de liberación, independencia y cientificidad, la neuroeducación prosperó precipitadamente sin atender a la multiplicidad de dificultades filosóficas, metodológicas y éticas que todavía la agobian. No obstante, la relación estructural entre psicología y neurociencias atisba la incapacidad de las últimas para desligarse del paradigma *psi*. Más aún, desde la contrapsicología, se puede argumentar que lo neuro, más que un estadio independiente, es una extensión de lo *psi* acondicionada a la época. Bajo este planteamiento, la neuroeducación no es una alternativa a la predominancia psicológica sino un retorno a ella que amenaza con la neurologización. Por ende, es imperativo que se revincule el aprendizaje a la cultura, se reconquisten los espacios educativos y se concientice a los maestros de su agencia para que la educación pueda, sin ignorar las valiosas aportaciones de las otras disciplinas, reconocerse a sí misma como un saber autónomo, eminentemente integrador e independiente.

Palabras clave

Neuroeducación, educación, psicología, cultura.

Introduction

Today, the progress of neuroeducation is undeniable. The marriage between the neurosciences and education is already giving its first and expected results, which concern topics of high relevance in the educational field such as: the acquisition of literacy (Huettig, Kolinsky and Lachmann, 2018), the learning of mathematics (Cargnelutti, Tomasetto and Passolunghi, 2017), the strengthening of memory (Markant, Ruggeri, Gureckis and Xu, 2016), the relationship of physical activity with learning (Mavilidi, Okely, Chandler and Paas, 2016) and the problems of learning (Camargo and Geniole, 2018). There is also evidence, as Pickering and Howard-Jones (2008) report, that their popularity among educators is booming, not to mention that several institutions of importance, such as UNESCO and Harvard University, are actively investing in the new discipline. Even its most outspoken and controversial detractors have been rebuffed or, failing that, have given in.

The argument that supports it reads like this: given that learning is intrinsically related to brain functioning and neuroscience is the scientific field that studies the biological basis of such functioning, it follows as a corollary that the neuroeducational project is not only feasible but highly desirable. Under this logic, education could abandon the psychological discourse, once valuable and now outdated, to take refuge in the cred-

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ibility of biology. At first glance, the above is a sufficient condition to justify neuroeducation. However, not all share that messianic vision of the project. To begin with, what motivates this union? As stated by Ansari, De Smedt and Grabner (2012), "neuroeducation presumes that the understanding of the biological mechanisms of learning is more informative, accurate or reliable than other explanations of a non-biological nature". Is neuroscientific knowledge intrinsically superior to others? Ortega and Vidal (2007) would say no, but that illusion responds to a cultural shift of the last decade, called neuroculture. Finally, De Vos (2016) asks: "where is education in neuroeducation?" What is included in this article could be close to an answer. The objective of this article is to analyze the triadic relationship of education, psychology and neurosciences within the framework of neuroeducation. To this end, an exhaustive review of the most relevant literature on the subject was carried out. Next, a brief historical approach to the psychological colonization of educational spaces is presented, from its introduction in the school with the para-school services to its directive role in the rethinking of the teaching objectives. Then the advent and rise of the neurosciences is described, emphasizing its incidence in the contemporary sociocultural and ideological climate and in the configuration of the new subjectivities of everything *neuro*. Subsequently, the neuroeducation project is analyzed in depth, revealing the multiple difficulties that arise from the internal relationship between its constituents. Finally, a critique of neuroeducation is presented, based on counter-psychology and, faced with the permanence of the psychological and the imminence of the neurological, the question is rescued: what should change in education with a view to neuroeducation? To test a possible answer, it is a priority to explore the origin of the dyad constituted by psychology and education.

Psi colonization: a historical approach to school psychologization

As it is of general knowledge, many subjects studied by psychology respond to educational topics because cognition is the medium of learning. The history of psychology is full of examples of this. The first psychometric intelligence assessment was developed specifically for use in schools. The discovery of one of the fundamental postulates of the behaviorist current, conditioning, was popularized as a teaching technique and was freely applied by educators. The work of psychologists such as Piaget, Vy-

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gotsky and Ausubel is enough to confirm the existence of a spontaneous and diffuse intersection between psychology and education. Even so, as De Vos (2016) puts it, it is not until the mid-twentieth century that there is a real coalition between psychology and school.

Until the end of the nineteenth century, psychology was composed of a tiny group of professionals, of negligible popularity and without influence in the scientific community, who still remembered the strong controversy surrounding the nature of its object of study. But shortly afterwards, in the words of Mulvale (2016), the sociohistorical movements would open a space for the nascent discipline: capitalism used the notion of entrepreneurial individuals who created their own destiny; secularization deprived the individual of the divine protection that provided meaning and values; and the neoreligiosity started with the idea of the transcendental God and the traditional rules to promulgate a personal faith based on the spiritual needs of each person. Psychology, after adopting an empirical-naturalist approach, emerged on par with the individualist current of the time, contributing to the production of new subjectivities: self-governed, self-sufficient and autonomous subjects.

Counting on that scientific credibility and prosecuted in the predominant cultural current of the time, the interwar period was an auspicious opportunity. Advances in psychometrics were well received for the standardized evaluation of immigrants, soldiers and students, giving psychology something of that long-awaited popularity. However, Lloyd (2015) argues that this would not reach its peak until after the Second World War, when the high prevalence of military psychiatric casualties led to a substantial increase in the funding of mental health services and called attention to the benefits of psychology. Soon, explains Mulvale (2016), individuals seeking answers to the events of war, happiness and self-realization turned to the young discipline that, in a short time and with great subtlety, had entered the mainstream culture.

After this successful acceptance, the incipient discipline made its way into the educational centers. According to De Vos (2016), this first incursion of psychology was through para-school services such as vocational guidance and psychological support, but soon the advances in cognitive matter gave it a directive role in schooling. For Marina (2012), this interference was justified in that, considering that learning also occurs spontaneously and involuntarily, if the objective of education was to react it intentionally, directed and optimally, it was necessary to understand the intricate biopsychosocial mechanisms. By the beginning of the 20th

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century, not only had there been an authentic psychological invasion of the school, but it had been, for practical purposes, a total success.

For Mayer (2001), the argument that justified this suspect marriage was clear: psychology would get practical problems in which to verify their hypotheses and education, theoretical knowledge to nurture their praxis. Indeed, the predominant psychological currents of that time provided numerous contributions to the educational practice that the teachers, for their part, diligently complied with. For De Vos (2016), that's how the *psi* terminology flooded the school, starting with the curriculum and ending with the educational content itself. Solé and Moyano (2017) point out that, after colonization, the student's expected objectives no longer referred to learning, but to reaching a maturity of the self, a degree of self-esteem or another psychological imperative to which constant references were made.

Education incorporated into its vocabulary the many psychological terms that then swarmed in the science of the mind, those concerning personality, cognition, behavior, etc. Psychological knowledge was regularly applied in class and differentiating it from educational knowledge became impossible. That spontaneous and diffuse limit between both disciplines had vanished, because the psychological discourse had permeated everything educational. In its eagerness to enrich the school, psychology had managed to kidnap it or rather psychologize it. Education had lost its jurisdiction and what was at first a slight act of intrusion was now a large-scale invasion.

