

KEY POINTS BETWEEN NEUROSCIENCE AND EDUCATION FROM THE “EMBODIED COGNITION PERSPECTIVE”

ASPETTI-CHIAVE TRA NEUROSCIENZE ED “EDUCATION” NELLA PROSPETTIVA DELL’EMBODIED COGNITION

Paola Damiani¹

University of Turin
paola.damiani@unito.it

Filippo Gomez Paloma²

University of Macerata
filippo.gomezpaloma@unimc.it

Abstract

Our work is part of the debate on the possible relationships between neuroscience and education, with reference to the close interrelationship between developmental and educational processes and the assumption of the transversality of bodily, emotional and relational dimensions, with particular attention to situations of fragility and diversity. Starting from the analysis of some contributions in the literature (Rushton, Larkin 2001, Gomez Paloma, 2009), this paper proposes a reinterpretation of the principles of neuroscience recognised for their heuristic and applicative potential in the educational and didactic field, with the purpose of identifying an updated, coherent and functional reference framework for the implementation of an inclusive and effective school model. The Embodied Cognitive Science (ECS) approach and the model of ECS-based schools (Gomez Paloma, Damiani, 2021) constitute a framework for the valorisation of the principles identified and for their implementation in the current school context.

Il nostro lavoro si inserisce nel dibattito sulle possibili relazioni tra neuroscienze e didattica, con riferimento alla stretta interrelazione tra processi evolutivi ed educativi e all’assunzione della trasversalità delle dimensioni corporee, emotive e relazionali, con particolare attenzione alle situazioni di fragilità e diversità. Partendo dall’analisi di alcuni contributi della letteratura (Rushton, Larkin 2001, Gomez Paloma, 2009), si propone una rilettura dei principi delle neuroscienze riconosciuti per le loro potenzialità euristiche e applicative in ambito educativo e didattico, con lo scopo di identificare un quadro di riferimento aggiornato, coerente e funzionale per la realizzazione di un modello scolastico inclusivo ed efficace. L’approccio della Embodied Cognitive Science (ECS) e il modello delle scuole basate sull’ ECS (Gomez Paloma, Damiani, 2021) costituiscono un dispositivo per la valorizzazione dei principi individuati e per la loro implementazione nel contesto scolastico attuale.

Keywords

1 Author of Paragraphs 1 and 2
2 Author of Introduction

Introduction

As it has been broadly stated in the call of this important monographic issue, and widely highlighted by the rich and varied contributions discussed during the REN Conference, in the last few years we are witnessing an increasing number of multi- and interdisciplinary studies and researches based on the idea that neurosciences can support the development of new approaches and methodologies, according to emerging needs and complex contexts. These motivations are highly relevant and necessitate a systematic and shared time and method, also at the level of the scientific community, to reflect on such richness and perspectives, which, like all new frontiers of knowledge, are not free of risks and criticalities.

Within this scenario, a research project has been launched in Italy to systematise and test some theoretical and methodological assumptions, aimed at “rethinking teaching” in the light of the evidence of neuroscience and Embodied Cognition, in particular. The ultimate and ambitious aim is to encourage the “construction of projects aimed at the wellbeing of people in the organisational, recreational and cultural spheres”, starting from the improvement of the quality of the learning and participation processes of everyone (students and teachers first and foremost).

Our work is part of the debate on the possible relationships between neuroscience and pedagogy and neuroscience and didactics, with reference to the interconnection between evolutionary and educational processes and the assumption of the transversality of bodily, emotional and relational dimensions, with particular attention to situations of fragility and diversity of the students.

The Embodied Cognition paradigm has inherited the phenomenological tradition (Husserl; Merleau-Ponty) and incorporates recent contributions from neuroscience in understanding the processes of development and understanding of people and the world. The body is the basis on which the world and the intellectual and emotional relational processes rest: “in order for the other not to be a vain word, it is necessary that my existence is not reduced to the consciousness that I have of existing, but must also involve the consciousness that one can have, and therefore my embodiment in a nature and the possibility of a typical situation (Merleau-Ponty, 2005, p. 21).

