

SHAPING THE TEACHING: INTERNATIONAL DIALOGUES

Dar corpo à didática: diálogos internacionais

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ABSTRACT

The article uses theoretical approaches as simplicity, neuroscience and enactivism to discuss everyday classroom activities. It tries to transpose the classical bipolar division between mind and body, through these approaches in cognitive science. Two experiments on the body's role in teaching are presented to demonstrate the relevance of the awareness of the body, to improve performance in the classroom. The first experiment uses neurofeedback to measure the body temperature, as a means to understand the role of the body in self-regulation and control of the attention. The second uses a bracelet multi-sensor, which provides data on the energy spent by the teacher in daily activities in the classroom. Italian and Brazilian researchers cooperate in this experimental path of inclusive teaching, to be used in classes with children and adolescents with Attention Deficit Hyperactivity Disorder.

KEYWORDS: Didactics; Simplicity; Enactivism; Neurofeedback

■ INTRODUCTION

The article investigates from an educational perspective the role of the body in the teaching act, trying to associate the points of view of didactics with some recent approaches such as simplicity, neurosciences and Enactivism.

Until recently, the body was always placed in a bipolar relationship in contrast to the mind. In this direction, in the Western thought, there are important contributions from Plato onwards¹, which give the body the role of passive channel of inputs from the brain world, or as mechanical executor of decisions and elaborations of the brain. Descartes has taken over and maintained that position, expanding the rift between body and mind.

In recent decades, there is a growing awareness in the cognitive sciences, the need to consider the

integration (more than this, *embeddedness*) of the brain in the body and the world, to understand aspects of cognition². In teaching the subject has followed different paths, perhaps even by the very centrality of the educational relationship in which two subjects, student and teacher, are fully "immersed", physically and cognitively.

One of the most significant positions is from Dewey and from the activist pedagogy³, which give the body a central role in the educational processes. The American educator criticizes the operative modalities in which are put into action manual activities to solve problems, "the senses are considered a kind of mysterious channel through which information is driven from the external world to the mind". In *Democracy and Education*⁴, the author points out how mind-body separation has two deleterious effects: in this approach, physical activity appears as an intruder, and with it, the body becomes a source of distractions and of useless and harmful processes that must be controlled. The student "brings" to school his body like a heavy burden, which takes up space and resources of the "important" activities (Ibid. 187). On the other hand, the split between mind and direct occupation with things emphasizes things at the expense of relationships and connections. It is also very common to separate perceptions and judgments of ideas, Dewey⁴ argues that, "because it contains an equivalent concept to make

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connections among the parts and not only examine the parts singularly”⁵.

During the second half of the last century, various philosophical approaches put into question the “fossato *galileiano*”⁽¹⁾ and, in particular, the research of Merleau Ponty⁵ appreciated the active role of the body in perception and therefore knowledge.

If before separation and distance from the observer of the world were observed to ensure the validity of knowledge, now is the contiguity between observers and observed and recursion between action and knowledge to ensure that knowledge occurs. On the action new studies that recover the insights of Aristotle, with differences in some points are concentrated. One of these points is exactly the new attention to the body. According to Joas, attention by the body’s role in knowledge derives from the necessity of listening, sensitivity and responsiveness⁶, functions guaranteed by the body in action.

Several approaches highlight the role of the body in the interactive processes between different systems. The Enactivism⁷ resends continuity and recursion brain-body-artifact-world as the core elements of its reflection. The studies of Varela, from the study of the cell, placed in evidence as may coexist the structural autonomy of living systems with the dialogue between them and see the structural coupling mechanism by which the interaction materializes.

Likewise, the theory of empathy⁸ shows how communication goes through processes, in which the subject overcomes his own perspective to approach the other. The same neural circuits⁹ involved in the control of action and the personal experience of emotions and sensations are also activated when they witnessed the same actions, emotions and sensations in others. This would be the process of “attunement” or tuning among many different subjects.

Other studies¹⁰, provide evidence as more or less complicated forms of imitation, learning, gestural and verbal communication found feedback in the activation of specific mirror circuits.

In this direction, are also significant the studies that were developed in the 2000s, aimed at the connection between autistic disorders and dysfunctions of the mirror neurons¹¹⁻¹⁴. Such studies explain the difficulties of autistic subjects on imitation, both in the motor level and linguistic level, in interpreting

the scope of the perceived actions (seen and heard), communication and social interaction.

