Body and Didactics. Possible directions of international research

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Abstract: *The paper investigates the role of the body in didactics. It looks up for points of contact between the functional sceneries of the classroom and some recent approaches, such like simplexity, neurosciences and enactivism. The two experiments presented they aim to demonstrate the importance of body awareness to improve the didactic quality. The first experience used a SenseWear Armband that provided data about the energetic expenditure of a teacher during different activities in a lesson. The second experiment relied on a neurofeedback device integrated to a sensor, it detected body temperature with the aim of understanding the role of the body in the process of self-regulation-learning and management of attention and arousal.*

Riassunto: *L'articolo analizza il ruolo del corpo nelle azioni didattiche alla luce di alcuni approcci recenti, come l'enattivismo e le neuroscienze. Due esperimenti sono presentati a scopo di dimostrare l'importanza del ruolo del corpo nella metrica didattica. La prima esperienza descrive l'esperimento con SenseWear Armband che fornisce varie informazioni sul dispendio energetico di un insegnante durante le diverse attività della lezione. Il secondo esperimento utilizza il neurofeedback integrato ad un sensore di rilevamento della temperatura del corpo al fine di capirne il ruolo del corpo nel processo di auto-regolazione e di gestione della attenzione.*

Key words: *Body, Didactics, Simplexity, Enactivism, Neurofeedback*, Self-regulation-learning.

Introduction

The contribution enquires from an educational standpoint the role of the body in didactic actions, aiming at interaction between the viewpoint of didactics and some recent approaches such like simplexity, neurosciences and enactivism.

* Even if the work is an all authors' collaboration, the pages 135-144 are made by Pier Giuseppe Rossi; pp. 144-150 are made by Catia Giaconi.

Until a recent past, the body was put in a bipolar relation that saw it contrast with the mind. In Western thinking, it is possible to track noteworthy contributions on the same themes. From Plato onward (Galimberti, 1999), the body was given the role either of a passive canal of inputs coming from the world to the brain, or of mechanical executor of brain elaboration and decisions. Descartes picked up and supported this setting, widening the gap between mind and body.

In the last decades, there is a growing awareness in cognitive science of the need to consider the embeddedness of the brain in the body and in the world to understand aspects of cognition (Chiel, Beer, 1997). In the pedagogical field the theme followed a different path. Perhaps, it was caused by the centrality of the educational relationship where two subjects, students and teacher are "soaked", physically and cognitively, with their whole person.

One of the most significant positions is seen in Dewey and in activist pedagogy that gives to the body a central role in the educational process (Rossi, 2011, 78). The American theorist criticises operative modalities, where even when used manual activities for problem solving, senses are considered as a sort of mysterious duct through which information is led from the outside world to the mind (Dewey, 1925, 190). In *Democracy and education*, Dewey underlines how the mind-body separation has a double harmful effect. Based on this assumption, on one side, physical activity appears like an intruder, and because of this the body becomes a source of distractions, useless processes and harmful to contain. The student "carries" his body to school as a dead weight, it takes space and resources away from the "important" activities (Dewey, 1916, 187). On the other hand, "mind's" separation from dealing directly with things, stresses the things in detriment of relations or connections. It is more than usual to split perceptions and also ideas from judgments, sustains Dewey, since understanding a concept is like gathering the connections of its parts and not just examining each part singularly (*Ibidem*, 192).

From the second half of the last century several philosophical approaches questioned the *Fossato Galileiano*[1] and, in particular, the research of Merleau Ponty (1945) praised the active role of the body in perception and, by consequence, in knowledge. In the past, the separation and distance of the observer from the world vouchsafed the validity of knowledge. Today, it is the proximity between observer and observed and the recurrence between action and knowledge to guarantee its possibility. Results

of recent research converge on action, rescuing Aristotle's intuitions, while diverging on some points. Among them is in fact the new attention paid to the body. According to Joas, the attention to the role of the body in knowledge originates from the need of listening, sensitivity and receptivity (Joas, 2001, 35), functions guaranteed by an active body.