This challenge, which is still underestimated in the educational and didactic sphere in its operationalisation and systematisation, is represented by the improvement of the quality of the school through the prevention of school failures and difficulties, the development of talents and the promotion of the well-being of each pupil (and their teachers as well). This is a rather challenging aim that has to be read from a relational-systemic perspective: working towards the improvement of one aspect contributes to the improvement of all the others. The relevance and cogency of the dimensions involved (learning, differences, talents, well-being, co-development), and the distance of most everyday school realities from these goals, justify the need to rethink the culture and educational and teaching practices in the light of current and enriched frameworks, which emphasise the many valuable elements already present in ministerial frameworks and, at the same time, can help to identify new aspects and prospects for improvement, based on scientific evidence. First-cycle schools (and even earlier the 0-3 year old childcare services) play a central role in this direction. In the context of recent neuroscience, the epigenetic perspective has demonstrated the power of environmental stimulation in the development of the human connectome (Burgio, Panisi, 2017); the timeliness and adequacy of environmental information - also in terms of methodological and didactic choices - can make a difference to the quality of health and learning and, consequently, to the possibilities of capacitation, freedom and happiness of individuals and the societies in which they live.

1. Embodiment come dispositivo formativo complesso in contesti complessi

The foundations of Embodied Cognition, which are now acknowledged in many scientific fields (Gallese, 2005; Barsalou, 2013; Clark, 2008; Borghi, 2013; Glenberg, 2016), are explored as resources for the enrichment and improvement of teaching (Lakoff Nunez, 2000; Abraham-

son, 2018), also from the perspective of Evidence Based Education (Fiorella, Mayer, 2015). The possibility of implementing effective didactics, based on evidence, and therefore able to facilitate the learning and participation processes of all learners, represents an essential feature of the inclusive approach. While the complexity of the concepts and processes involved can be problematic from an epistemological point of view and difficult to investigate in the transfer between neighbouring but different disciplinary fields, it also opens up perspectives and dimensions that would otherwise be destined to remain “missing” and traces hybrid spaces that can better represent the complexity and variability of educational processes and human functioning.

Embodiment constitutes the transversal key concept from which we have started to develop an EC-based educational approach. As Wilson and Golonka (2013) state,

“Like all good ideas in cognitive science, however, embodiment immediately came to mean six different things. The most common definitions involve the straight-forward claim that “states of the body modify states of the mind.” However, the implications of embodiment are actually much more radical than this. If cognition can span the brain, body, and the environment, then the “states of mind” of disembodied cognitive science won’t exist to be modified. Cognition will instead be an extended system assembled from a broad array of resources. Taking embodiment seriously therefore requires both new methods and theory” (p. 1.)

In our perspective, this can be usefully interpreted as an “extended process and relational context” consisting of mind - body - environment, and the relationships between them, and as such represents the primary context within which the educational and didactic process takes place (Gomez Paloma, Damiani, 2015; 2021). Knowledge of the mind (Extended Mind) can only take place in the context of its relationships with the body that interacts in the world (Wilson, 2000); more specifically, the body represents the primary mediator for development and learning in significant relational contexts (child-mother; child-family; child-school).

“Body and action emerge, in the embodied view, not only in the notions of body-consciousness and body-identity, but, also, in the constructs of learning, intelligence, memory, emotion (Fischer et al., 2007; Stern, 2005)” (Ceciliani, 2018). Taking up Merleau-Ponty’s conception (Embodiment as the perceptual experience of engagement of the body in the world), Gattario et al. (2020) highlight the multidimensional and situated valence of the construct:

“Merleau-Ponty conceived of embodiment as the “perceptual experience of engagement of the body in the world”, whereby “perceptual experience” referred to the meaningful interpretation of perceived experiences, always in relation to a particular location of the body in the world (Crossley, 1995; Merleau-Ponty, 1962). The body engages actively and meaningfully with its environment in ways that both derive from a range of cultural skills and schemas, and, concurrently, shapes cultural practices (Crossley, 1995; Merleau-Ponty, 1962) (...) this construct reflects attunement to inner states, captures a broad range of experiences, and addresses the reciprocal relationships between body and culture”.

The Embodiment paradigm therefore enables the complexity of the school context to be “crossed” by recognising differences and promoting the success of all pupils in specific situations; in synergy with the bio-psycho-social model assumed by the ICF international classification (WHO, 2001), the valorisation of the differences of people and contexts is facilitated, framed according to a holistic perspective.