■ CASES PRESENTATION

In the 70s and 80s, a significant contribution on the role of the body in teaching was given by the studies on psychomotricity¹⁵⁻¹⁶.

The psychomotricity moved toward causing the emersion of symbolic experiences “that have their roots in the unconscious” to get “the deeper strata of the personality and approach the psycho-affective core that determines the becoming of the being”. There is a perspective that completely changes the problematic of education. “It is the availability of the being which will permit the release of desire and the acquisition of the true knowledge. Going beyond means to strive in one’s drives, primitive desires, in the unconscious and find the body, the movement in its affective meaning, the “erogenous body” that education strives to ignore”¹⁶.

Today, rethinking the role of the body requires a revision of earlier views and understanding of its active role in the knowledge and management of actions and communication. The body not only says what we do not mean or do not know what we say, but also intervenes in understanding the world therefore participating of the narrative flow of our doing. If there is a line between the affective and cognitive is thanks to the body, which supports the action in close connection with the language¹⁷.

In the scientific literature of special pedagogy, authors such¹⁸ provide evidence of the body’s role in didactical acting and inclusion processes, which are also held through the mediation of the body where “hands, arms, body, voice” are “basic facilitators of the relationship”. The body and the quality of sign and motor mediation become indicators of quality of an education system marked by inclusive connotation.

The rhythms of didactical action

Reflecting on the corporeity regarding teaching opens new perspectives. In the acting of the teacher, it affects the position, posture and body movement, and especially the hand gestures, tone, intensity and voice.

Likewise, the acting of students materializes through their bodies. The position, gaze, posture are indicators of the state of the students, their participation to the lesson, whereas permitting the teacher to understand the level of attention or, conversely, moments of loss of interest.

The corporeity of the teacher is very significant in the complex system of intermediaries, or “processes of half”¹⁹, through which who teaches puts into action

(1) Understood as the space between the phenomenological qualities of experience and quantitative measures of physics, such as the delightful sensation of speed in a race and the distance traveled with the speed reached in it. Galileo Galilei (1564-1642) believed that life was based on these two irreducible domains.

the activity of regulation in action²⁰, which enables you to rearrange the planned route and find balance between different logics and tensions.

The article proposes the individuation and testing of possible indicators to detect the participation of the body in a didactic mediation. Despite the interest in corporeity, there is a lack of experimental research that allows us to compare physical and metabolic information with activities and behaviors in the learning process.

In sport and analysis of movements, instruments that provide information related to caloric and energy expenditure from the subjects are more developed. The purpose of the experiments reported here is to use these instruments in school environments.

The hypothesis of this paper: is it possible to analyze the rhythms of teaching through physical and metabolic variables?

The concepts of structural linkage, empathy and attunement to describe pathways where two guys go into “tuning” were previously introduced. Is it possible to apply these concepts to the teacher-student relationship and emphasize how the tuning favors learning processes?

Returning to concept of empathy⁸, according to which “it is possible, at the same time, to maintain the point of view of the subject (egocentric) and change the point of view, which places the subject in the other’s place (allocentric). I define this simultaneous multi - perspective operation”. There are two parallel processes that materialize in the didactical act: on one hand, the teacher is placed on the student’s perspective and listens to understand the obstacles he encounters and the naive conceptualizations, on the other hand, the student is placed in the epistemological perspective of the subject, in particular, the language and the point of view to observe the world.

For the analysis of empathy, this work focuses on the rhythms present in the classroom. Communicative methods of teaching, the effort and intensity with which he conducts activities following an undulating way, as demonstrated by the experiments reported below. Similarly, the act also follows a student’s swing tempo in terms of effort, interest and attention. Phases with a higher emotional-cognitive tension alternate with periods of lower intensity and time succession of phases in drawing an oscillation characterized by certain regularity.

It is important to note that in the didactic acting many rhythms are present, one for each actor and consistency between such rhythms, if present, it indicates a line in the class group. It is also necessary to emphasize that there is a rhythm in any form and is not possible to make hypothesis about a continuous tension and a continuous attention.

The teacher, as an orchestra conductor, regulates the rates of development of the lesson. The teacher, for regulation, operates on rhythms of the lesson development and participation of various actors intervening on three main variables: (1) frequency/period of oscillation, (2) intensity, (3) synchronization between the rhythm itself and students. To make the rhythms consistent with each other and functional to learning, the teacher has available strategies, instructional facilitators and his own communicative modalities. Furthermore, the rhythms are suitable to the relevance of the covered topics, the presented difficulty of the thematic and ultimately to the knowledge of the rhythms of both students’ attention and the management of attention.

