

# THE NEURODIDACTIC MIND AND BODY BETWEEN PEDAGOGY AND NEUROSCIENCES

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## ABSTRACT

This work represents an interesting contribution of neurosciences to the recent studies in the field of education through which, today, we know that the brain makes the reality of the past and weaves a tapestry that combines feelings, information and experiences.

Feelings, knowledge and experiences are the subject of historical debate on the connection between body and mind. The whole body-mind, in its fascinating complexity, not to suppose that there are single-discipline studies, thorough exhaustive and rigorous, can provide a comprehensive model of its cerebral operation and its use. The mind, in fact, can be defined as a process – rather than as a structure - and this mind – process is building as shared construction (co-construction) with other minds. It follows that biological and psychological events are linked in a relationship of circular causality, which is hardly possible to identify a primary determinant.

In this perspective, the body assumes a meaning and a educational determinant value. On the bases of these presuppositions envisaging an interdisciplinary relationship between Neurosciences and Didactic, there seems to be the new epistemic horizon through which to explore this circular reaction of body and mind. Neurosciences offer a new prospective to the study of brain activities separated from emotions such as traditional philosophy has supported, but they open up to a new set of analysis creating a fruitful subject, Neuro-Didactic, where education becomes the promotion of human evolution. Therefore, the aim of this study is to investigate how the meta category Neuro-Didactic can rise to the interpretative mind-body relationship and, at the same time, encourage the growth of a Being who feels with his mind's eye speaking of the heart.

**KEYWORDS:** Corporeality; Learning; Neuroscience; Didactics; Emotion.

# 1. Embodiment between Pedagogy and Neurosciences

In the last years, there has been a growing interest in the progress of neurosciences, it is not a new interest, but certainly *renewed*, thanks to the ability to *visualize* the brain processes active during the more complex functions, which still require study/elaboration as experience of emotions or learning.

Why does education show/appear in this world?

To study the brain, under the investigation of the neurosciences, it is like crossing a circle that closes on itself: is the person who studies the organ that allows him/her to think, to study, to know, to memorize, to live emotions!

Is the person who, through the functioning of his/her brain, deflect thoughts for the logic processing on the sciences that study it, allowing society to advance about knowledge. But it is also the mind, as a process and not as an organ, to justify, to contextualize and to attribute value and meaning to neurobiological mechanisms of the brain.

The reading of this cultural and scientific binomial, which operates in our lives in perfect harmony, is an intriguing field of investigation, a reading that is processed on a pluri-perspective level that induces the individual doctrines to deepen the inter cultural nodes that justify some phenomena of our lives. Each of them must not meet the error of distorting itself for to generate others.

Regarding the epistemology and pedagogy of Neuroscience, the path to understand than they actually need to confront and take reflected advantage of the heuristic, long and tortuous system.

However, if the school is a formal agency for education in which the student has the opportunity to think, to study, to learn, to memorize, to excite and to live, it is legitimate to consider the possible cultural correlation with neuroscience (Caine RN & Caine, G. 1990).

This short intervention represents an interesting contribution to recent neuroscience research in the field of education thanks to which today we know that the brain makes the reality of the past and weaves a tapestry that combines feelings, information and experiences to create a memory that links the real facts, with everything it might hope or desire (Siegel, DJ 2001).

What are the questions and what are the dilemmas that afflict the pedagogists and scientists?

Starting with the first key questions for this thought: what is the role of emotions in learning?

What mechanisms allow to develop the mind and the brain and promote the attainment of an emotional balance (Imbasciati, 1998).

In particular, in which sense the pedagogy and the neuroscience can find an epistemic, supportive and complementary interaction in Neurosciences Didactic?

Neuroscience Didactic, therefore, can rise a locus of dialogue between two subjects can be the interpretative meta-category of a new paradigm, that it can discuss to "even-numbers"?

The relation body-mind in its fascinating complexity, can't support that there are mono-disciplinary studies, as thorough and rigorous, can provide a comprehensive model of its operation.

The neuro-scientific aspect based on a phenomenological epistemology of neuro-biocognitive character drawing from that phenomenology of Husserl as an ei-

detic research of the “human essence”, mainly concerned to the study and description of the ways in which the essences present themselves to us and how the intentional consciousness they relate to external reality.