The rethinking of teaching, and of schools in general, in the context of Embodiment outlines non-linear, reticular trajectories, which make it possible to understand the relationships between dimensions and phenomena and to work effectively for their improvement in the direction of the formation of each person in the (unique and original) relationship with the world. These trajectories are consistent with the directions outlined by the new scientific paradigms and the Unesco framework (2015), which identifies closely interrelated dimensions, at macro and micro level, between the system-world and the system-person, material, physical and mental (cf. Unesco Agenda, 2030). The educational, didactic and evaluative processes must work with/for the respect, enhancement and strengthening of all these dimensions; Embodiment represents a conceptual and methodological background able to help teachers to achieve this, even in the

current scenario, through the new forms of distance, integrated, digital education.

The emergency moment dictated by the Covid-19 pandemic constitutes a first experience for everyone, characterised by criticality and strong ambivalences, first of all that of a school that “despite everything is present” (even at a distance), through devices that break habits and reconfigure spaces, times and materiality, provided that the educational relationship (with the teacher and among peers) “holds”. In this sense, we are witnessing a reconfiguration of relational dynamics in the relationship between *on-life* and *off-life* (Floridi, 2020), in which technologies enter (also) in favour of the human, and not “in substitution” of the human, and enter with an educational and didactic task also outside the school. Recalcati (2021) reminds us that the School has always continued to be open despite being closed; according to the psychoanalyst, this aspect, as all teachers are well aware, represents a contradiction in terms because didactics implies as such the relationship, the presence of bodies, being together in a living community without the aseptic mediation provided by technology”. However, as we have already observed (Damiani, Gomez Paloma, 2021), embodied, deep relational dimensions - emotional, perceptual, sensory - “act and work” anyway, even through screens, in line with what is testified by teachers’ narratives and the first evaluations at ECS schools (Ibid.). Our hypothesis on Embodiment as background and glue for the educational relationship, in multiple and complex contexts, seems empirically supported by the “tightness” of the educational relationship in these last two years of “School in the time of Pandemic.”

What Recalcati asserts concerning the awareness of the educational role in the new scenario is of fundamental importance; counteracting the risk of *victimisation* with regard to the sacrifices and limits that pupils have to face is the ethical and educational gesture of those teachers “who spend themselves doing somersaults in order to make distance teaching stand up”. In this way, the centrality of the teacher’s role and relationship is reaffirmed even outside the usual training settings, even in emergency and unforeseen conditions, highlighting the essence of the educational professionalism in its bodily, mental and value multidimensionality (the “ethical and educational gesture”). This means, first of all, reinforcing awareness, attitudes and actions (competences) on the part of the adult educating community, of which teachers are the main actors, identifying “universal and solid” values and strategies in global and liquid contexts, able to orientate new forms of educational care through the care of embodied (physical and ethical) relationships, to preserve the (adult) quality of the encounter, regardless of the context and the means in/with which the relationship is realised. Being there mentally, being in relationship and seeing the other without authentic attention and interest, is an embodied existence even in the absence of the material body.

Embodied Cognition, based on a paradigm of “extended rationality” body-mind-environment, encompasses deep and hidden dimensions and generative and creative, ethical and aesthetic existential modes, which are the foundation of every educational relationship. In the context of Embodied Cognition, bodily and motor experience is characterised as an experience of integrated and global relational understanding, based on the interconnection of the different “basic” dimensions: body movement, movement representations, emotions, affections, perceptions, memories and thoughts, communicative rhythms, capable of favouring the construction of evolved and refined prosocial competences, “second level” such as admiration, trust and gratitude. Thoughts that develop in the brain can trigger emotional states, translated into action by the body; at the same time, the body can change the course of thoughts (Corona & Cozzarelli, 2012). It is not possible to separate parts of this experience, which is immersive, global, and therefore also includes aspects such as fear, envy, limitation, imperfection, but also wonder, amazement, gratitude, courage, artistic creation (favourable attitudes for facing the uncertain and coming out of crises).

Embodiment therefore constitutes a functional device for the ambitious aims set out above: promotion of the co-development of people and contexts, including critical and emergency contexts, through the improvement of teaching-learning processes, the development of capacitation processes, the emancipation of systems-person and world, the prevention of disorders and difficulties, the enhancement of differences and talents and the promotion of well-being.