Various different approaches highlight the body's role in interactive processes between systems.

Enactivism (Varela *et al.*, 1991), stresses the continuity and recurrence of brain-body-artifact-world as central elements of his reflection. Varela's work, starting from cellular studies, showed how the structural autonomy of living systems could cohabit with the dialogue among the same actors and see in structural matching the means of the interaction.

Likewise, the Empathy theory by Berthoz (2004) shows how communication goes through processes in which a subject goes beyond his perspective to get near someone else's.

Gallese (2003) sustains that the same neural circuits involved in action control and in personal experience of emotions and sensations are also active when witnessing the same actions, emotions and sensations of others, respectively. This process is the basis of attunement between different subjects.

Other studies, such as the ones of Marcus (2004), stress that more or less complicated forms of imitation, learning, gestural and even verbal communication find a precise validation activating specific mirror circuits (*Ibidem*, 32).

Along this direction, research made mostly after 2000 are significative, sometimes it investigates the connection between autistic disorders and dysfunction of the mirror neurons system (Williams *et al.*, 2001, Théoret *et al.*, 2005, Villalobos *et al.*, 2005, Dapretto *et al.*, 2006). These research explain the difficulty of autistic subjects in imitating, both at motor and linguistic level, in the interpretation of the reason of the actions perceived (seen or heard), as well as in communication and social interplay.

The body in didactics

In the 1970's and 1980's a significant contribution on body's role in didactics was supplied by research on psychomotor education. In particular the work of Vayer, Lapierre and Aucuturier in the eighties. Resuming Lapierre and Aucuturier, psychomotor education moved toward the emergence of

the symbolic experience "that has its roots in the unconscious" to attain "to the deepest layers of the personality and reach to this psycho-affective nucleus that determines the whole growth of the being" (9). Beforehand, these is a perspective that wholly modifies the problematic of education. "It is the disposition of the existence that will allow the liberation of the desire and the acquisition of real knowledge. […] climbing further is getting engaged with the drives, primitive desires and unconsciousness, to find the body, movement, in their affective meaning, the «erogenous body» that all education strives to ignore" (Aucuturier, Lapierre, 1975).

Re-thinking the role of the body today bides a revision of previous positions and understands its active role in the knowledge and administration of actions and communication. The body does not say only what we do not want to say and what we cannot say, but, also, intervenes in our understanding of the world and, on the other, it takes part in the narration of our doing. Therefore, affective and cognitive are tuned together because the body supports action tightly bound with language (Le Boulch, 2000).

In the scientific literature regarding special pedagogy, authors like Caldin (2011) highlight the role of the body in didactics doing and in inclusion processes. They become fulfilled also through the body's mediation, where, "hands, harms, body, voice" are "basic facilitators of the relation itself" (*Ibidem*, 35). The body and the quality of gestural and motor mediation become the indicators of quality in an educational system that shapes itself as inclusive.

Rhythms in didactic doing

New perspectives are opened by reflecting on corporeality.

In the educator's work, position, posture, body movement and especially, hands gestures, tone, intensity leaning of the voice all play a role.

In the same way, the students' activity reifies through their bodies. The position, the viewing and posture of the students are the indicators of the student's state, their participation to the lesson and let the educator understand the level of attention, or, on the contrary, their loss of interest.

The educator's corporeality belongs fully to the complex system of mediators or "middle processes" (Damiano, in Giaconi 2008, 21) and with it the teacher operates the regulatory activity (Cerri, 2007; Rossi, 2011) that re-organises, according to the situation, the planned path and finds a bal-

ance between logics and tensions.

This contribution aim to find and test probable indicators, which will enable the rating of participation of the body in the process of didactic mediation, because beyond the interest in corporeality, there is a lack of experimental research that allow us to compare bodily and metabolic data with activities and behaviors related to learning processes.