Vittorio Gallese claims: “One of the important questions that Edmund Husserl (1859-1938), father of phenomenology, tried to answer, can now be taken up by cognitive neuroscience: how is it possible to study the subjective, the approach in first-person to reality, so it is possible to describe scientifically but not limited to understand in the ineffable way of introspection, which does not allow the objective communication typical of science?”

One of the main goals of current cognitive neuroscience research, which is the branch of neuroscience that has as object of study the more sophisticated aspects of our intelligent behaviour, is the project aimed to understand what are the neural mechanisms that make it possible to enter into a communication with our fellow man, transmit to him our desires, our beliefs, our intentions, and, simultaneously, to understand what others are doing and why they do it” (Gallese, 2009).

The pedagogical aspect and in particular the phenomenological pedagogy as claimed by P. Bertolini rejects “any attempt to enclose in formulas and preconceived patterns the educational experience, since it is always an experience in the situation”.

Pedagogy, therefore, as science of education, has an epistemic horizon oriented towards research of a dimension of education of person as process of humanization of person in the complex society, according to the following scheme: brain- mind- language- culture.

Culture is, what is makes it possible to learn and know, the emergence of the culture that is produced through the complexity of the person and the society, and complexification.

It is necessary to ask, as stated by Roberta De Monticelli (De Monticelli, 2008): “These are people that most social actors?”. It is necessary to speak about emergence of people that are contextualised into society respecting their human nature. Edgard Morin and the same Roberta De Monticelli speak of an epigenetic transposition to *Homo sapiens* to the concept of person.

As Baker (Baker, 2008) says, “what makes us special ontologically is our being before to be people.

According to Baker, there is a next-mathematical relationship between the development of the person and its body.

In fact, to shape the body means to shape the personality. But who shapes the body if not the culture? Who creates that first-person prospective (being unique, each with their own identity) if not the culture and the relate of the mind to it through the body? Can Neuro-didactic start from culture as a common ground between Neuroscience and Pedagogy? Can the pedagogy together with neuroscience play a “parental” active? Wich genetic heritage Pedagogy provides the Neuro didactic? Seems to be “recessive” than neuroscientific. Then as work around this?

The pedagogy should do just the appearance of being “bioenergy”: must learn to decipher “body language”. A theoretical primary reference in Bioenergetic analysis is the concept developed by Reich for the unit. Unity refers to the fact that the body works as a everything.

The function of neuroscience, an adjunct to the treatment of Neuro didactic also provides an “epistemic- dominant- genetic”, in the sense for which environmental cultural influences and the interpersonal relationships have, in fact, a key role in the structuring of the mind; it is a parallel process to the ways in which the brain is shaped (Siegel, 2001).

There are three basic principles defined by Siegel:

1. the mind emerges from processes that influence the flow of energy and information of the brain and connects to other brains;
2. the mind is formed as a result of the interaction between neuro-physiological internal processes and interpersonal experiences;
3. structure and function of the brain are developed from genetically determined programs shaped and influenced by experiences, especially interpersonal (Siegel, 2001).

Combining the ideas of Siegel and those of the most important contemporary neurobiologists, the mind can be defined as a process - rather than as a structure - and this mind-process is building as a shared construction (co-construction) with other minds (Searle, 2005).

Different and varied mental experience: *memory, attachment, emotions, representations, self-regulation, interpersonal connections and integration.*

One of the most interesting elements for the world of education is memory.

For a long time, memory has been considered as the “store” where engrams are stored.

This not only represents the research of lost time, it can reasonably be regarded as more important better function in that, through its role as a bridge between perception and learning, allow us to generalize, organize and mean everything around us and ours, including personal identity.

From the pedagogical point, each a unique synthesis of physical, social and historical factors, in which the plasticity of the human brain and the nature of the organism in its evolutionary history, represents the not by passing prerequisite, the natural and specific gift for the emergence of consciousness and the cultural bend out of ego or personal identity.

The personal identity, therefore, would generate it according to the reading of Albert Bandura, as a “social learning”: the individual’s personality is formed through a sort of “modelling by imitation” of learned behaviours from the interaction of the same person with the environment.