It is undeniable that psychological knowledge, at the beginning, was useful to enhance the work of the teacher, allowing a greater understanding of the cognitive processes that operate in learning and reanimating empirical research in education; nevertheless, the psychological discourse soon became hegemonic and further corroded the fragile professional identity of the educator. This phenomenon would be known as psi colonization, the beginning of a long history of the predominance of psychological discourse in education. For purposes of this occupation, De Vos (2008) states that the school had been redesigned as a place not only of schooling, but of therapy, where teachers abandoned teaching to integrate into a vast disorder detection network. For Solé and Moyano (2017), this is the triggering factor for the abuse of diagnostic classifications in the school, a catastrophic but expected consequence in the psychologized school.

Under the Piagetian premise that there is a natural and universal cognitive-behavioral development dependent on the evolutionary ad-

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vance of the individual, teaching takes a back seat. The responsibility for any delay or deviation in the educational timeline now lies with the subject, who triumphs or fails to achieve the expected accomplishments. In the case of failure, this is understood in clinical terms as an alteration of the functioning or normal development of the individual, a disorder. In view of that, educational research quickly abandoned pedagogical discussions to focus on deviations that interfere with the individual's learning, diminishing the teacher's agency. According to De Vos (2016), this would be the main reason for the sudden increase in the prevalence of mental illnesses in educational environments, a phenomenon preceded by childhood overmedication.

Thus, according to Solé and Moyano (2017), the inappropriate behaviors that generate friction in school dynamics were grouped into etiological, watertight and superficial categories, which completely rejected the subjective experience. For Rodriguez (2016) this outcome would not surprise Canguilhem, who saw in the psychologist a technician of social normalization whose objective is the adjustment of the subjects to the current reality, identifying health with conformism to the established order and illness with opposition to this. Once intruded in the educational environment, the psychologist's role becomes a crime, pivoting between the concepts of adaptation and abnormality under which, from his utilitarian logic, the individual who meets the curricular objectives is normal and who is doesn't, is abnormal and his maladaptation is pathological.

For Grace (2018), psi colonization is a natural consequence of the inability of education to cement its own identity, insecurity that has led it to rethink and obsessively question the validity of its knowledge. This makes it especially vulnerable to the invasion and occupation of others that, on dubious guarantees, promise scientificity and a robust frame of reference. On this view, education sees itself as dependent and in need of a discipline-another that provides support. On the other hand, De Vos (2008, 2012, 2014, 2015, 2016) argues that psi colonization is a consequence of the intrinsic nature of psychology, a fact that underlies a complex sociological analysis of the psychological irruption in culture, politics and society. Such a position is hardly new, since critics of the psi disciplines, from Husserl to Foucault, have warned about the monopolizing tendency of psychological discourse and its expansive and invasive nature as a science. On this, Mulvale (2016) would conclude questioning if after the irruption of the psi in the daily life one can realistically imagine a de-psychologized society.

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The advent of the "neuro" and the brain subject

For the time being, De Vos (2015) affirms that, at least in education, the long reign of psychology as a privileged sovereign has been arguably exceeded. During the last years, the interdisciplinary study of the nervous system has had an immense upturn thanks to the discovery of new and better imaging technologies, from the classical image by functional magnetic resonance to the new imaging with diffusion tensor (images of diffusion tensor). However, its innovative paraphernalia and its great explanatory power is not enough to elucidate the pre-eminence of neurosciences in contemporary society. As Frazzetto and Anker (2009) clarify, this is because, in studying the underlying factors of our individuality, advances in this field not only stand out for their scientificity but also for their resonance on a personal, social and cultural level. As Ibáñez, Sedeño and García (2017) explain, the explanatory power of the neurosciences allows a neurobiological perspective on topics classically monopolized by the philosophical and psychological tradition, such as consciousness, subjectivity and intersubjectivity. That is why it is no surprise that, despite its technical and theoretical complexities, it has easily captured the common interest.

This fascination is not exclusive to postmodernity. From the Greeks to modern philosophers, the privileged place of the brain in the social imagery is remarkable. According to Crivellato and Ribatti (2017), Alcmeón of Crotona was the first to maintain that the soul, understood as consciousness, was in the brain, thus inaugurating the encephalocentric theory that would defend Hipo of Samos, Hipocrates de Cos and Plato. Later, Galen grouped the characteristics of the human being in the animal pneuma, whose seat was the encephalon. Descartes would continue the tradition by placing the soul in the pineal gland and Bonnet at a conjectural point within the brain. The birth and rise of phrenology, the first theory that attributes psychological qualities to specific neocortical regions, confirms the vivid interest in the study of the brain in the nineteenth century. In the current date, it is enough to read recognized authors like Shoemaker, Putnam, Churchland and Ferret who, following the Lockean tradition, make constant use of mental experiments on the brain and the mind.

Currently, neurocentrism has crossed the boundaries of academia and has been mixed in culture, successfully integrating into the social fabric. In the words of Álvarez (2013), the paradigm of the neuro, sustained in the authoritative agency of the discourse of science, offers the illusion of "finding answers to the most complex aspects of our existence (...) why we are what we are, and the why we do what we do" (p. 155). That is

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to say, that historical fascination of the human being by the soul, psyche or mind moved to the nervous system, becoming a universal interest in neurosciences and in the tacit desire that its study provide an answer to the existential questions of being. For Frazzetto and Anker (2009), this is neuroculture, the irruption of neuroscientific knowledge in daily life, social practices and intellectual discourses that affect the way in which the individual perceives himself, his body and others.

Gazzaniga (2006) argues that in this new paradigm is implicit the notion that the brain is what sustains, manages and generates the sense of identity and, therefore, is the corporeal representative of subjectivity. As Purdy and Morrison (2009) explain, the psychological attributes that at first were linked exclusively to the mind, the immaterial res cogitans, were now irreflexively ascribed to the brain, resulting in a mutant form of Cartesianism. In neuroculture, the individual is reduced to his brain and the brain is praised as the defining property of it. Such an affirmation can be exemplified as follows: if A receives the heart of B, A has a new heart; but if A receives the brain of B, then B has a new body. If we grant that the brain makes the mind and Cartesian dualism has been effectively overcome, Rose and Abi-Rached (2013) ask: are neuroscientists engineers of the soul? These and other questions arise in the era of the "brainized" human being. As Ehrenberg (2004) affirms, a being contained in an organ implies a new subjective conception in itself.

In a first attempt to conceptually capture this phenomenon, Changeux (1997) proposed a *homo cerebralis* to highlight the material basis of the ego identity. Hagner (1997) postulated *homo cerebralis* to explain the historical evolution of the brain, from its status as a recipient of the soul to be the organ-subject. Then, Rose (2003) proposed the concept of the neurochemical self, understood as the notion that the total personality can be summarized in terms of economic balance and imbalance of ions, enzymes and neurotransmitters. Finally, the aforementioned concepts would converge on the brain subject, a new conception worked by authors such as Ehrenberg (2004), Ortega (2009), Battro, Fischer and Léna (2008) and Silva and Fernandez (2016). As explained by Ortega and Vidal (2006), this would be an anthropological figure that embodies the notion that being, and his personality are essentially reducible to his nervous system, considering all the social and cultural effects that this entails.

Vidal and Ortega (2017) affirm that this neurocentric view of human subjectivity is at the heart of some of the most important current debates, from philosophy to politics. Certainly, the occurrence of neuro dimensions has permeated many areas, even the most unlikely ones. One of

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them is the market, where it is now common to find products such as music for brain stimulation (Brain.fm), nootropics (HVMN), neuro-drinks (Neuro), neurobics and brain training video games (Dr. Kawashima's Brain Training). Moreover, some practices that until recently were of the order of fiction have gained popularity with several startups undertaking chemical brain preservation projects with brain cryopreservation (Nectome), mental digitization (Neuralink) and human robotization (Humai).