2. Concepts, principles and guidelines to rethink the Embodied curriculum in an inclusive direction

Within this transdisciplinary scientific and cultural background, inclusion and effectiveness are two principles/values that, although “high and meta,” are not abstract, but strongly empirical and strategic. We will therefore illustrate some of the concepts, principles and orientations consistent with the Embodiment paradigm, declined as a device, at the basis of the model of Embodied Cognition Based Schools (ECS Schools).

2.1 L’Ambiente di apprendimento esteso (WEE)

Consistent with the biopsychosocial model, the learning environment is represented by the designation of different components such as objects, individuals, sociality, contexts and their culture. We have defined “*Wide ECS Environment*” (WEE) as the extended and integrated environment able to enrich and enhance the ECS school curriculum from a threefold perspective: personal (the internal environment including the mind-body of pupils and teachers); physical-material (including learning spaces, times and places such as indoor and outdoor environments); pedagogical-didactical (including all educational and didactic devices). The quality of the school and the educational success of its pupils are influenced by the characteristics of these elements and, above all, by the quality of the relationships between them. The characteristic aspect of the CSE perspective is the deep and continuous interconnection between all three dimensions (internal environment; physical environment; pedagogical environment) and their constituent elements; it is not possible to think of acting, organising, training and evaluating each of them in a clearly separate way, as every change produces effects at all levels.

In line with the ICF model (WHO, 2001; 2007), the key element is the integrated and interconnected context of personal and environmental factors. The context represents “the inseparable whole of objects, smells, sounds, colours and people who inhabit it and relate to it in and with it in a background that contains everything” (Borghi, 2015, p. 119). It represents the physical, psychic and relational dimension where the educational process develops. Basically, the idea of extended and embodied context of the ECS school represented by the WEE model is very close to the one expressed in the last century by Carlo Perfetti, recalled by Andrea Carnevaro:

“The context [...] is not identifiable in the sum of the objects with which movement allows contact, but in the set of all the elements that are indispensable for programming the achievement of specific aims. It should not be ignored that it is increasingly confirmed by neurophysiologists that the central nervous system does not receive afferences, nor sensations, but information” (Perfetti, Pieroni, 1992, p. 195)”. (Gomez Paloma, Damiani, 2021).

2.2 Integrated skills

Consistent with scientific principles and discoveries about the functioning of the mind, and of learning processes in particular, the identification of the construct of *integrated competences* (Gomez Paloma, Damiani, 2015) constitutes a key aspect of the Framework underpinning our approach. It includes both the competences assumed by the ministerial (national and European) frameworks of disciplinary, methodological and transversal kind (Key-competences, EU, 2018; Unesco 2020), which learners have to acquire and which have to be assessed and certified in terms of observable complex behaviours, (which we define as Level I - superficial), and the “Level II” competences (deep, embodied, affective, bodily, cognitive, metacognitive, ethical and aesthetic) recognised by the scientific literature as functional to the development/acquisition of Level I competences. Neuroscience has demonstrated that the embodied emotional system constitutes a primary system in an ontological and hierarchical sense; according to this perspective, learning therefore requires the coexistence of three conditions: motivation to learn, ability to learn and therefore attention capacity, memory, but, above all, it is necessary to have an emotional system that allows both motivation, attention, memory and any other cognitive function (Vitiello, Davico 2018), even of a higher order (planning and problem solving capaci-

ty; critical and creative capacity). The existence of different kinds of learning and knowledge, implicit and explicit or procedural and declarative, must therefore also be read in the light of these models. Procedural knowledge, the knowledge of how things are done, is not based on language, but on more archaic elements anchored to the use of one's body and the emotions connected to it (emotional memory).

As a complement to the construct of integrated competences, using the metaphor of the mirror system, we identified the concept of *mirror competences*, which is based on the awareness of an isomorphism between the generative and healthy relational and thinking capacity of the adult caregiver-educator and the capacity to develop the thinking and mind to think and to learn in the child-pupil. It is the responsibility of adults to contain and distribute the physiological suffering and limitations inherent in the relational learning experience (Meltzer, Harris, 1983). Constructive emotional functions (generating love, instilling hope, containing discomfort, thinking) characterise the actions and processes necessary for the promotion and support of healthy and inclusive educational contexts, able to "withstand the shocks" of emergencies and to supervise the "tightness" of the educational relationship.