To confirm this: The neuro-scientific work of Rizzolatti and Sinigaglia have paid particular attention to the functioning of particular neurons called “mirror neurons” located in area F5 of the pre-motor cortex that are activated not only when a person does an action but also when it is made by another person, and therefore can be represented the taken action as the mirror image.

This means that for to activate the neurons responsible for the action, it is not necessary to do it, but it sufficient to observe it.

The activity of mirror neurons is not restricted only to the sensory input of the vision of a simple movement, but to a real “vocabulary of acts” that the subject recognizes as providing meaning and belonging to its own experience. The larger and richer this vocabulary of acts, the more the subject is able to learn, the more his identity is structured. This resonance mechanism that is based on experience, is the basis of imitation, whereby a person can learn just by looking.

The system of mirror neurons is, therefore, for the person the possibility to *immediately establish a bridge between the observer and the actor*, to determine, that is, an *area of shared action*, in which every act and every chain of actions, our and others, appear to be immediately recognized and understood, without requiring any explicit or deliberate “operation learning”.

Memory, therefore, not only represents the genetic trace of our being but it is the trace of the personal, social, historical, identity as Edgar Morin says, planetary identify and future identity.

Historical memory is the humus of that construction of identity and of that paidea upon which pedagogy is oriented and orientated.

In this particularly worrying perspective, but interesting in terms of science, neuro-didactic could help and allow that this is projected in the light of the collective consciousness, of that planetarium ego that teaches and is taught.

From the perspective of neuroscience, the memory, therefore, is considered as an activity of system that operates within the structure of the brain and therefore is affected by biochemical events from which it cannot be ignored.

Being this a modular structure, memory must be considered an activity that operates in different systems, but that has as primary objective to integrate the information processed by these planets, from both outside and inside of the person. (Kandel, Schwartz, Jessel, 1991).

As a property of the system, it is a continuous process of subjective reconstruction of the events following correct strategies and evolutionarily advantages; memory works on different levels in different ways, and each level has a specific “schematic organization” that is formed by the integration of acquired and innate characteristics with experience, this organization works through mechanisms of “assimilation” and “arrangement” (Piaget, 1991), that is “imposing its rules “in the process of processing of new data and at the same time” self-modifying, “integrating these new data with those data that are acquired in the past”.

Working in different systems interacting, being governed by subjective processes of “ emotional underlining “ and being its activity is not totally conscious, not controllable, it is not possible to predict in a “linear” way the effects generated by processes of “disorganization” in one or more systems, this can be ascribed to the systems in which the memory and the mind itself, in the “ dynamic complex non-linear systems” 17 (Siegel, 2001).

The memory builds the important traces of learning, changes, orientations of each adaptive achievement.

We are made up of learning and memory always! DNA is learning and memory of life, the human body is learning and phylo-genetic memory of living being, the brain is the map and the custody of its evolution and its memory.

Learning and memory, then, trace the first paths of psychic development along the way of bodily experience, in the first reports, the child learns and stores, treats and shapes thoughts and feelings, create the personality, the way of understanding life and world.

Siegel says: “Interpersonal relationships have a central role in determining the development of brain structures in the first stages of our lives, and continue to exercise important influences on the activities of the mind throughout our existence” (Siegel, 2001).

“Each experience comes from a set of sensory stimuli which are able to excite

different parts of the brain: visual area, auditory, sensory-motor and limbo/thalamus area. These areas are already in connection between them, but when they are excited together, additional connections are established that are strengthened when the same experience is repeated time after time there is only the excitement of all the neurons that were interested in the time of observation repeated of the picture, neurons too far apart belonging to various brain areas. These sets, as already mentioned, are called *engrams*. "Every time, if we resume a memory we are to rebuild it from scratch if it is a particular image will be interested especially to neurons in the visual area, if a writing the area that is located in the left temporal hemisphere, together with other neurons for example in the area of emotions.

This is only the stimulation of a circuit, however, when the memory surfaces not always the correspondent engram is exactly same to that is produced during the original experience.

This is due to other experiences in the meantime that person lived, to information that he/she learned" (Dal Lago, Rovatti, 2003).