The neurosciences also managed to permeate other areas of knowledge, giving rise to new transdisciplinary fields of knowledge. They allow to apply the new theoretical developments and the methodological advantages of the neurosciences to their study, generating an immense value in themselves, such as neuropsychology, neuroeconomy and neuroethics. However, these were not the only epiphenomena of the irruption of the neuro in knowledge. Corredor and Cárdenas (2017) identify other initiatives that arose in order to take advantage of the "neuro" juncture to obtain credibility, becoming pseudoscientific niches that have little or nothing to do with the interdiction of neuroscience and the disciplines in question, among them neurolinguistics, neuromarketing, neuromusics and neurojurisprudence.

Neuroeducation: perfect combination or unstable mixture?

These multiple appropriations of the neuro, both in popular culture and in academia, point to the existence of a further phenomenon, the connection between neurosciences and the current socio-cultural and ideological climate. On this line of thought, it can be deduced that neuroeducation is another epiphenomenon of neuroculture, whose particular purpose is to integrate neurosciences into a new domain: education. In its beginnings, this new area aroused both interest and distrust. A collective, aligned with the expectations of Battro, Fischer and Léna (2008), expressed their enthusiasm and optimism regarding the possible applications of this new knowledge in the field of educational policy and the classroom. Some even claimed a role as evangelists, preaching the fabulous promises of this nascent discipline.

A concrete example of this is the article by Carew and Magsamen (2010), published by the prestigious journal Neuron, whose ambitious title reads *Neuroscience and Education: An Ideal Partnership for Producing Evidence-Based Solutions to Guide 21st Century Learning*. As is evident from

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its epigraph, the text iterates insistently the incalculable potential of neuroeducation, whose only barriers, mentioned in two modest paragraphs, are the popularization of neuromyths, a topic to be discussed later, and the need for greater funding. Trapped in this rhetoric, neuroeducation seems to be the zenith of the educational project and the scientific response to the eternal question of how to educate. The neurosciences would be the platform from which education would reach its peak of development.

Another group was skeptical about the true scope of the unlikely offer. Cigman and Davis (2009) stated categorically that neurosciences could not account for the nature of learning and what constitutes good human performance. Others, including Clark (2013) and Bowers (2016), argued that those seductive promises were very general to be taken seriously or directly false. In this group is Bruer (1997) who in his iconic article *Education and the Brain: A Bridge Too Far* argued that the gap between education and neuroscience could be, until that moment, insurmountable. However, a decade after the publication of this article it is impossible to ignore the extensive theoretical framework that has been built. Research such as Ansari, De Smedt and Grabner (2012), Campbell and Pagé (2012), Nouri and Mehrmohammadi (2012), Zadina (2015) and Howard-Jones *et al.* (2016) justify its relevance and argue for the validity of the transdisciplinary study of the neurophysiological bases that support the cognitive functions involved in teaching-learning processes. Moreover, several organizations, universities and research institutions have made evident investments in the field of neuroeducation.

The Organization for Economic Cooperation and Development initiated the Brain and Learning project for neuroeducational research. UNESCO established a scholarship for research in neurosciences and education. Several renowned universities such as the University College of London, University of Bristol, Columbia University, Harvard University, and Vanderbilt University are offering graduate degrees in the subject. In Latin America, universities in Bolivia, Chile, Colombia, Mexico and Paraguay have joined the cause, offering professional diplomas. In addition, articles on neuroeducation have appeared in some of the most important academic journals in the world, such as the previously mentioned *Neuron* (Carew and Magsamen, 2010), *Scientific American* (Stix, 2011) and *Nature Reviews Neuroscience* (Howard-Jones, 2014b). Specialized journals such as *Mind, Brain, and Education* have also emerged in 2007, *Trends in Neuroscience and Education* and *Neuroéducation* in 2012 and *Educational Neuroscience* in 2016. Academic associations have also been formed around the discipline, including the International *Mind, Brain*

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and Education Society, the *Neuroeducational Network*, the Neurosciences and Education Laboratory and the *Ibero-American Center for Neurosciences, Education and Human Development.*

Although the progress of this discipline is irrefutable, there are still serious difficulties that need to be avoided. As stated by Gracia (2018), neuroeducation is subject to compulsive questioning itself because of the internal relationship maintained by its two essential components: the neurosciences and education. For that reason, for Patten and Campbell (2011), their most urgent difficulties are to establish a solid theoretical and philosophical basis, to find empirical models that allow their investigation and determine ethical standards that guide their development. The union between neuroscience and education cannot be conveniently reduced to the application of knowledge of the former on the praxis of the latter, because this superficial reasoning ignores the countless subtle and important changes that this interaction evokes.

Starting from the foundations, Samuels (2009) points out the existence of a contradiction between the predominant philosophical perspectives in the constituents of neuroeducation: the materialist empiricism that prevails in the neurosciences and the predominant constructivism in the educational sciences. On one hand, materialist empiricism posits that knowledge is perceptible, which implies that it is possible to access reality and obtain objective truths. In the other, the constructivism of relativist roots rejects this notion by objecting that reality is socially constructed, making the existence of universal truths impossible. This ontological antagonism between both positions reveals a first obstacle in the neuroeducational project.

This serious difference is evident in the methodological standards of each area. On the one hand, neuroscientists use techniques from the natural sciences, seeking correlates and causalities from neurophysiological measurements in experimental contexts where there is manipulation of the variables. On the other hand, as Flobakk (2016) explains, in the educational sciences the aim is to encompass the complexities of social realities through qualitative measurement, conforming to the exploration and description of phenomena in themselves. Educational research does not pretend to know, much less control all the variables that intervene in, for example, learning within the classroom, because such presumption is unfeasible and would require transgressing its own proper limits. Crifaci, Cittá, Raso, Gentile and Allegra (2015) consider that perhaps this is why some educators, whose research tradition is accustomed to studying natural and rich environments influenced by a myriad of factors, perceive with skepticism the neuroscientific, artificial and sterile experiments.

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Horvath and Donoghue (2016) raise a similar argument based on the concept of levels of organization. Taking biology as an example, it is understood that tissues are composed of cells, organs are made of tissues, individuals are constituted by organs and so on. This transition, better defined as integration from Bleger (1983), implies a multi-stage development of progressive improvement and complexity in which each state of organization coincides with the appearance of new properties that are not exhibited or predictable at the previous level. The properties of cells are not assimilable to those of tissues, organs or individuals, therefore, it is necessary to study them from different branches such as cytology, histology, etc. This would explain, from the levels of organization, the emergence of different scientific areas or specializations that study the same phenomenon from different paradigms.

As Horvath and Donoghue (2016) explain, each of these disciplines presupposes the use of a single set composed of research questions, terminology and tools, incompatible with previous or subsequent levels. In other words, although each discipline studies different aspects of the same phenomenon, they start from radically different premises that make interchange difficult, if not impossible. This is explained by Castorina (2016) by stating that each discipline is defined by its objects of study, therefore, its frame of reference is suitable for the investigation of particular phenomena, but not others. Thus, neurosciences would deal with neurological phenomena, while education would deal with teaching-learning processes and even if there are coincidences between them, it is not possible to pass unjustifiably from one category of phenomena to another. Therefore, although education and neuroscience coincide in the same object, this will be approached from different levels of integration, representing a cooperative difficulty.