In the field of sport and motion analysis, tools, that provide data related to caloric and energetic expenditure of subjects, are developed. We propose to test their use within a non-specialist school setting.

This contribution proposes, however, a specific hypothesis: is it possible to analyse teaching and didactics actions through physical variables and metabolic rhythms?

The concepts of structural coupling, empathy and attunement have been introduced before to describe the ways in which two subjects "tune up". Is it possible to apply these concepts to the educator-student relation and underline how the tuning facilitates learning?

Considering again Berthoz empathy concept, according to it: it is possible to keep simultaneously the subject viewpoint (self centered) end the change of viewpoint that puts the subject in someone else's place. I define this operation as simultaneous multiperspective (Berthoz, 2011).

In the didactic action there are two parallel processes that reify: on one side the educator adopts the student viewpoint and listens to him to understand the obstacles that he finds and the simple conceptualisations; on the other, the student gets into the epistemological perspective of the discipline, especially the language and the viewpoint to watch the world. The analysis on empathy here focuses on the rhythms in the lesson. The educator communication modes, effort and intensity used to run the activities have a wave-like movement, as shown in the following experiences. Likewise, the doing of the student has a swinging rhythm, the effort, interest and attention. Phases with a higher emotive-cognitive tension alternate with lesser intensity moments and the phases' succession designs a swing marked by certain regularity.

Clearly, there are many different rhythms in didactic action, one for each actor and their coherence, if existing, shows fine tuning in the group. Also, It must be stressed that a rhythm exists in any case and that it is not possible to expect continuous tension and attention.

Like a conductor, the educator regulates the rhythms with which the lesson unfolds.

To regulate, the educator works on the rhythms which evolve with the lesson, where various actors play, working on three main variables: (1) frequency/oscillation periods, (2) intensity and (3) educator's synchrony with the students. In the view of making the rhythms coherent and functional for learning, the educator can choose strategies, didactic mediators and his own communication modes. Furthermore, rhythms should be adequate to the theme discussed, to the presumable difficulty of it and, finally, to the knowledge both of the rhythms of students attention, and the managing of the attention. How to define the three variables and how to operate with them?

The length of a swing in attention is the **period** that lets the teacher realise the duration of his own and the students' physical and mental engagement. The height of the swing is the **intensity** and it allows the underlining the points of main interest in the discipline or to rescue students' attention in particular moments. As **synchrony** is understood that in the classroom the waves of doing in relation to some subjects are in tune, that is that teacher and students rhythms have similar periods and their peaks contemporary; a tuned running of the different waves grants the tuning among students and teacher and favours learning. The techniques of catch and trigger (Proulx), often used by educators, are functional to synchronise the rhythms in the classroom.

Davis, Sumara, Luca-Kapler (2000) highlight that "since learning is a constant enactment of embodied sensitivities, rather than a string of fully aware choices […] Strategies such like recurrence, right time questioning, underlining, practise, discussion and re-symbolisation, may help to draw the attention of students. Elaborate explanations, long instructions and out of context formulations should not be emphasised".

Some potential avenues for investigation will be shown below, right now, they are in the center of theoretical reflections and of experimental paths of research groups in Italian and International Universities.

Experiment 1. SenseWear Armband and didactic action

The first study is related to the recently started research by the research group of Professor Rossi on issues of enactivism, and developed in collaboration with the research group of Professor Sibilio, University of Salerno.

The tool used in the experiment is a *SenseWear Armband (SWA).* It is a metabolic multi-sensor band that is worn on the triceps of the right arm

for a continuous period of time. It provides information about the tested subject and finds application in many medical activities. The SWA is constituted by a set of tools: accelerometer, thermometer, galvanometer and calorimeter. Based on the results of the various instruments provides the summary measure of METs (Metabolic Equivalents of Task).