Learning is the process whereby the new information about the world around us, is acquired, while memory is the process that ensures the storage of that information it is the secret code that holds together the infinite fragments of the life experiences and memories that have participated in the construction of our personal identity.

*To perceive* means classifying the different objects and this occurs through the activation of associative networks that represent these objects in the memory. In this regard, it is considered that any new association added connections to an existing network, any cell or group of cells, may be part of many networks and, therefore, many types of memory.

Thanks to the connections created by the neurosciences, changing the perspectives about the formation of human experience, the theories and the methods that support our work as a teacher have been revised and given new impetus to the role of emotions in memory, giving more meanings to learning which produces a physical change in the brain.

It is necessary, then, that the successful teachers produce *changes* in the brain of the student; the science can tell us what is the learning, and what affects influence it, but applying this knowledge is an art. Feelings, emotions, thoughts, directly influence the behaviour and attitudes, the emotional centres of the brain are strongly connected to areas of thought, here is how the teacher must find the way to make learning gratifying; it must, that is, evoke emotions and engage the student.

In this regard, Siegel insists on the principle of the plasticity of structures and cerebral sensitive connections to the play of activated forces from the exercise of memory, *emotional experience*, phenomena of attachment.

This sensitivity, only in part determined by our genetic inheritance, is conditioned by the work of elaboration and organization of lived experiences, with sense along a timeline.

Estimating with the complexity of lived experience, generating new thoughts or modify that previous showing symbolically important connections.

"Remembering not only means calling to mind the original registration of information, the memory is the result of the construction of a new profile of neuronal

excitation that has the characteristics of initial engramm, but also element of memory derived from other experiences and which reflects the influences from context and from state of mind in which we are in the present" (Siegel 2001). And in this "memory" re-enters the true skill of the teacher who must be able to *build on what exists*. You must be able to find the pieces of existing networks, which are "right" and help the student to give new values that generate understanding. This approach suggests that much of what we consider "wrong" is simply incomplete.

The sharing of stories reflects the important role that the narrative processes carries out in giving meaning to our experiences and linking our minds.

In addition, relations that assume importance in emotional and affective sphere build the basis for mental development.

We can say then that methodologically and epistemologically Neuro didactic must make the two "genetic" paradigms of pedagogy, as a discipline that aims to provide a horizon ever more sense done; and Neuroscience that equip the strong base of epistemic and methodological concreteness wich allow it to rely as neo discipline accompanied by the genetic material (DNA) as transmitted by both disciplines. Obviously, this refers to all that is subject to examination of Pedagogy (education, learning, education) and Neuroscience (memory, intelligence, cognitive development, neural sctructure and learning). The first step is to consider Neuro didactic that relates the biological elements of the Neuroscience and education elements of pedagogy.

## 2. Neuro-didactic: from pedagogy to the teaching of knowledge of the mind and heart

The scientific view for centuries has focused all attention on the rational mind, only in recent decades, studies are gradually changing, surpassing the mental attitude of looking at mental life emotionally flat, hardly relevant and not very significant.

It has begun to recognize the important role of emotion in thought (Goleman, 1996), the power of emotions in the mental life and the benefits that they entail. Nowadays, pedagogy and psychology agree in pointing out that there is no a single type of intelligence (Gardner 2005).

It has came in the last period to talk about emotional intelligence: emotions and mind are linked together, and this belief has emphasized the potentialities of the deformed and original expressive and maturational processes in all interlocutors of the educational process.

Human beings have two mental systems, one that thinks that the other what feels, and these two modality of knowledge, so fundamentally different, interact to build our mental life.

Goleman speaks of an inter-subjective space of empathy for to understand that space in which it has created an emphatic relation between actors and promotes the development of emotional intelligence defined as *"the ability to recognize our feelings and those of others, to motivate ourselves, and to manage positively our emotions, internally, and in the social relations"*.

These emotional skills ensure success at work and in the personal life and represent, according to Goleman, an attempt to bypass the widespread opinion that it is better to put a barricade between emotion and thought.

Daniel Goleman differentiates two important subcategories: the personal skills, which are related to the ability to capture the different aspects of their emotional life; the social skills relating to the manner in which we feel with others and we relate to them.