How to define three variables and how to operate within them? By **period** we mean the length of an oscillation, which allows the teacher to take into account his own times during the physical and mental efforts and the students’. By **intensity** we mean the height of oscillation, which allows highlighting the main points of interest in the subject or recovering the attention of students in a specific stage. By **tuning** we mean that the waves of acting in the class with various subjects are in a specific phase, i.e., the rhythms of teachers and students have similar peaks and contemporary periods; a phase of progress in several waves ensures harmony between students and the teacher and promotes learning. Techniques to catch and shoot (*catch and trigger*) (Proulx) are often adopted by the teacher and are functional to tune the various rhythms present in class.

The authors²¹ put in evidence as “learning is an agreement (*enactment*) constant of incarnated/embodied sensibilities rather than a sequence of conscious choices (...) strategies such as recursion, questions in the appropriate moment to emphasize, practice, discussion and re-symbolization, can help guiding students’ attention, while the elaborate explanations, extensive instructions and decontextualized formulations should not be emphasized”.

The following illustrate some potential research directions, which are currently at the center of theoretical reflections and experimental ways of the research groups of Italian and international universities.

Experiment 1. Neurofeedback and didactic metric

This research experience is part of a larger project involving researchers at the University of Macerata (Italy), the Universidade Federal do Rio Grande do Sul (UFRGS) from Porto Alegre and UNESP from Marília, São Paulo, Brazil and, approved by the Committee of Ethics in Research

with Humans under statement nº 663/2012. This project aims to analyze, design and realize inclusive didactics in classes with children and adolescents with Attention Deficit Disorder and Hyperactivity Disorder. From the recent findings of neuroscience, procedures based on the analysis of videos with neurofeedback to understand indicators related to didactical metric were incorporated.

It presents an experiment that used neurofeedback instruments integrated with a sensor to measure the body temperature, in order to inquire about the role of the body in the processes of self-regulation and management of attention and activation (arousal).

Neurofeedback is a noninvasive method that allows self-regulation of activity through specific training and awareness of physiological information converted by appropriate devices, sounds and images. The scope of neurofeedback is to enhance awareness and understanding of how the activities of thought influence the physiology and vice versa.

These devices are considered part of the broad spectrum of biofeedback techniques based on feedback from various physiological signals, such as electrical activity of muscles or skin body temperature. In this sense, we find in the literature various types of biofeedback: muscles, temperature, heart rate, breathing, skin conductance, brain waves (neurofeedback). These methods are based on a set of software and hardware, directed to the observation of some indicators or physiological parameters: frequency, amplitude, coherence and location system. They are used for specific training, which aims to actively regulate personal activation (arousal) and rebalance these parameters.

The procedures can be used in international clinical setting for the treatment of attention-deficit disorder and hyperactivity²²⁻²³ and autism²⁴⁻²⁵. They can also be used to improve self-control and self-regulation at work to enhance the sporting activity, to improve academic performance and to decrease stress and the called Burn out syndrome.

During neurofeedback training electrodes are placed on the head to check brain activity. One can associate other instruments of control of bodily indicators which transmit the signals through devices directly to the computer. On the screen are displayed with delay of a few milliseconds, the brain waves and other bodily indicators, in the form of bars, video game or cartoon. The purpose of training is to increase attention and decrease the tendency to distraction. Thus, when the level of attention of a person decreases (as in school or at work), the display (colors and shapes) on the screen changes in a way that the person perceives and self-regulate her behavior.

In the reported experiment, neurofeedback has been integrated with a sensor to verify the peripheral body temperature (from the fingers and hands). Studies showed that the temperature is significant for the activation of the nervous system and conditions of emotional stress, when it is recorded peripheral cutaneous vasoconstriction, with consequent decrease in temperature.

After calibration of the instruments, by specialized professionals, bands with electrodes and thermocutaneous sensor were placed on the heads of researchers. They were asked to solve two similar activities in a foreign language: in the first the researchers did not have any prior instruction, in the second; they were suggested solution strategies to the beginning of the exercise.

We present some initial results with reference only to the correlation between body, management of personal attention and level of activation and attention, obtained during the solving of the two activities described above.