The teacher wore the SWA continuously for a week, both during lectures hours and in the remaining hours of the day. During some lectures to two students also wore a SWA. In addition, the lectures were video-recorded so as to superimpose the data from the SWA with the video track.

The Armband detects the energetic expenditure of a teacher during different moments and activities of the lecture. Videos are useful for having an idea of what the teacher actually does during the lesson (reading, sitting down, standing up and walking, explaining, simply chatting, explaining or discussing…) and knowing the related energetic expenditure.

Early results

By observation the data for the entire week, or considering both teaching activities, as well as those of everyday life, we see that the value of METs of the teacher during the frontal lecture, especially at times when standing in front of the class, is similar to, or slightly lower than the average value found in the same subject during a walk at a normal pace.

The interesting aspect is that in both cases the accelerometer detects data very differently, namely the movement of the teacher during the lesson has a value much lower than indicated during the walk, while the value of METs is similar. This indicates that the teacher during the lecture has a high energy consumption, even if the shift is minimal. In other words, the activity of the teacher is physical and cognitive at the same time. Furthermore, the physical intensity, i.e. the energy consumption measured by the SWA, is greater in two special cases: when we get to the topical moments of the content and, in such cases, the teacher emphasizes with his whole person the importance of the addressed node; with the tone and intensity of the voice, with the movement of the body and arms, in particular, almost to direct and in the phases in which the teacher perceives a lowering of the students' attention.

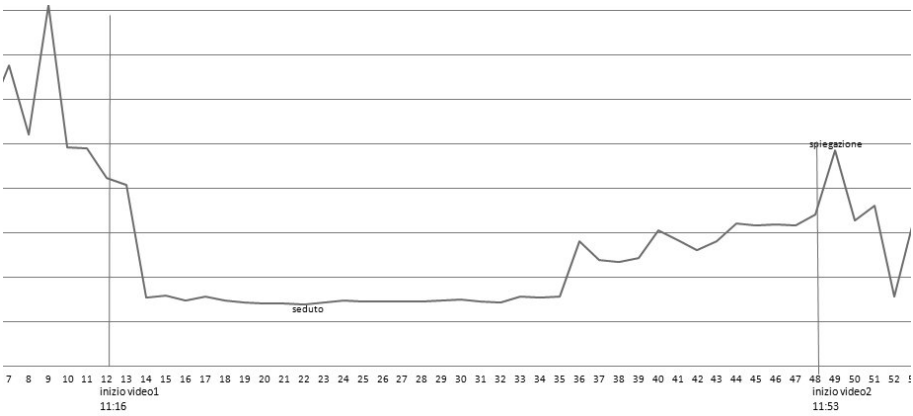

Figure 1. Presents the graphic of a lesson on 04/12/2012.

As the graphic shows, didactic mediation develops as an alternance between dynamic and static moments, with different levels of energetic expenditure; this is obvious as during the lesson the teacher does different activities and actions.

Remarkably, also in static moments, despite of the absence/reduction of ample movements, there can be revealed little changes in the energetic expenditure.

During the break that goes from minute 03.15 to 21.20 (Figure 2) the teacher sits down and views the lesson of another educator. This explains the low level of METs. Yet, it is possible to see small changes in energetic consumption in specific points. Through the video, we noticed that those peaks correspond to moments in which the teacher is busy in activities like turning the pages of the book to find specific ones, intervening to clarify and explain some concepts, recalling some information in the context, describing a situation, recalling elements from the past. Overall, the differences are small and the experimental conclusions must be supported with more evidence.