*Emotional personal intelligence* includes the *awareness of self*, which give a name and a sense to our *negative emotions*; it allows an objective self-assessment of their abilities and their limits, so as to be able to propose realistic aims, then choosing the personal resources most appropriate to them.

To power own motivation, then, is an essential capacity, a good dose of optimism and spirit of initiative, attitudes that lead to following own goals, actively responding to the failures and frustrations. Emotional social intelligence consists of a set of characteristics that allow us to relate positively with others and to interact constructively with them.

One of the most important components of this aspect of intelligence is made up of empathy; being empathetic means to perceive the inner world of the other as if it were our own, but maintain the awareness of its otherness in relation to our views. According to Goleman, emotional intelligence can be developed through a correct training, directed mainly to capture the feelings and emotions, ours and others, directing them in a constructive way.

For the transverse nature of Neuro didactic approach may represent the concrete translation similar premises.

Neuro didactic has, in fact, a particular importance in differential areas: in the helping relationship, in the educational and didactic commitment planning, in the social psychologist and work, in the organization of work, because the person who would be involved is made of thought and feeling, intelligence and affectivity and needs to be encouraged in a global and integrated manner in relation to any growth objective to be achieved (Trombetta, 1991).

The educational process cannot be an intellectual phenomenon of, nor instinctive and immediate, it should be, to the contrary, a process that can avoid these two poles, interacting in the subject that educates as well as in the subject to be educated, the interaction between mind, emotion and embodiment.

An emotional intelligence feeds through the appeal of the dialogue of the body, which is the primary channel through which to express itself in the deepest valences and meanings, a channel of access to reality and sensory information of the surrounding context, a world where applies the phenomenological perception of Merleau Ponty and deep empathy of analogical language.

Here the phenomenological reflection, while comparing the consciousness to sensory-motor structure of the human organism is not identified in it, but considers it as emerging from the relationship between three different and separated phenomena, the body, the world, the others.

As a result of the relationship between these phenomena, consciousness, therefore, is not subject to purely materialistic explanations, but it requires of methodological procedures that account of its process related to the fact that emerges from bring the world into a determined time and space.

Therefore, a body that can represent an excellent cognitive setting and that inherits



the new conceptual representation of the embodied mind (*embodied cognition*). In terms of educational intervention, this means resuming some considerations of P. Bertolini, to optimize the results of teaching according to *the authenticity of the learner*, so the ability of the teacher must adapt its intervention on the basis of interpretations of the subject.

Another aspect of didactic is important, that we can define as the *heart* and of *mind*, whose study was opened by the neurosciences, crediting next to psychologies of deep, the nature and structure of the brain, as stated by E. Goldberg, "*the soul of the brain*" (Goldberg, 2004).

The emotional charge is important in learning processes, not only because it provides colour and shape to concepts, especially as each individual learning sees to work the mind with the body, the psychological element with the biological in evolution that to be accomplished, always need of "something to think about giving" (Groppo, Antonietti, 1992).

Nowadays, the didactic research can power a neuro-didactic; a connection of the learning and memory processes with the part that is capable to recite the cerebral hemispheres, never separated together but harmonized in the belief that, while has become a sure mental economy, are opened interesting prospective for artificial intelligence and for ways of thinking that to establish a new seat of the soul, not only in heart but also in the brain, why is this "magic box" that comes the conscious tension that directs the action and gratifies the commitment and the weariness resulting from intellectual research (Gardner, 2005).

The teacher conscious of any neurobiological mechanisms justifying the scientific properties with which humans interact and act, is undoubtedly *have and edge* for measure out, to graduate and to colour the learning strategies in the school. The teaching innovations are able to treat more involvement and more communication are related to recalling the *motivation*, to the didactic of *discovery*, the strengthening of *teamwork*, the same *personalization*, in the sense of personal self of the student as the cultivation of more intimate vocations (Mottana, 1993). It leads to a didactic *iter* more difficult, complex, articulate, but it is possible if the school works on this principle and gives the tools to make it.

It is not an utopia, but rather an audacious work, not urgent that can or should be rejected.