Although it is true, education and neurosciences do not share the same objective, however, in the words of Battro, Fischer and Léna (2008), the joining of efforts between both disciplines, in order to elucidate the complex biopsychosocial relations of learning, constitutes the so-called neuroeducation project. Considering the undeniable progress of the discipline to date, it must be granted that between neuroscience and education there is an association, if not entirely correct, at least effective. However, the efficiency of such a relationship remains compromised. The ability of both disciplines to mutually collaborate has not been corroborated in practice and even, as Zadina (2015) postulates, there is evidence against it. The neuroeducational project requires, in the first instance, to open effective communication channels between neuroscientists and

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educators, but the distance between both disciplines presents a problem. Poor communication can generate misunderstandings that, in that gray area between neuroscience and education, are called neuromyths.

Neuromyths are erroneous assumptions about brain functioning based on the misinterpretation or exaggeration of neuroscientific research results (Ansari, De Smedt and Grabner, 2012, Ferrero, Garaizar and Vadillo, 2016). Although much research has focused on denouncing their high prevalence among educators, others such as MacDonald, Germine, Anderson, Christodoulou and McGrath (2017) and Papadatou-Pastou, Haliou and Vlachos (2017) have shown that neuromyths are not exclusive to that collective. In the field of public policy there are examples of measures taken based on simplifications of neuroscientific postulates, as pointed out by Purdy and Morrison (2009) and Lowe, Lee and Macvarish (2015). Also, there is evidence that neuromyths are common in the general population. Pallarés-Domínguez, (2016) highlights as some of the most frequent the following: one cerebral hemisphere predominates over another, only 10% of brain capacity is used, the existence of preferred learning styles and classical music during intrauterine life stimulates brain development, among others.

According to Bruer (1997), one of the first to warn about the occurrence of neuromyths, the development of neuroeducation depends on the ability of educators and neuroscientists to bridge the gap between them. However, he concludes that there is an insurmountable gap between both disciplines and that a third intercessory element, cognitive psychology, is necessary. In the later, authors like Tokuhama-Espinosa (2013) would stick to the now famous metaphor of the bridge of neuroeducation. Some would agree that it is imperative that psychology acts as an intermediary between the two essential disciplines. Others like Codina (2014) consider that this alone would be insufficient, therefore, it would be necessary to integrate more intermediary elements, such as philosophy or ethics, to supply that function. Im, Cho, Dubinsky and Varma (2018) proposed a novel model that adopts both cognitive psychology and educational psychology.

Although these have been the most popular proposals, they have not been the only ones. Crifaci, Cittá, Raso, Gentile and Allegra (2015) suggested the adoption of an alternative thought system that allows collaboration between both disciplines: embodied cognition. This model of mind holds that cognition emerges from the coaction of cognitive, motor and perceptual processes. As Lalancette and Campbell (2012) explain, if one considers the mind and the brain as different elements of the same

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unit, the mind-brain, one avoids falling into a mentalist or materialist logic of subjective experience. Another novel proposal is that of Gerdes, Tegeler and Lee (2015), who recommend a change of perspective towards an allostatic neuroeducation, suggesting a constructivist revision of neuroscientific optics considering the novel biological concept of allostasis. This, in contrast to homeostasis, poses a possibility of remaining stable while being variable. Although it is still early to evaluate the reception of these latest proposals, they are innovative alternatives that must be considered.

Ultimately, as explained by Horvath and Donoghue (2016), consensus tends towards the adoption of at least one mediator, psychology, concluding that the direct translation between neuroscience and education is a chimera. Some, like Andrade (2006), had already glimpsed this quality of intercessor of psychology in other branches such as pedagogy or the philosophy of education. Although the discrepancy between explanatory levels and the proliferation of neuromyths have evidenced the need for at least one intermediary between education and neurosciences, its function is not clearly explained nor how its integration into the neuroeducational project is conceived. On the one hand, there is the analogy of the Bruerian bridge that, more than an explanation, is an intuitive and attractive metaphor. On the other hand, there is the argument of mediatization or translation that, although more developed, tacitly implies that neuroscientific knowledge, as raw material, must be processed through psychology before being used by educators. For the sake of formalizing this new discipline, it is not imperative to think, but to rethink, how the associated elements should interact beyond the materiality of the facts.

The metaphor of the bridge and the translation argument are unsustainable because they are based on a linear model of simple, unrealistic and limiting interactions. These respond perfectly to the treatment that in the literature has been given to neuroeducation. Since its inception, neuroeducation has been seen as a mixture, this is a substance formed from two or more components joined, but not effectively combined. In other words, it is understood that their elements have not reacted with each other, so they retain their identity and individual properties. This outlook relegates neuroeducation to the field of subdisciplines, with no option to develop independently or outside the limits of its constituents. If this were the case, it would suffice to theoretically justify a strategic alliance between the two sciences, without delving into the intricate relationship between them. Granted that this is not the case, a transliteration of the colloidal system of chemistry can be useful in conjecturing an alternative.

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If something is clear in the literature is that the two primary components of neuroeducation are immiscible, as they are unable to integrate homogeneously due to their discrepancies. Therefore, it is necessary to discard the idea of a perfect combination and embrace the possible alternative. In chemistry, the addition of a third agent in emulsifying function is possible to disperse one component in another, managing to integrate two immiscible substances. Under this example, neuroeducation would be a more or less stable union between neuroscience and education, using psychology not as an addition, but as an emulsifying agent that enables incorporation. Neuroeducation is not a linear process of transmission or translation, but, as in practice and in the colloidal system, its elements intimately interfere, dissipating the real or imaginary divisions between the two. In this way, one can escape from the simplistic views of neuroeducation and conceive a more realistic interaction between its components.

Thus, the question of De Vos (2016) on the *place* of education can be reformulated in the sense of how much education there is in neuroeducation. As the first question was asked about the presence or absence and not the precise location of education, the reformulation of the question about how much does not ambition a quantitative response but a relative one. If neuroeducation is the moderately consolidated aggregation of education and neurosciences, there must be a proportion. Returning to the previous example, the emulsion process is summarized as the dissolution of one constituent in another due to the emulsifying action; however, the nature of the resulting substance changes not only due to the proportionality of the components, but also to the affinity of each with the emulsifier. Under the same rule, neuroeducation is not only updated according to the relative proportion of education and neurosciences, but also according to the affinity of each one with psychology.

Once the union is achieved, there is still one final dilemma to solve. Education contains two aspects, one descriptive and the other normative, which neuroeducation must assume. The first, easy to agree, focuses on studying the teaching contexts and the learning experiences of the students in order to understand, in depth, the educational process; however, the second aspect, that which seeks to establish principles and procedures that guide the objectives of education by determining an ideal, is infinitely more problematic. For Nouri (2016), the crux of the matter is that the normative aspect limits the descriptive one, since the dominant ideology determines what type of learning is considered educational or not, distinguishing it from mere training, propaganda or indoctrination. Therefore, as stated by Koetting and Malisa (2004), every educational ac-

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tion requires a decision of a priori preference for certain values and human goals over others, which not only directs its practice but defines it in itself. Nieves (2017) and Collado (2017), in their respective works, would indirectly address this issue from different approaches.

Just as education cannot be a morally neutral enterprise, neither does neuroeducation, while it assumes the task of the first. However, to consider that all the properties that are ascribed to education are directly inherited by neuroeducation results, in the best of cases, in theoretical incongruity. Therefore, it is assumed that the axiological component of education is intrinsic in its subject, while in neuroeducation it is not, and the latter must justify such authority for itself. This effort is made under the term neuroethics that, according to Lalancette and Campbell (2012), despite being coined for the first time to refer to bioethics applied to the brain, today deals with intimate issues of our understanding of what we make us humans and exposes deep-rooted preconceptions about the mind and brain relationship. Moreover, it must show that neuroeducation, under the conditions previously discussed, can be entrusted with the transcendental norm of regulating the transmission of culture.