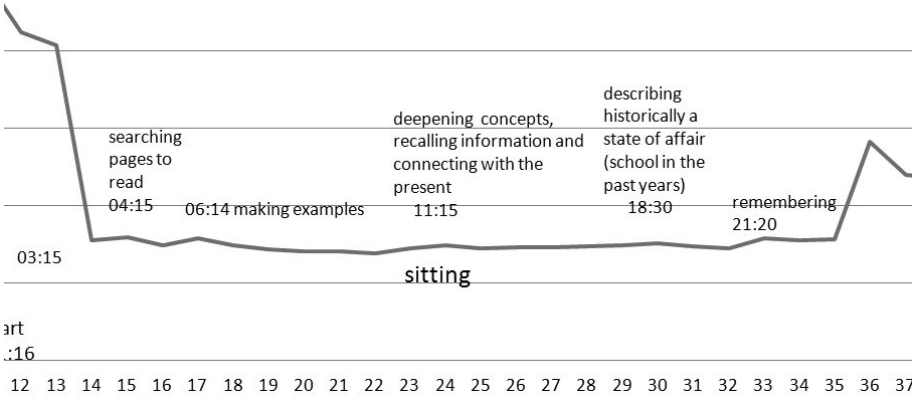

Figure 2

Even more significative data derived from the comparison between the tracks of the educator and the two students during the dialogued lesson of December, 5, 2012.

The graphic (Figure 3) shows three tracks: the uninterrupted track is the educator's METs, while the dotted and hyphened tracks relate to the METs of two students. From minute 17.50 to 18.10 there is group work. The teacher speaks to single groups, the rhythmic period lasts approximately 3 minutes, the wave is constant in its length. Furthermore, there is not coherence between the educator's lines and those of the students. The students unfold their activities and it is not just in they are not in tune with the teacher's graphic, also among the students graphics there is no tuning.

The situation is different from minute 18.10 to 18.45. During this period, the teacher performs a frontal lesson and recovers the key concepts of the lesson. Analysing the track a rhythmic doing appears, the wave more closely related to the teacher lasts 5.2 minutes. It must be stressed the presence of a main wave reaching a peak in points 2, 4, 6, 8 and a secondary wave with lower intensity in points 1, 3, 5, 7, 9. The video examination shows an increasing intensity in tune with the METs data.

It is worthwhile here, to stress synchrony in the curve of the educator and the students. The peaks of the teacher correspond, most of the times, to the ones of the tracks of the students. At minute 18:23 student 1 wave, always seated, shows a peak due to an intense noting down. On the other hand, student 2, tracked by hyphens, has a lower grade of energetic con-

sumption comparted to student 1. His peaks correspond the teacher's although they reach maximum peaks slightly before, as if the activity focused on anticipation followed by synthesis.

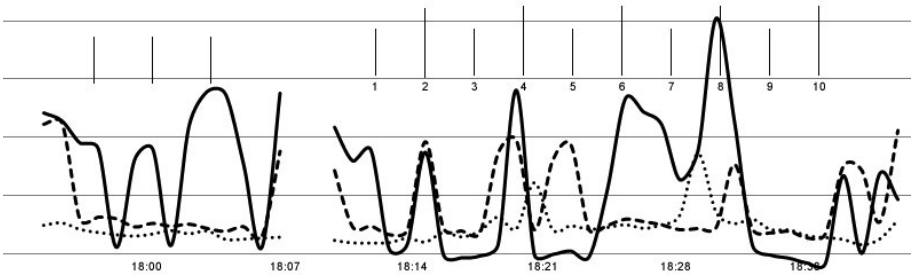

Figure 3. Uninterrupted line: educator; hyphened track: student one; dotted line: student two.

Experiment 2 - Neurofeedback and self-regulation-learning

Background

The following research experience belongs to a wide project that involves researchers from the University of Macerata, Department of Psychology at IBGEN (Brazilian Institute of Management) and Department of Phonoaudiology at UNESP (University of the State of São Paulo, Brazil), turned to investigate different procedures of analysis, planning and fulfillment of inclusive didactics in classrooms that include children or teenagers with Attention Deficit and Hyperactivity Disorder. Starting from recent acquisitions in the neuroscience field, procedures based on the video analysis were integrated with other ones based on neurofeedback, to understand indicators related to didactic metrics. We refer to an experimental path that relied on the neurofeedback tool integrated to a sensor of detection of body temperature with the aim to understand the role of the body in the process of self-regulation and management of the attention and arousal.