■ RESULTS

The results of the experiment were analyzed from the comparison between the curve of attention during the resolution of exercise and thermocutaneous detection measured by the sensor.

Indicators observed during the exercise were:

- Frequency of the rate of attention;
- Intensity of the peaks of attention;
- Consistency between the curves of attention and temperature.

Regarding the first exercise, frequent moments of decreased attention after the first ten minutes of activity were recorded. These moments correspond to attempts at solving activity in a foreign language. The passages between attention and relaxation were recorded infrequently.

Almost absent result the consistency between rhythm of attention and the choice of strategies for solving the exercise.

During the stages of decline or little activation, peripheral cutaneous vasoconstriction and lower temperature were recorded, which explains the general cognitive-emotional stress situation.

Following this first implementation, training was repeated after analyzing the parts of the job where losses and meager attention level of activation were recorded. The specialized trainer provided some resolution strategies for these parts of the task. The same indicators were taken into account. The results showed a regular wave frequency and greater intensity of the peaks of attention, over the first exercise. The peaks correspond to the choice

of strategies to apply to the year and a peripheral cutaneous vasodilation, which explains the situation of lower cognitive-emotional tension.

This first experiment showed the importance of the correlation of body and bodily indicators in the processes of self-regulation of attention and personal level of activation.

Experiment 2.

SenseWear Armband and didactical action

The present study relates to research recently undertaken by the research group of Professor Rossi, on themes of Enactivism, developed in collaboration with the research group of Professor Sibilio, from the University of Salerno.

The experiment used the SenseWear Armband (SWA), multi-metabolic band sensor, which was placed on the triceps of the right arm, for a sustained period of time. The SWA provides extensive information on the subject tested and has many applications in medicine and other health areas. It is composed of a set of instruments: accelerometer, thermometer, galvanometer and calorimeter. Based on the results of the various instruments, the device provides a summary measure of METs (Metabolic Equivalents of Task).

The teacher used the SWA in continuous way for a week, i.e. both in the classroom and in the hours of free time. During some lessons, two students also used the SWA. Moreover, the lessons were recorded on video in order to make the overlap data from the SWA to the video. While the instrument detects energy consumed by the teacher during

class time activity, the video is useful to give an idea of what the teacher does during a lesson (read, sit, stand, walk, talk, speak, explain, argue, etc.) and meet the energy spent on these activities.

■ DISCUSSION

From the observation of the data of a week, considering the didactic activities and everyday life, it is noted that the value of the teacher's METs during a frontal lesson, especially when he is standing on his foot and talking to the class, is similar or moderately slightly lower than the value of the same subject during walking in a normal rhythm. It is interesting to note that in both cases the accelerometer detects very different data, i.e., the movement of the teacher during class has a value much lower than indicated during walking, while the value of the METs is similar. This indicates that the teacher during the lesson has a high energy cost, even with minimal displacement. In other words, the teaching activity is both physical and cognitive. Moreover, the intensity, i.e., energy consumption measured by SWA, is higher in two specific cases: the content in important moments, when the teacher is placed entirely on the situation and underlines the importance of the faced issue: with tone and voice intensity, with the movement of the body and arms, almost like conducting, and the phases in which the teacher perceives a decrease in students' attention.