According to Clark (2013), Hume had already raised the impossibility of deriving a prescriptive conclusion from a body of descriptive statements since one or more normative premises would be needed. Neuroeducation frequently passes from "being" to "must be" without admitting the logical inadmissibility of that or without recognizing the arbitrary introduction of a normative component. Understanding that the neurosciences, by the formal nature of their discipline, do not involve normative aspects, then the latter must be of education, psychology or, failing that, psychologized education. If neuroeducation, in fact, is governed by the ethics of education, the latter must adapt to contemplate the new project. Finally, two hypotheses stand: either neuroeducation assumes normative premises of psychology or assumes an education a priori psychologized.

For critics of psi knowledge, among them Mulvale (2016), the individualistic tendencies of psychology and its singular capacity to produce subjects accommodated to the demands of a system, making use of the credibility enjoyed by science, convert it in a formidable ideological apparatus and to psychologists, in architects of the preservation of the status quo. Therefore, for Rodríguez (2016), psychology, more than a science or scientific discipline, is "a technique provided with a discourse that justifies its performance at the service of society" (p.106). Inasmuch as it is associated in one way or another with education and taking part in the

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process of transmission of culture, not only its reach grows exponentially, but also its possibility of participating in the cultural industries.

Paradoxically, the central concerns of the neuroeducational project do not seem to revolve around education or the neurosciences, but rather to that behind-the-scenes tertiary. Neuroeducation was presented as the panacea of the educational field, promising to break with the hegemonic predominance of psychological discourse in education and to ratify the scientificity of educational research. Through this new discipline, education was expected to transcend the theoretical limits challenged by psychology and to de-psychologize the school. However, the consensus about the new discipline not only rescues the crucial role of psychology in neuroeducation, but also highlights it as the only adherent capable of enabling the interdiction of the other components. Based on the above, the neuroeducational role falters and its promises seem to become threats. What is even more worrisome is that psychology, as De Vos (2015) puts it, is more than a problematic element.

From psychologization to neurologization: the rebirth of psi criticism

According to Purdy and Morrison (2009), Wittgenstein asserts that any initiative to map the exact nature of the mental apparatus is doomed to fail because it pretends to apprehend an ulterior process supposedly hidden behind visible manifestations, but at best, it only finds concomitants of the sought trait. An example cited by Castorina (2016) is that cognitive neurosciences tend to confuse psychological connections with neurophysiological connections or, better said, mental activity with brain activity. Brain imaging techniques are the guarantee of objectivity of neuroscientific research. In a standard case, says Clark (2013), participants are asked to perform certain cognitive tasks, such as reading or writing, and the associated neural activity is recorded. However, Álvarez (2013) recognizes that data, collected and summarized in numerical factors, refers to a physical variable; nevertheless, however accurate it may be, it remains insignificant until a theoretical framework is added to give it meaning. De Vos (2016, p.9) asks "what is a marker of brain activity? What is a meaningful activity? How are the brain areas and their limits defined?".

In the words of Smeyers (2016), all that is observable are the neural correlates of mental activity, not the mental activity itself. De Vos (2015) agrees that neurosciences can show silent images of chemical and electri-

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cal reactions in the brain, but no matter how much one must measure, count and record, there is nothing to know. That recorded is a set of points that only make sense when paired with psychological constructs, such as self-esteem, depression or anxiety. However, these categories are not neutral, because they contain normative presuppositions conditioned by particular sociohistorical configurations. Moreover, its veracity or, rather, its general acceptance by the psychological community depends on its adherence to the prevailing frame of reference of the time. Even the most studied and popular theoretical constructs have undergone serious conceptual transformations.

For example, until the end of the last century, experimental psychologists considered that simple sensory processes constituted the essence of intelligence and measured them using a collection of bronze instruments, as explained by Gregory (2012). With the advent of psychometrics, intelligence became a unitary group that brings together different capacities such as judgment, understanding and reasoning. Each model or theory of the mind, from the computational to the connectionist, advocated its own definition of intelligence and, in turn, its own preferred methodology. Finally, innumerable theories will be developed, among which the bifactorial, multifactorial, Triarchic and Gardnerian stand out. If anything proves this brief passage through the history of intelligence is that dissension is a constant in the psychological community. Arriving at a consensual definition, with this or any other psychological construct, is not an easy task and even if such a level of acquiescence was achieved, it would only be temporary and not absolute.

The contemporary psychologist assumes that using psychometric evaluations it is possible to reliably quantify almost any psychological characteristic of an individual. This underlying feature, which apparently exists without mediation in nature, is reified by making excessive and indiscriminate use of statistical techniques as if they were irrefutable evidence. In the same way, the neuroscientist starts from the premise that his observations, extracted with sophisticated brain imaging instruments, are faithful correspondents of certain defining psychological characteristics, obviating the fact that the former are physiological indicators and the latter, hypothetical constructs. The subjective reality of the individual is reduced to a set of arbitrary measurements whose relationship with the trait to be studied is temporary and, in addition, conventional. Cognitive neurosciences can only offer knowledge about the neural concomitants of thought, but not about thought itself. Authors from Purdy and Morrison (2009) to Lowe, Lee and Macvarish (2015) agree on that. De Vos

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(2016) summarizes affirming that it is neuroscientific research that can not get rid of its psychological inheritance, because it works based on foreign concepts and is structurally incapable of detaching itself from the psi paradigm.

Once the deep relationship between psychology and neuroscience is established, the irruption of the neuro in the culture ceases to seem a strange phenomenon for history. Neurocentrism, neuroculture, neuromania and neurophilia, all terms that refer to a fascination, obsession, exaltation and propagation of the neuro have their parallels in past and contemporary psi criticism. The concept of psychologism, as proposed by Mulvale (2016), already pointed out, in general terms, the tendency of discourse and psychological practice to extend beyond the limits of the academy to permeate other areas of study and daily life in itself. Psychologization, on the other hand, referred to the process in which psychological theories become central in our new attempts to understand ourselves, others and the world, resulting in a fundamental change of modern subjectivity, as De Vos explains (2015). Just as the theoretical, technological, economic and biopolitical mutations in past decades allowed psychology to escape the limits of the laboratory and permeate the outside world, Rose and Abi-Rached (2013) affirm that the current situation has opened its doors to neuroinvasion.

On the one hand, it could be argued that the invasive behavior of the neuro is analogous to that of the psi. Alternatively, it is possible to rethink the neuro not as an independent stage, but as an evolution or extension of the psi discourse. Following Mulvale (2016), psychology is the favorite science to apprehend all that scientific materialism cannot: the human, the meanings, the moral and the spirit; but by encompassing everything inherently human, it also becomes a prism for experiencing life. At present, says De Vos (2008), psychology is so prevalent that it operates in invisibility, asserting itself as a direct and pure reality from which there seems to be no escape: postmodern man is the *homo psychologicus* living in an a priori psychologized habitat, this habitat is the ideology, as defined by Althusser (1988), an imperceptible representation of the imaginary relationship of individuals with their real conditions of existence that, due to their transhistorical condition, can vary in content, according to particular sociohistorical formations of an era, but whose function remains unchanged.