The aim is to try to take care, not taking them for granted, of the complex and deep personal and professional mental, adult and generative capacities, which should be "guaranteed" in all teachers and educators (which also include regressive, anti-educational and anti-inclusive parts), according to an updated pedagogical perspective.

As Blandino (2000) observed, it is not a question of "laying organisations and professionals on the couch". Consistent with what has emerged so far, our training approach is built as an integrated device based on the development and enhancement of the negative capacity (Bion, 1970) (capacity to wait, to tolerate lack and uncertainty) and of the emotional-relational capacities in general, on the construction of times and spaces for reflection, on the enhancement of the expressive and relational modalities for the understanding of the experience and for its representation.

2.3 La progettazione arricchita: Embodied co-design

Young boys and girls become the active protagonists of the learning processes, with all their potentials and limits (body, mind, emotions), in relation to the potentials and limits of their specific contexts. In full consistency with the WEE tripartite model, the design contemplates all the interconnected elements, taking shape as an educational, didactic, architectural, technological design, enriched by the characteristic dimensions of embodiment (bodily, emotional, critical, ethical dimensions...), which fully enter the design device through the use of coherent tools specifically designed for this purpose. Upstream, in the ECS school, a reorganisation of spaces and times is prepared, which includes, among other things, the organisation of breaks and the merging of curricular disciplines. Break times are to be rethought and enhanced in terms of their educational and health potential. They are imagined as flexible places depending on the needs of the context, of the people who will use them, of the functions they are called upon to perform, starting from Montessori experiences. The pause spaces in the context of embodiment enhance the prospect of a renewed economy of time, and a pedagogy of calm, for the well-being and enhancement of the learning process, through the time necessary for re-elaboration, feedback, reflection, emptiness and silences...

With regard to disciplinary learning, as we have already pointed out, the *evidence-based* principles of neuroscience and embodied cognition make it possible to improve the quality of learning through more effective teaching for all learners. The embodiment device is based on and enhances multisensory, multidimensional and global experiences; materials of various kinds, outside and inside school, and multimodal processes for learning to read, write and count are accessible to all and potentially able to engage individual differences.

Before children learn to use language, they learn to use their bodies. Declarative or propositional knowledge concerns what we know; procedural knowledge is generally implicit, we do not know we have it and we find it hard to put it into words, but it is more stable and durable

than declarative knowledge. As Giacomo Stella points out, we will forget what we have read, but we cannot forget how to read. Automatic procedural learning (automatisms) are the basis for later, declarative and complex learning. In the case of specific learning disorders, children fail precisely in this first type of (automatic) learning, however, it is possible to follow complementary and/or different paths that can prevent and compensate for deficits and disorders (Dehaene, 2009; Cornoldi, 2015). When learning takes on different trajectories from a neurobiological point of view, the school must also take on different trajectories: the neurodiversities manifested in learning difficulties and disorders require “neurodifferences in teaching and the learning environment” (Gomez Paloma, Damiani, 2021).

We would like to conclude this brief review of EC-based teaching proposals with a mention of the use of spaces outside and beyond school. Several studies and researches highlight the educational value (not “only” educational) of outdoor environments, understood in a broad sense or sparsely anthropised (Oliverio and Oliverio Ferraris, Farnè, Agostini, 2014; Cardarello, Pintus, 2019; Guerra, 2019), with particular attention to the many experiences concerning “teaching gardens”, as implemented in ECS schools. “Moving within an educational and didactic perspective that allows each and everyone to experience the natural environment means considering that experiences in nature must necessarily respond to the Universal Design for Learning principles of “equity, flexibility, simplicity, perceptibility, tolerance of error, containment of physical effort, sufficient measures and spaces” (Antonietti, 2021, p. 50).

In the second school cycle, the PCTO - Percorsi per le Competenze Trasversali e per l’Orientamento (Pathways for Transversal Competences and Orientation) (formerly alternating school-work), reinterpreted in the light of Embodiment, open up new horizons of meaning and new planning paths for students, teachers and operators in the territory. The essential step is that of co-design between teachers, between teachers and educators, between school and family and territory; as Floridi (2021) points out, complex problems, in complex contexts (such as educational, school and social ones) require co-design in which all subjects coordinate, collaborate and cooperate. The ECS schools’ integrated competence framework protects and enhances the capacity/ability to collaborate and, above all, to cooperate and co-design; in other words, to create an innovative and inclusive school for a better society.

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