The figure 1 shows the graph of the class on 04/12/2012

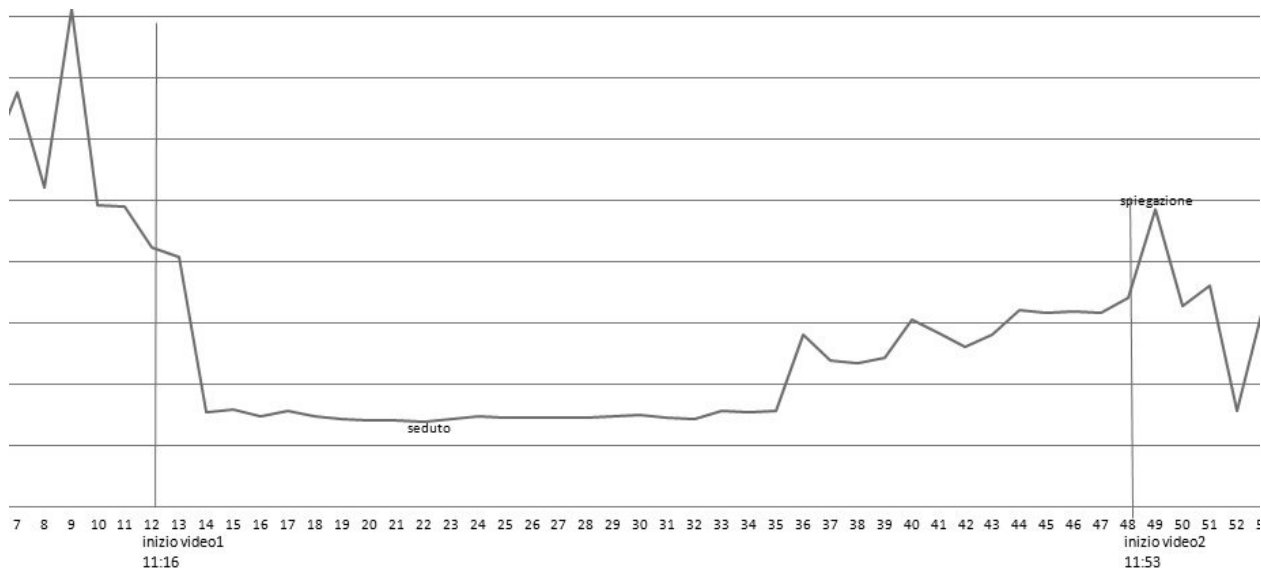


Figure 1 – The figure 1 shows the graph of the class on 04/12/2012

As you can see from the chart, the didactic mediation develops alternating between dynamic and static movements, with different levels of energy consumption; this is obvious if we consider that during the lesson the teacher performs different activities and actions.

It is interesting to note that even in static moments, regardless of the absence or reduction of large movements, it was observed small changes in energy expenditure.

During the interval, ranging from minute 3:15 to minute 21:20 (Figure 2), the teacher sits and watches

the lesson of another teacher. This explains the low value of the METs. Still, we can notice small bumps on energy consumption at specific points; watching the video we noticed that those peaks correspond to times when the teacher is focused on activities like flipping through the book to find specific pages, intervening to clarify or deepen concepts and associate information to the present situation, describing something, remembering past issues. The differences are small and tentative conclusions should be based on more data.

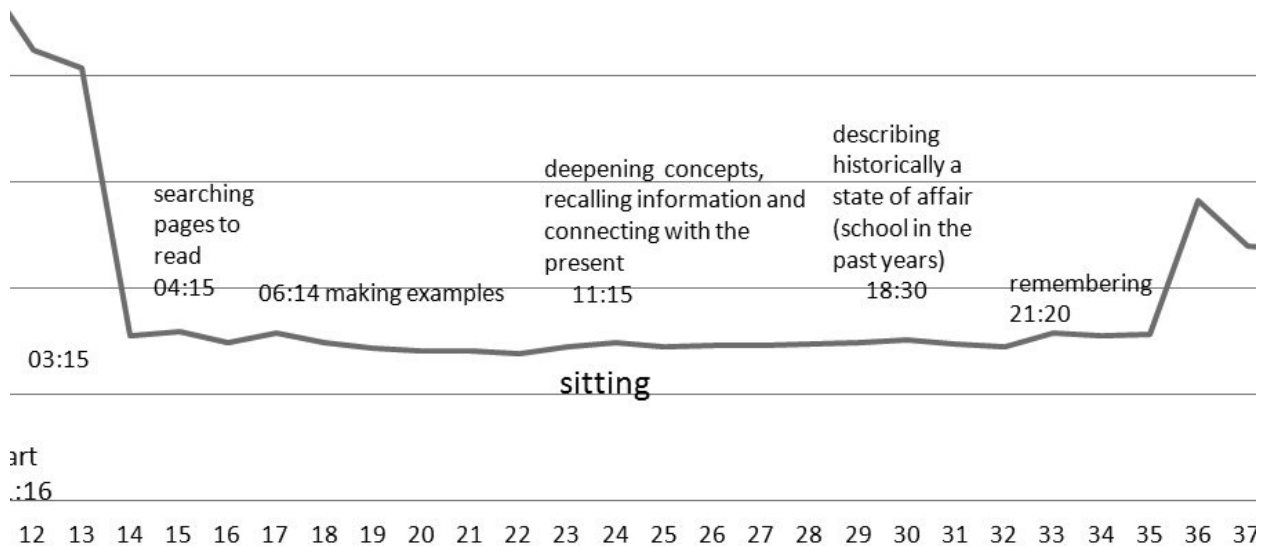


Figure 2 – Minute interval between 03:15 and 21:20, of the class on 04/12/2012

Even more significant data were obtained from the confrontation between the strokes of the teacher and the students during the two frontal, expository and dialogic class, which happened on December 5, 2012.