The treatment of psychology not as a science or technique, but as an ideology, opens the possibility of understanding its historical transmutation. According to Rodríguez (2016), Canguilhem had already ar-

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Print ISSN: 1390-3861 / Electronic ISSN: 1390-8626, pp. 139-166.

gued that psychology understood as a natural science would eventually lead to a psychology of neurophysiological basis. This prediction would go hand in hand with that of Cassirer, who in 1927 affirmed that psychologism had not been defeated and that, although different in form and justification, it could reappear under new appearances, according to research by Mulvale (2016). Finally, when Husserl referred to psychology as a permanent calamity, Rodríguez (2016) hypothesizes that he may have been attending to its transhistorical nature. Presenting the case, it would not be premature to argue that neurosciences are, in fact, a new and reconfigured expression of psychological knowledge, adapted to contemporary society in its postmodern, scientistic and infatuated by the seductive promises of technocapitalism.

In this case, neuroeducation is not an alternative to psi colonization but a return to it, a return to the psychological discourse that has historically dominated education. This criticism is succinctly expressed in the ingenious title of the article by De Vos (2015): *Deneurologizing Education? From Psychologisation to Neurologisation and Back*. Therefore, psychologism and psychologization would be more than mere conceptual antecedents of neurologism and neurologization but would be their direct genealogical predecessors. The implementation of neuroscientific knowledge in school curricular reforms would not be a substitution of one discourse for another, but an update. Moreover, the introduction of neuroeducational teaching strategies in the classrooms would not empower the educator, but to reenact that first psi invasion of the school. The fundamental question posed by De Vos (2015) is: What changes in education when the predominant psychological discourse is replaced by the neuroscientist? The answer proposed here is that the psi has not been and will not be replaced by the neuro, since the latter is no more than a phenomenal extension of the first. The biologicist, ultrapositive and neurological facade that accompanies the neuroeducational project is nothing more than that, a fragile countenance. Beyond the formal, the psi discourse remains as valid, vigorous and hegemonic as ever.

The stage of colonization went without opposition of education that, by omission, has accepted the psi dominance of its epistemological space. Thus, the plea of Grace (2018), on the dependence on education, or that of De Vos (2016), on the pervasiveness of psychology, the effects of psycho-neuro-logization in the school are already evident and there are reasons to think that they could increase. For example, if as Solé and Moyano (2017) we affirmed that the model of academic and investigative knowledge of psychology was already causing a "asphyxia of thought" in

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the educational field, marginalizing "any singular and practical experience of thought that is not circumscribed to laboratory research or to the excesses of statistical evaluation" (p. 102), then the neuroscientific paradigm will cause hypoxia. Neuroscientific research, because of its quantitative obsession, cannot distinguish between qualitatively dissimilar elements nor admit variables that do not operate, in the numerical sense, on a quantum of learning, thus reducing the intricate interrelation of school factors to a few ineffective measurements.

For Mulvale (2016), the intrusion of the neuro would also affect the lines of educational research, bringing the possibility that the topics distance themselves from their social nature to respond directly to those issues that are more relevant to institutionalized power. De Vos (2015) goes further and asks if neuroeducation will not be the instrument that will eventually commercialize the school. On this, there have already been, if not concrete examples, several warnings that iterate on possible and existing fraudulent neuroeducational interventions marketed directly to educators, such as those presented by Howard-Jones (2014b) and Jorgensson (2003). Along the same lines, several critics have denounced the already existing over-medicalization of school problems, but Rose and Abi-Rached (2013) hypothesize that, under the paradigm of neuroeducation, the pharmaceutical industry can redouble its influence in the diagnostic system of learning disorders and promote, even more, the use of neuropharmaceuticals as the first line of intervention for behavioral problems. These possible threats are not novel, they were present before the arrival of the neuro and the latter only increase. So, faced with the permanence of the psi and the imminence of the neuro, the question, before fundamental and now urgent, is: what should change in education with an approach to neuroeducation?

For Solé and Moyano (2017), the generalized expansion of psychology and neurosciences are, ultimately, "emptying the school and other educational contexts of their pedagogical function, that is, the exercise of their responsibility in the generational chain and the construction of social affiliation" (p. 102). For this reason, it is essential to rescue Hurtado and Giraldo (1992), who affirmed that it is necessary for the educator to assume a professional identity and generate his own knowledge, legitimized in his experience and practice, which allows him to overcome the intellectual dependence on other areas and the stagnation of the discipline itself. However, education is not only the responsibility of the teacher, but also of anyone who makes education a science: neuroscientists, psychologists, neuroeducators and especially, philosophers of education. Due to

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their unique condition, the task of the latter is to open a space outside the ideologies from which they can be criticized, therefore, they must contribute to the imperious debate on the philosophical problems that are generally ignored by those who are not critically engaged to this field. In this last field, it is already possible to see the work of Clark (2013), De Vos (2015) and Mulvale (2016).

Contrary to the proposal of Solé and Moyano (2017), this article does not advocate a "return of the educational function to face this discourse and (...) establish a new pedagogical contract capable of overcoming psychologism" (p.102). For Hurtado and Giraldo (1992), the vindication of the educational sciences cannot be done ignoring the valuable contributions of the other disciplines but allowing their interdiction and becoming a place for themselves. Although the question, at some point, was whether neuroeducation can work in a stable manner under all the contingencies that make up its situation, the answer today is clear and forceful: neuroeducation is here to stay. Despite all the criticism, its influence on the educational environment, public policy and society in general continues to grow exponentially. Once learning is re-linked to culture, educational spaces are reconquered, and teachers are ideologically aware of their agency in the future of the school, then education will be able to recognize itself as an autonomous and eminently integrating knowledge where inter-didactically converge various disciplines, without being diluted by these and without prejudice to their own independence.

Conclusion

Based on the arguments previously discussed, it can be concluded that: neuroeducation is already an incontrovertible fact and not a contingent possibility. This does not imply the overcoming of psychological discourse, but its ratification, either as a structural agent that enables cohesion or as an inalienable inheritance of education and neurosciences; and that it is not enough to acknowledge its various achievements, but rather that its urgency must be prudently assumed. At this point, any initiative that seeks to stop or even restrain the persistent progress of neuroeducation is doomed to failure. This is the effect of a complex plot of sociohistorical motivations that, like a system of gears, only responds its own march. The analysis of those motivators, which date long before the psi colonization and merits a deep transdisciplinary study, can give meaning to the present transformations and timidly glimpse possible future scenarios.

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Therefore, it is necessary to redirect the efforts of the unfruitful opponents to reflective analysis, which in sum will be beneficial for all the areas involved. This requires, of course, substantial changes in the way in which the issue has been addressed. In the first instance, one must stop at once with the excessive prophecy regarding the potential of neuroeducation, starting with the too ambitious and premature promises that revolve around the project. Most of these, as mentioned in the literature, are so general that they border on being propaganda or are unfounded, so they could even be false. Then, it is urgent to abandon the simplistic models, such as the metaphor of the bridge and the structure of mediation-translation, by more realistic ones that favor a sensible, holistic and organic perspective. Finally, any plan to educate in which education is not present is, in the best of cases, a disappointment and at worst, a danger.

The neuroeducation project should not, even if it could, continue until the educators are not in the vanguard, directing the development of the incipient discipline. These merits, in addition to a solid identity as practitioners of such a historical and transcendental discipline, a sense of belonging to one's own knowledge and praxis. By logic, this previous step is the only one that enables the educator's agency in the future of education, empowering themselves in their direction. Ultimately, it is up to the educator to take a stand in front of the contemporary ideology that threatens it, despite the paradox involved in looking for a space in what is ubiquitous in concept. It is at this moment, when efforts seem futile in the face of the inevitability of the future, that the task of criticizing using philosophical tools becomes the quintessential mode of resistance.