Neurofeedback is a non-invasive tool, it allows self-regulation and activities through a specific training and thanks to the growing awareness on converted physiological information translated, through special devices, in the form of audio or video. The goal of neurofeedback in fact is to

strengthen awareness and understanding how the activity of thought influence physiology and how, on the contrary, physiology influences thoughts.

This device belongs to the wide spectrum of biofeedback techniques, they are based on retroaction of different physiological signs, such as muscular or skin electrical activity and body temperature. In this direction, scientific literature show diverse biofeedback modalities: muscle, temperature, heart rate, respiration, skin conductance, brainwave (neurofeedback). They are based on softwares and hardwares to observe some indicators or physiological parameters such as frequency, amplitude, coherence and location system. The aim is to train to regulate actively personal arousal (activation level) and balance out these parameters.

This procedure is used in the clinical field, at international level, to treat Attention Deficit and Hyperactivity Disorder (Thompson, Thompson 1998) and Autism (Jarusiewicz, 2002). It is used also at professional level to improve self-control and self-regulation, to exploit potentiality in sports, in the academical/working fields, and also to reduce stress and Burnout Syndrome.

During the neurofeedback training some electrodes are put on the head, to monitor brain activity; in a biofeedback session, body detectors – pulse, muscles, and others – are used, they send a signal straight to the computer through special devices. According to the feedback, on the screen are displayed, with a few milliseconds delay, the brain waves or the other body indicators, in the shape of coloured bars or videogame or cartoon. In a training the goal is to increase attention and reduce the tendency to distraction. By consequence, when concentration levels decrease (at school or at work) the display changes (colours and shapes) on the screen, in a way that the person realises the drop in attention and self-regulates his behaviour accordingly.

The Neurofeedback procedure has been integrated, in experimentation, with a sensor to monitor peripheral body temperature (fingers, hands). Researches highlight that the data of the temperature is significant in the activation of the nervous system of the organism and for emotional stress conditions. This happens where a peripheral cutaneous vasoconstriction is recorded, with a consequent drop in temperature.

After specific calibration of the device by specialised personnel, the trainer put on the educator's heads the band with the electrodes and a thermocutaneos sensor. The teachers were asked to solve two similar problems in a foreign language: in the first one, did not have any suggestion on

how to procede; in the second activity possible solutions were given at the beginning of the session.

Some early results follow below and refer exclusively to the relation between body, management of the attention and personal level of arousal and attention, in the resolution of both problems.

Partial results

The experimental procedure results were analysed in reference to a comparison between the attention in the performance in the problematic and the thermocutaneous detection measured by the specialised sensor.

During the performance were observed the following indicators:

- Frequency of attention rhythm;
- Intensity of attention peacks;
- Coherence between attention and temperature curves.

Concerning the first training, frequent drops in attention were recorded after the first ten minutes of activity, the moment that corresponded to the implementation of the solution plan to the problematic in foreign language. The swings between attention and relaxation are states of irregular frequencies.

The coherence between attention rhythm and the adoption of applicable solution strategies results near absent.

In periods of drops of activity and of low activation it is monitored a peripheral cutaneous vasoconstriction and a lower temperature, these explain the general cognitive-emotive stress.

After the first session, the training has been repeated after analysing the parts of the assignment where were recorded drops in attention and low activation. The specialised trainer brought in some strategies to solve those parts of the assignment where drops in attention and activation were recorded. The same indicators were considered, the results showed some frequency in the regular wave and a higher intensity in peaks of attention in comparison to the first training. The peaks correspond to the adoption of the strategies used and to a peripheral cutaneous vasodilatation, this explains the general condition of lower cognitive-emotive stress.