The graph (Figure 3) shows three paths: the continuous trace is the teacher's METs, dotted and dashed traces are the two students' METs.

From minute 17:50 to minute 18:10, a group work happens. The teacher talks among the groups, the pace is a period of about 3 minutes and the wave is constant in average amplitude. Furthermore, there is no consistency between lines of the teacher and the students. Students are performing their activities and there is no tuning with the teacher's graph, nor the line between students' graphics.

The situation is different in the period that goes from minute 18:10 to minute 18:45. In this period the teacher gives an expository, frontal lesson that incorporates key concepts of the lesson. From the

analysis of the stroke it can be noted a rhythmic doing and the reference wave which is closest to the action of the teacher in a period of 5.2 minutes. It is important to highlight the presence of a primary wave with peaks in 2, 4, 6, 8 and a secondary wave with peak intensities lower in points 1, 3, 5, 7, 9. Examining the video it is noted a growing intensity of the lesson in line with data from METs.

In this case, there is synchrony between the curve of the teacher and the students. The points at the peaks of the teacher's curve are, in most cases, the points where the traces also show peaks of students'. The minute 18:23 student 1's wave, always sitting, shows a peak due to the intense activity of taking notes. The student 2, indicated by a dashed line, there is a range of energy consumption lower than the Student 1 and the peaks are consistent with the teacher's, even if the maximum was anticipated even if a little, as if the activity is concentrated at work and anticipation and after synthesis.

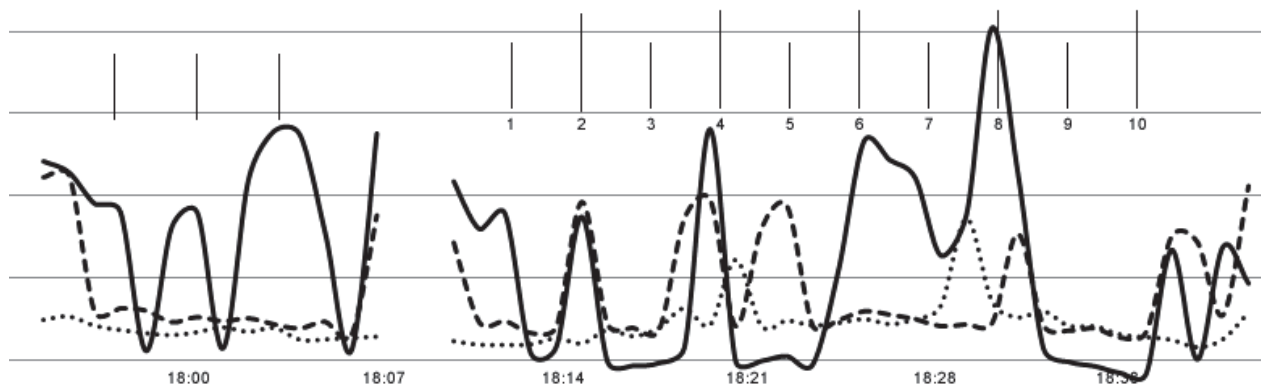


Figure 3 – Comparison between the traces of the students and the teacher during lecture on 05/12/2012

■ CONCLUSIONS

What do the professionals who work with didactics look for when they use non-invasive methods to monitor emotions, electrodermal activities, biofeedback, galvanic skin responses, heat flux, among other variables, during activities in the classroom instruments?

An assumption that is based on the use of these instruments is that the skin conductance, or electrodermal activity (EDA), reveals anxiety, attention, arousal, when the value increases, and decreases when there's calmness and relaxation. The instruments demonstrate some physiological functions and give clues about methods for working with them aiming awareness of learning, i.e. metacognition. Signs and styles, silent or usual, may be revealed through the information provided by the instruments. All learning processes involve changes in behavior, attitudes, feelings, etc. Some technologies can help these changes serve as a mirror to work with strengths and weaknesses in the teaching relationship. They are secondary, auxiliary means to achieve results, not replacing the essential expertise of the teacher.