Bibliography

ALTHUSSER, Louis
1988 *Ideología y aparatos ideológicos del Estado. Freud y Lacan*. Buenos Aires: Nueva Visión.

ÁLVAREZ, Martha
2013 La neurociencia en las ciencias socio-humanas: una mirada transdisciplinar. *Ciencias Sociales y Educación, 2*(3), 153-166.

ANDRADE, Ximena
2006 El lugar de la psicología en la filosofía de la educación: Superando la visión behaviorista de la psicología. *Sophia: Colección de Filosofía de la Educación 1*(1), 154-183.

ANSARI, Daniel, DE SMEDT, Bert & GRABNER, Roland
2012 Neuroeducation. A Critical Overview of An Emerging Field. *Neuroethics, 5*(2), 105-117.

© Universidad Politécnica Salesiana del Ecuador
Print ISSN: 1390-3861 / Electronic ISSN: 1390-8626, pp. 139-166.

BATTRO, Antonio, FISCHER, Kurt & LÉNA, Pierre
2008 *The Educated Brain: Essays in Neuroeducation.* Cambridge: Cambridge University Press.
BLEGER, José
1983 *Psicología de la conducta.* Madrid, España: Paidos.
BOWERS, Jeffrey
2016 The Practical and Principled Problems With Educational Neuroscience. *Psychological Review, 123*(5), 600-612.
BRUER, John
1997 Education and the Brain: A Bridge Too Far. *Educational Researcher, 26*(8), 4-16.
CAMARGO, Edson & GENIOLE, Débora
2018 Neuroeducação, dislexia e dificuldades de aprendizagem: princípios, implicações pedagógicas e curriculares. *Revista de Pós-graduação Multidisciplinar, 1*(2), 167-178.
CAMPBELL, Stephen & PAGÉ, Pierre
2012 La neuroscience éducationnelle: enrichir la recherche en éducation par l'ajout de méthodes psychophysiologiques pour mieux comprendre l'apprentissage. *Neuroéducation, 1*(1), 115-144.
CAREW, Thomas & MAGSAMEN, Susan
2010 Neuroscience and Education: An Ideal Partnership for Producing Evidence-Based Solutions to Guide 21. *Neuron, 67*(5), 685–688.
CARGNELUTTI, Elisa, TOMASETTO, Carlo & PASSOLUNGHI, María
2017 The interplay between affective and cognitive factors in shaping early proficiency in mathematics. *Trends in Neuroscience and Education, 8-9*, 28-36.
CASTORINA, José
2016 La relación problemática entre Neurociencias y educación. Condiciones y análisis crítico. *Propuesta Educativa*, (46), 26-41.
CHANGEUX, Jean
1997 *Neuronal Man. The Biology of Mind.* Princeton: Princeton University Press.
CIGMAN, Ruth & DAVIS, Andrew
2009 *New philosophies of learning.* Chichester: Wiley-Blackwell.
Clark, John
2013 Philosophy, Neuroscience and Education. *Educational Philosophy and Theory*, 1-11.
CODINA, María
2014 Neuroeducación: reflexiones sobre neurociencia, filosofía y educación. *Postconvencionales: ética, universidad, democracia*, (7-8), 164-181.
COLLADO, Javier
2017 Reflexiones filosóficas y sociológicas de la educación: un abordaje paradigmatológico. *Sophia: Colección de Filosofía de la Educación, 23*(2), 55-82.
CORREDOR, Karen & CÁRDENAS, Fernando
2017 Neuro- 'lo que sea': inicio y auge de una pseudociencia para el siglo XXI. *Revista Latinoamericana de Psicología, 49*(2).
CRIFACI, Giulia, CITTÁ, Guisseppe, RASO, Rossella, GENTILE, Manuel & ALLEGRA, Mario
2015 *Neuroeducation in the light of Embodied Cognition: an innovative perspective. Recent Advances in Educational Technologies.* International Conference on Education and Modern Educational Technologies (EMET2015), at Zakynthos Island, Greece.

Sophia 26: 2019.
© Universidad Politécnica Salesiana del Ecuador
Print ISSN: 1390-3861 / Electronic ISSN: 1390-8626, pp. 139-166.

CRIVELLATO, Enrico & RIBATTI, Domenico
2007 Soul, mind, brain: Greek philosophy and the birth of neuroscience. *Brain Research Bulletin, 71*, 327-336.
DE VOS, Jan
2008 From Panopticon to Pan-psychologization or, Why do so many women study psychology? *International Journal of Žizek Studies, 2*, 1-20.
2012 *Psychologisation in Times of Globalisation.* Nueva York: Routhledge.
2014 The Death and the Resurrection of (Psy)critique: The Case of Neuroeducation. *Foundations of Science, 21*(1), 129-145.
2015 Deneurologizing Education? From Psychologisation to Neurologisation and Back. *Studies in Philosophy and Education, 34*(3), 279-295.
2016 ¿Dónde está la educación en la neuroeducación? *Teoría y Crítica de la Psicología,* 1-16.
EHRENBERG, Alain
2004 Le sujet cerebral. *Espirit, 309,* 130-155.
FERRERO, Marta, GARAIZAR, Pablo y VADILLO, Miguel
2016 Neuromyths in education: Prevalence among Spanish teachers and an exploration of cross-cultural variation. *Frontiers in Human Neuroscience, 10.*
FLOBAKK, Fride
2016 Educational Neuroscience and Reconsideration of Educational Research. *Pedagogika, 66*(6), 654–671.
FRAZZETTO, Giovanni & ANKER, Suzanne
2009 Neuroculture. *Nature Reviews Neuroscience,* 815-821.
GAZZANIGA, Michael
2006 *El cerebro ético.* Barcelona: Ediciones Paidós.
GERDES, Lee, TEGELER, Charles y LEE, Sung
2015 A groundwork for allostatic neuro-education. *Frontiers in Psychology, 6,* 1-16.
GRACIA, Javier
2018 El fin ético no naturalista de la neuroeducación. *Recerca, Revista de Pensament i Análisi, 22*, 51-68.
GREGORY, Robert
2012 *Pruebas psicológicas: Historia, principios y aplicaciones.* México: Pearson Educación.
HAGNER, Michael
1997 *Homo cerebralis. Der Wandel vom Seelenorgan zum.* Berlin: Berlin Verlag.
HOOK, Cacey & FARAH, Martha
2013 Neuroscience for Educators: What Are They Seeking, and What Are They Finding? *Neuroethics, 6,* 331–341.
HORVATH, Jared & DONOGHUE, Gregory
2016 A Bridge Too Far - Revisited: Reframing Bruer's Neuroeducation Argument for Modern Science of Learning Practitioners. *Frontiers in Psychology, 7,* 1-12.
HOWARD-JONES, Paul
2014a *Neuroscience and Education: A Review of Educational Interventions and Approaches Informed by Neuroscience.* Londres: Education Endowment Foundation.
2014b Neuroscience and education: myths and messages. *Nature Reviews Neuroscience, 15*(12), 817-824.

© Universidad Politécnica Salesiana del Ecuador
Print ISSN: 1390-3861 / Electronic ISSN: 1390-8626, pp. 139-166.