It is important to create the enthusiasm in the teachers to organize significant relationships (Iannaccone, Longobardi, 2004) in the class and give to susceptible, critical, communicative subjects in the sense of empathy, subjects with a rational and emotional mind: emotional mind that has bring out the awareness the instincts, lived behaviours, the communicative states of the subject and to pass them through according to an awareness and opinion point of view.

In this perspective, the body size, and psychological operations, as typical of the person, invite the pedagogy, through *education*, to the development and recovery of individual abilities.

The Aim of didactic, therefore, must be given the tools to every teacher for *self-education*.

So which method would be more appropriate? As Aldo Nardi said, "to propose a workshop inside the school (but not only), may represent an important base in the face of a shared and clear objectives that are clear to all participants," it seems "an opportunity for a different appropriation of knowledge".

Teaching laboratory has its theoretical roots activism and subsequent pedagogical constructivism; initially used for the teaching of technical disciplines, is currently considered a valid approach for all disciplines. Promotes the motivation to study and inclusion will be especially beneficial to students with learning difficulties of various kinds.

The laboratory is a learning environment that integrates effectively not only knowledge and skills, cognitive and social aspects, but especially the emotional-affective dimension with the planning and operation characterized as a privileged *place* for the practice of personalization teaching.

This approach is the way it's supposed to be any kind of significant learning: a space in which to gain experience with the others, where you learn to use procedures, materials and methods that promote the "construction" of knowledge. In the teaching laboratory is fundamental research strategies of teaching\learning appropriate to the cognitive styles in the group class, an educational proposal that is valid cannot take into account the existence of multiple intelligences, first of all the emotional mentioned Goleman. You can't, in fact, talk about learning without taking into account the emotional and relational inner dimension of the subject. If the primary function of the teacher is to facilitate the acquisition of skills, this inevitably develops within a relationship where you need to capture the emotions, feelings, experiences that determine how the student learning. Despite such an approach suggesting uncertainty, certainly will cause both actors of the report to take an attitude of continuous research, discussion, attention and listening to each other. The laboratory acts as the emotional cornerstone of its two core assumptions: to excite and to be excited.

Because learning and teaching involves, as we have seen, an emotional relation for all the participants/actors in the process. Because a teaching of the mind cannot escape from a teaching of the heart. Because the feeling of the mind is the feeling of the heart.

### **3. Experimental evidences and educational protocols**

The reason we have presented this work is because, in order to clarify the possible implementation of a "Neuro-didactic approach", it had become obvious the need for a survey of the theoretical reference profile to come to a possible application of specific protocols.

Currently, research groups and scientists of education are trying to achieve applicable protocols for schools. Although the real acceptance of a teaching focused on corporeality (which finds justification in the biological foundations of the learning processes) is not still widespread, a first experiment was conducted at a series of schools in the province of Salerno, in order to identify a methodology that serves as an integrative background between the bio-neuro-scientific and educational disciplines.

The Departments of Education Sciences and Pharmaceutical Sciences of the University of Salerno have promoted this project.

Before discussing the description of the project, whose analysis is not over yet, we'd better carefully pay attention on the already emerged data. Indeed, this project represents the first academic research that combines biological data

with psycho-pedagogical data without making it become a health investigation.

Indeed, schools barely allow pedagogical researchers to investigate on the biological parameters, usually considered part of the only bio-medical areas. In the light of these circumstances, the hypothesis of a neurodidactic methodology-approach shows particularly suited to the attempt to match the experimental data of the neuroscientific research with the certainties deriving from the systematic observations and the experimental psycho-pedagogical data of the educational research. The proposal, in the didactic framework, of recreational-motor laboratory methodologies and approaches as independent variables aimed at enhancing the role of corporeality in the activation and strengthening of the learning processes is, in effect, a real form of application of neurosciences to education.

### 3.1 Brief description of the research

The research is based on the idea that the activation and strengthening of mnemonic processes might be indirectly related to the variation of the cortisol hormone in its hippocampal feedback (Wang, 2005). Therefore, it was deemed appropriate that proposing a teaching of corporeality could have efficacy in the knowledge co-building, in the acquisition of awareness of the self and in the long-term memory processes, assessed on the basis of a hypothetical answer in the variations of the salivary cortisol. 250 pupils belonging to 10 classes from the 1st to the 5th grade of primary school have taken part in this assessment. As a mode of action-research, the experimental classes have been taught corporeality, for which the teachers had previously been trained, along with a traditional didactic of control groups. The effectiveness of the integrated didactics to corporeality has been evaluated through the biological parameter, the cortisol, by comparing the variations to the data deriving from a quantitative and qualitative assessment with the aim of evaluating the learning and psycho-pedagogical levels, such as the Visual Motor Integration (measurement of the visual-motor skills) and the Potential Intelligence Test (measurement of the cognitive modifiability in situations of adaptation).