This first experimental attempt shed light on the importance of the role of the body and the relation of body indicators in the self-regulated process of attention and in the personal level of activation.

In future perspective, the two research units aim to develop these early partial results to correspond to the complex dynamics of managing a classroom and in the rhythms of didactic actions (role of the students and teachers bodies), in the reciprocal processes of self-regulation of the metrics of didactics.

Conclusions

What are professionals involved in didactics looking for when with different non-invasive instruments monitor emotions, electro dermal activity, biofeedback, galvanic skin response, heath flux among other variables, during a lecture?

One main assumption behind these instruments is that skin conductance, electro dermal activity (EDA), reveals by increasing its value emotional states such as anxiety, attention, excitement, and when low relaxation and calm. These machines show some human physiological functions and the method to work with them is a constructive use of data to obtain awareness of learning, or metacognition. Silent or usual signs or styles can be revealed analysing the information provided by the instruments. All learning processes involve changes of behavior, attitude, feelings, and so on. Different technologies can help these changes by serving as mirror of strong and weak points to be worked out. Not in an absolute way, but as a secondary mean to reach results, involving the essential teaching expertise.

The challenge of the two experiments contained in this article is to improve the awareness of learning, among teachers and students. For doing so, they are employing instruments like Sense wear Armband, HEG, among others. Other instruments can be used to improve didactics. An interesting monitoring instrument is the Q Sensor (Affectiva). This is a wireless and wearable biosensor that measures emotional arousal through skin conductance. The modulation of electro dermal activity, high or low, shows changes in the person's states of mind. The Q Sensor promises effective use in various fields, such as education in general and learning disorders, clinical research, market research, nonverbal communication, ADHD (attention deficit hyperactivity disorder), depression, among many others.

These instruments usually used in the field of sports, only to a less extent they are used to learning and cognitive processes were applied to studies on didactics.

The considerations made earlier in the article point out that bodily activity and participation, through rhythms, movements expressions and general gesturing of teachers and students, relate to mediating didactics and learning processes. Active participation based on bodily complexity, through the path brain-body-artifact-world, lies in the line of authors previously referred, such as Varela, Berthoz, Gallese, Noë, authors in the psychomotricity tradition, and so on.

The border between senses and physical data becomes thinner. The same is valid for the dichotomy senses and mind. The body is not longer a weight to carry into the classroom, together with the senses it makes a whole with the mind. The mind is not an organ; learning is not just a physical process in our body. The mind is present all around our bodies, resulting in our actions, thoughts and feelings. Although, these products of the mind are important elements, alone they do not allow us to decipher the information about the functioning of our minds. Future use of such experiments can be organised, sistematised, compared, quantified, to fill the requirements of science. Saying so we reach the aim of this article, to examine perspectives for future international cooperation in this field, while maintaining its character of a work in progress.

Next steps

The analysis described above has certainly an indicative value and paves the way for new research. The path must be extended working both on the same subject and context in a steadier way, and on other subjects and contexts too.

The hypotheses that needs to be validated are the follows:

1. Is there a rhythm typical of any teacher or does the rhythm depends, not only on the teacher, but also on the context and the characteristics of the teaching? Is there a link between rhythm and habitus of the teacher?

2. In a longitudinal analysis with the same class from the beginning to the end of a year of studies is there a progressive greater harmony between the lines of the teacher and the students? In what cases?

3. In a longitudinal analysis of a lesson in what activities is there a better match between the rhythms of the teacher and the students?

4. How the analysis of the traces can support the adjustment of the didactics actions carried out by the teacher?

5. How the analysis of the traces can support the teacher in the educational choices of didactc mediation?

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Notes

[1] The gap between the phenomenal qualities of experience and the measured quantities of physics, for example, the pleasant sensation of speed in a race and the measures of distance and speed themselves. Galileo Galilei (1564-1642) believed that life was made by these two not reducible domains.

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