HOWARD-JONES, Paul *et al.*
2016 The Principles and Practices of Educational Neuroscience: Comment on Bowers (2016). *Psychological Review, 123*(5), 620-627.
HUETTIG, Falk, KOLINSKY, Régine & LACHMANN, Thomas
2018 The culturally co-opted brain: how literacy affects the human mind. *Language, Cognition and Neuroscience, 33*(3).
HURTADO, Rubén & GIRALDO, Juan
1992 Psicologización en la enseñanza. *Revista Educación y Pedagogía, 3*(7), 155-166.
IBÁÑEZ, Agustín, SEDEÑO, Lucas & GARCÍA, Adolfo
2017 *Neuroscience and Social Science: The Missing Link.* Dordrecht: Springer.
IM, Soo-hyun, CHO, Joo-yun, DUBINSKY, Janet & VARMA, Sashank
2018 Taking an educational psychology course improves neuroscience literacy but does not reduce belief in neuromyths. *PLoS ONE, 13*(2), 1-19.
JORGENSSON, Olaf
2013 Brain scam? Why educators should be careful about embracing 'brain research'. *The Educational Forum, 67*(4), 364-369.

KOETTING, Randall & MALISA, Mark
2004 Philosophy, research and education. En D. Jonassen, *Handbook of Research for Educational Communications and Technology: A Project of the Association for Educational Communications and Technology* (pp. 1009-1020). New Jersey: Association for Educational Communications and Technology.
LALANCETTE, Helene & CAMPBELL, Stephen
2012 Educational neuroscience: Neuroethical considerations. *International Journal of Environmental & Science, 7*(1), 37-52.
LLOYD, Aeron
2015 *Mental Health fo the Everyman: World War II's Impact on American Psychology*. Washington: History Undergraduate Theses.
LOWE, Pam, LEE, Ellie y MACVARISH, Jan
2015 Biologising parenting: neuroscience discourse, English social and public health policy and understandings of the child. *Sociology of Health & Illness, 37*(2), 198-211.
MACDONALD, Kelly, GERMINE, Laura, ANDERSON, Alida, CHRISTODOULOU, Joanna & MCGRATH, Lauren
2017 Dispelling the Myth: Training in Education or Neuroscience Decreases but Does Not Eliminate Beliefs in Neuromyths. *Frontiers in psychology, 8*(13-14), 1-16.
MARINA, José
2012 Neurociencia y Educación. *Participación Educativa, 1*(1), 7-14.
MARKANT, Douglas, RUGGERI, Azzurra, GURECKIS, Todd & XU, Fei
2016 Enhanced Memory as a Common Effect of Active Learning. *Mind, Braind and Education, 10*(3), 142-152.
MAVILIDI, Myrto, OKELY, Anthony, CHANDLER, Paul & PAAS, Fred
2016 Infusing Physical Activities Into the Classroom: Effects on Preschool Children's Geography Learning. *Mind, Brain and Education, 10*(4), 256-263.
MAYER, Richard
2001 What Good is Educational Psychology? The Case of Cognition and Instruction. *Educational Psychologist, 36*(2), 83-88.

© Universidad Politécnica Salesiana del Ecuador
Print ISSN: 1390-3861 / Electronic ISSN: 1390-8626, pp. 139-166.

MULVALE, Sussanah
2016 *From psychologism to psychologization: Beyond the boundaries of the discipline and practice of psychology.* Toronto: Universidad de York.
NIEVES, Gerardo
2017 Hannah Arendt y el problema de la educación. *Sophia: Colección de Filosofía de la Educación, 23*(2), 219-235.
NOURI, Ali
2016 The basic principles of research in neuroeducation studies. *International Journal of Cognitive Research in Science, Engineering and Education, 4*(1), 59-66.
NOURI, Ali & MEHRMOHAMMADI, Mahmoud
2012 Defining the Boundaries for Neuroeducation as a Field of Study. *Educational Research Journal, 27*(1-2), 1-25.
ORTEGA, Francisco
2009 The Cerebral Subject and the Challenge of Neurodiversity. *BioSocieties, 4*, 425-445.
ORTEGA, Francisco & VIDAL, Fernando
2007 Mapping the cerebral subject in contemporary culture. *Electronic Journal of Communication, Information & Innovation Health, 1*(2), 255-259.
PALLARÉS-DOMÍNGUEZ, Daniel
2016 Neuroeducación en diálogo: Neuromitos en el proceso de enseñanza-aprendizaje y en la educación moral. *Pensamiento, 72*(273), 941-958.
PAPADATOU-PASTOU, Marietta, HALIOU, Eleni & VLACHOS, Filippos
2017 Brain knowledge and the prevalence of neuromyths among prospective teachers in Greece. *Frontiers in Psychology, 8*(804).
PATTEN, Kathryn & CAMPBELL, Stephen
2011 Introduction: Educational neuroscience. *Educational Philosophy and Theory, 43*(1), 1-6.
PICKERING, Susan & HOWARD-JONES, Paul
2008 Educators' views on the role of neuroscience in education: Findings from a study of UK and international perspectives. *Mind, Brain, and Education, 1*(3), 109-113.
PURDY, Noel & MORRISON, Hugh
2009 Cognitive neuroscience and education: unravelling the confusion. *Oxford Review of Education, 35*(1), 99-109.
RODRÍGUEZ, Roberto
2016 *Contrapsicología. De las luchas antipsiquiátricas a la psicologización de la cultura.* Madrid: Ediciones Dado.
ROSE, Nikolas
2003 The neurochemical self and its anomalies. En R. Ericson (Ed.), *Risk and Morality* (pp. 407-437). Toronto: University of Toronto.
ROSE, Nikolas, y ABI-RACHED, Joelle
2013 *Neuro: The New Brain Sciences and the Management of the Mind.* Nueva Jersey: Princeton University Press.
SAMUELS, Boba
2009 Can the difference between education and neuroscience be overcome by mind, brain, and education? *Mind, Braind and Education, 3*(1), 45-55.

Sophia 26: 2019.
© Universidad Politécnica Salesiana del Ecuador
Print ISSN: 1390-3861 / Electronic ISSN: 1390-8626, pp. 139-166.

SILVA, Divino & FERNANDEZ, Alexandre
2016 A emergência do sujeito cerebral e suas implicações para a educação. *Childhood & Philosophy, 12*(24), 211-230.
SMEYERS, Paul
2016 Neurophilia: Guiding Educational Research and the Educational Field? *Journal of Philosophy of Education, 50*(1), 62-75.
SOLÉ, Jordi & MOYANO, Segundo
2017 La colonización Psi del discurso educativo. *Foro de Educación, 15*(23), 101-120.
STIX, Gary
2011 How to be a better learner. *Scientific American, 305*(2), 50-57.
TOKUHAMA-ESPINOSA, Tracey
2013 *The new science of teaching and learning: Using the best of mind, Brain and Education Science in the classroom.* Nueva York: Columbia University Teachers College Press.
VIDAL, Fernando & ORTEGA, Francisco
2017 *Being Brains: Making the Cerebral Subject.* Nueva York: Fordham University Press.
ZADINA, Janet
2015 The emerging role of educational neuroscience in education reform. *Psicología Educativa, 21*, 71-77.

Date of receipt of document: July 19, 2018
Date of document review: August 20, 2018
Date of document approval: September 22, 2018
Date of publication of the document: January 15, 2019

Sophia 26: 2019.
© Universidad Politécnica Salesiana del Ecuador
Print ISSN: 1390-3861 / Electronic ISSN: 1390-8626, pp. 139-166.