The challenge of both experiments is to improve the awareness of teachers and students in the learning process, using tools such as those described. These tools are widely used in sports, but less used in cognitive processes and learning. In the reported experiments, the instruments were used to study the didactic act.

Many other instruments can be used to improve teaching and teaching-learning process: from special keyboards (expandable, reduced, programmable, associated with video, etc.), ergonomic mouses, touch screen, sensors, accessible games, among many other hardware and software. Some more specialized, such as *EyeGaze edge standart* (LC Technologies), mono-ocular system that allows

alphabetical direction and management of computer communication through movement of the pupil. A high resolution telecamera is positioned below the monitor with an infrared light that intersects the position of the pupil, which is interpreted by software and transformed into information of the focus of the person using the equipment. A person looks at the letters on the virtual keyboard or the icons, which after a time are selected on the display. Thus, the words will be composed and can also be spoken by the PC (Loquendo vocal synthesis). The set consists of a telecamera, a small PC, an LCD monitor.

Another monitoring tool is the *Sensor Q* (Affectiva), wireless biosensor that measures emotional arousal, through skin conductance. The modulation of high or low electrodermal activity demonstrates changes in moods of people. The *Sensor Q* is used in various fields: education in general and learning problems, clinical and market research, non-verbal communication, attention deficit disorder, hyperactivity, depression, among many others.

Other sensors are adaptable to different needs, such as controllable *integraswitch* through the mouth and breath; *leaf* to be used with the forehead and the head, *grasp*, controllable with the fist; *fingerbottom*, pressing with the fingers, among many others.

The considerations previously made in this article, indicate that the participation and activities of the body by means of rhythms, expressions, movements and gestures of teachers and students, are related to teaching mediation in learning processes. Active participation, based on the complexity of the body, following the brain-body-artifact-world way are lines of thought from authors such as Varela⁷, Berthoz^{8,26-28}, Gallese^{9,30}, Noe³¹, and authors of psychomotor tradition.

The boundary between senses and physical data becomes increasingly tenuous. The body is not just a weight to be loaded into the classroom

and, together with the senses, forming a whole with the mind. The mind is not an organ; learning is not only a physical process in our body. The mind is present throughout our body, resulting in our actions, thoughts and feelings. Despite the importance of this, many mental processes remain an enigma, some more than others. The future use of this type of experience needs to be more organized, systematized, compared, quantified, to meet the requirements of science.

The analysis described certainly has an indicative value and suggests a line of research very interesting. The path needs to be expanded, operating on the same subject and context of continuous basis or on other subjects and contexts.

The hypotheses that need to be validated are:

1. Is there a typical rhythm for each teacher or does the rhythm depend on, besides the teacher, the context and characteristics of the teaching activity? Is there a link between rhythm and teacher's *habitus*?
2. In a longitudinal analysis of the same class, from the beginning to the end of the school year, is there a progressive greater tuning between teacher's and students' tracings? In which cases?
3. In a longitudinal analysis of a lesson, in which activity is there a better tuning between the teacher's and students' rhythms?
4. How can the analysis of the traces be an aid to set the didactic act during activities performed by the teacher?
5. How can the analysis of the traces be an aid to the teacher in choosing the didactic mediation?

In future studies, the two study groups intend to develop the preliminary results, particularly regarding the complex dynamic management of classroom teaching and the pace of action. As well as the role and participation of bodies of teachers and students, the reciprocal processes of self-regulation in didactical metric.

RESUMO

O artigo utiliza abordagens teóricas como *simplexidade (simplicity)*, neurociências e enativismo para discutir cenários cotidianos de sala de aula. Busca transpor a clássica divisão bipolar entre mente e corpo, por meio destas abordagens das ciências cognitivas. Dois experimentos sobre o papel do corpo na didática são apresentados para demonstrar a relevância da conscientização do corpo, para melhorar o desempenho em sala de aula. O primeiro experimento utiliza o neurofeedback para medir a temperatura corporal, como meio para entender o papel do corpo na auto-regulação e gestão da atenção. O segundo utiliza um bracelete multi-sensor, que fornece dados sobre a energia gasta pelo professor nas atividades cotidianas em sala de aula. Pesquisadores italianos e brasileiros cooperam para que esta trajetória experimental de didática inclusiva, seja utilizada em classes com crianças e adolescentes com Déficit de Atenção e Hiperatividade.

DESCRITORES: Didática; Simplexidade; Enativismo; Neurofeedback

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