Here is an overview that summarizes it all.

TOOLS	Salivary analysis	VMI	PIT	Verification sheet
Aims	Cortisol rate	Manual abilities	Potential intelligence	Learning of the U.A.
Reasons of use	Possible correlation	Space-Time organization	Problem Solving	Linked to the planning

During some months, the administrations of the surveys and the analysis of the data have alternated according to the following schema

PHASES	1	2	3		
Dates/ Periods	February/March 2011	19 of April, 2011	04 of may	05 of may	06 of may
Activities	Teachers training (30 ore)	Administration of the VMI (incoming)	Cortisol detection (pre-experimentation)		

PHASES	4	5					6
Dates/ Periods	09 of may, 2011	16 Of may	17 Of may	18 Of may	19 Of may	20 of may	23 of may, 2011
Activities	Administration of PIT and Assessment (incoming)	Cortisol detection (experimentation)					Administration of PIT and Assessment (outcoming)

PHASES	7	8			9
Dates/ Periods	26 of may, 2011	30 of may	31 of may	01 of June	06 of June, 2011
Activities	Administration of the VMI (outcoming)	Cortisol detection (post-experimentation)			Assessment (final)

For what concerns the protocol of the activities promoted in the experimental classes with the approach of the corporeal method, it's possible to follow the below tab.

PROTOCOL 2 h/per day for the U.A.	20 minutes	40 minutes	20 minutes	40 minutes
Proposed activity	Environment exploration	Corporeal experience	Verbalization	Metareflection
consequences	pro-active predisposition	Corporeal cognition	shared cognitive re-processing	Curricular contextualization

From the analysis of the quantitative data relating to a part it has emerged that the corporeal didactic in the experimental classes has determined an elevating cortisol rate of approximately 6 times more than the average of the initial surveys, which has improved back in the final phase of the project. Otherwise, in the control classes, the increase of the cortisol rate has resulted constant and slight and has improved, in the most part of the experimental class, in the final phase. At the same time it was detected, by the verification tests, an increase of the successful learning in the experimental class. With respect to VMI and PIT, it has emerged an improvement in the performances of the experimental class. In cases where the results should be extended to the entire sample, it may then infer that it needs a higher cortisol rate in order to learn better, thus a healthy

cognitive tension (Siegel, 2008). On this basis, a real protocol for a corporeal education (Gomez Paloma, 2009) as innovative methodology is able to foster training conditions that promote the interest and curiosity and critical attitude towards knowledge in students<sup>1</sup>.

In conclusion, the reflections of Kandel about the existence of epigenesis, thus a process of differentiation of the embryonic cells in later stages of development, which underlies the environment, reveal the presence of a cerebral matrix naturally predisposed to the social context to which the child belongs from his/her birth. And it is precisely the belonging context that makes possible the generation of that experience which, according to LeDoux, selects the "intervention/activation" of specific synaptic circuits that coincide with a certain mental and "emotional" state. The hypothesis of the existence of an emotional brain attaches a key role to the environmental inputs that are able to preserve or enhance the neuronal networks.

This strengthens and supports the thesis that the cognitive processes are generally influenced by the environment rather than hereditary factors (Plomin, 2000). Today it is perhaps possible to assert that all the recent contributions of cognitive neurosciences, on a single thread, help draw an idea of cognitive and learning development as processes that are deeply interconnected to the authentic experience of the "lived body".

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1 For more information on this research you can see the article: F. Gomez Paloma (2011), *Correlazione tra apprendimento e cortisolo come possibile dialogo fra didattica e neuroscienze*, Atti Accademia Pontaniana, Napoli - N.S., Vol. LVX (2011), Napoli: Giannini.

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