Proceeding

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Body and didactic mediation. Experimental use of a Sense Wear Armband in a university context

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ABSTRACT

Rossi PG, Sgambelluri R, Prenna V, Cecoro G, Sibilio M. Body and didactic mediation. Experimental use of a Sense Wear Armband in a university context. *J. Hum. Sport Exerc.* Vol. 8, No. Proc2, pp. S10-S18, 2013. The aims of this study was to understand whether instruments used for motion analysis can detect significant information about the processes of learning and teaching. Moving from Enactivism and the awareness of the embeddedness of the brain in the body and world during cognition, we tested a tool that provide data related to caloric and energetic expenditure of subject (Sense Wear Armband) in a non specialistic school setting, to understand if it is possible to detect the effective bodily participation during cognitive processes (in our experiment, during didactic mediation). For starting the experiment within using a Sense Wear Armand we monitored the activity of didactic mediation done by the professor to detect the energetic expenditure, compared with the other kinds of activities during the day; we also monitored two volunteers students that followed the lectures. Data of every lecture were then elaborated by the specific Sense Wear Software and shown through graphs that we analyzed. Graphs showed that didactic mediation developed as a succession of dynamic and static moments, with different levels of energetic expenditure; what we found interesting is that a minimal but not negligible component of metabolic activity seem to be involved even in essentially intellectual activities. This paper describes only the first step with the first results of our work. The analysis performed here has only an exploratory value and we think it might be useful to the development of the experiment; we don't believe we have obtained definitive results, but only useful information for the development of the survey. We hope to move forward as soon as possible. **Key words**: ENACTIVISM, EMBODIMENT, SENSE WEAR ARMBAND, DIDACTIC MEDIATION.

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INTRODUCTION

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).

Many authors and perspectives have moved in this direction: Husserl's phenomenology (1900), Merleau-Ponty's phenomenology of perception (1945), Maturana's studies on *autopoiesis* (1976), the concept of *embodied mind* of Lakoff and Johnson (1999), the perspective of the Embodied Cognition (Kiverstein and Clark, 2009) and finally the Enactivist theory (Varela, Thompson, Rosch, 1991, but also Begg, 2000; Proulx, 2004, 2008; Noe, 2010; Rossi, 2011).

For Enactivism, the knowing subject is immersed in the world through a body with a biological, neurological, sensory-motor structure, a body with skills and abilities which offers certain possibilities of action[2]. The "living body" (Thompson, 2007) put the subject in relation to the *other-than-self*, it interacts with its surroundings, and en-acts the reality catching the *trigger*s (Proulx, 2004) that it offers. Many authors talks about a bodily manner to be in the situation. There is a body that speaks, listens, learns (Sibilio, 2011).

If the subject is immersed in the reality, in relation to the other-than-self, knowledge is not a rational-cognitive and purely individual process, but rather seems to emerge from a circular flow of sensory-motor interactions between brain-body-artifact-environment (Rossi, 2011).

The findings on mirror neurons (Gallese & Rizzolatti, 2001; Welsh, 2007) in the field of neurosciences have contributed a lot to enhance the connection between mind-body-artifact-world, so as to suggest that the cognitive unit lies into the organism-environment unit (Damiano, 2009, 2011).

If theoretical insights have gathered awareness about this strong relationship, experimental researches that allow us to compare bodily and metabolic data with activities and behaviors related to cognitive and learning processes haven't been developed yet.

In the field of sport and motion analysis, tools that provide data related to caloric and energetic expenditure of subjects are developed. These instruments have so far found little application in the non-motor didactic.
One of these tools is the Sense Wear Armband. It is a metabolic multi-sensor band that is worn on the triceps of the right arm for a continuous period of time. It makes continuous measurements of physiological parameters and data of physical activity determining the energetic expenditure, through specific algorithm. These sensors calculate and store the following data:

- Total Energetic Expenditure.
- Active Energy Expenditure.
- METs (displacement of our morpho-functional ability).
- Total number of steps.
- Duration of physical activity.
- Duration of sleeping.
- Time of lying down.

[2] "Cognition depends on the kinds of awareness that come from having a body with various sensorimotor capacities". F. J. Varela, E. Thompson, E. Rosch, *The Embodied Mind,* London: MIT Press, 1991, p. 173.

The tool uses four physiological sensors:

- Skin surface temperature.
- Galvanic skin response.
- Heat dissipation.
- 2-axis accelerometer.

The Armband acquires data for periods ranging from 10 minutes to two weeks and stores them in its memory for a subsequent transfer into PC. Through the included Sense Wear Software it is possible to view all the data collected and therefore have an accurate and precise statistic of physiological and metabolic values. For exporting and processing data and to have a graphical representation of them it is instead necessary the Sense Wear Professional Software.

Sense Wear Armband finds application within nutritional diagnosis, metabolic patologies, pediatrics, pulmonary and cardiac studies, geriatrics, internal medicine, occupational medicine, neurology, psychiatry, screening of sleep. It is clear that applications in other kinds of fields aren't developed yet.

We propose to test their use within a non-specialistic school setting. Why the school setting? Because it is a context in which the major component of the work is mental, cognitive, not physical, and it would be interesting to understand whether instruments used for motion analysis can detect significant information about the processes of learning and teaching.

This article describes only the first step of the experiment and the first results that we could get, because several technical problems have forced us to interrupt the activities waiting for a solution.

MATERIALS AND METHODS

Setting
The research is carried out during lectures of Didactic at the Faculty of Science of Education, University of Macerata (Italy).

Participants
We started with a first experience (December 4th, 2012) with the Professor of Didactic. We proposed to start monitoring a single subject; we didn't know what kind of information we would have obtained through the use of the Armband and if they would have been significant or not. We chose to start with a single survey to eventually extend the sample in case we realized that it was worth it. For a second experience (December 5th, 2012) we involved two volunteers students; unfortunately, we weren't be able to extract and analyze data of students in time for this paper.

Instruments
The tool used in the experiment is the Sense Wear Armband combined with video recordings. Why the Armband? Because it detects the energetic expenditure of a teacher during all the different moments and activities of the lecture. The final graph elaborated by the software showed two lines: one indicating the amount of movement, the other was the related energetic consume. This was useful for understanding the amount of energy expenditure in relation to the amount of movement performed by the subject during the lecture.

Why Video recordings? Analyzing videos was useful for having an idea of what the Professor actually does (reading, sitting down, standing up and walking, explaining, remembering, simply chatting, explaining or argumenting…) and knowing the related energetic expenditure. Combining the data from the Armband with videos analysis we could understand which activities or functions could modify the energetic expenditure of the subject involved.

Procedure
First step: Install Sense Wear Software on PC.

Second step: Configure the Armband for the subject tested, opening the software and entering information about the subject in the Subject Info Tab.

Third step: Wear the Armband on the triceps muscle of the right arm touching the skin; when the monitor makes secure contact with the body, the Armband automatically turns on and starts to collect data. Professor first, and after the students, wore the Armband during 2 hours of lecture of Didactic. In our case, it was important that the Professor wore it all the day in order to compare the measurements obtained during school hours with those for other daily activities. The first measurement took place on December 4th, 2012, from 11 to 13 am.

Fourth step: Retrieve Data. After the lecture, using both the Software we extracted the data into an excel file and we get a graph for a subsequent analysis.

RESULTS

Figure 1 shows the energetic expenditure during the lecture, with the Armband worn by the Professor.

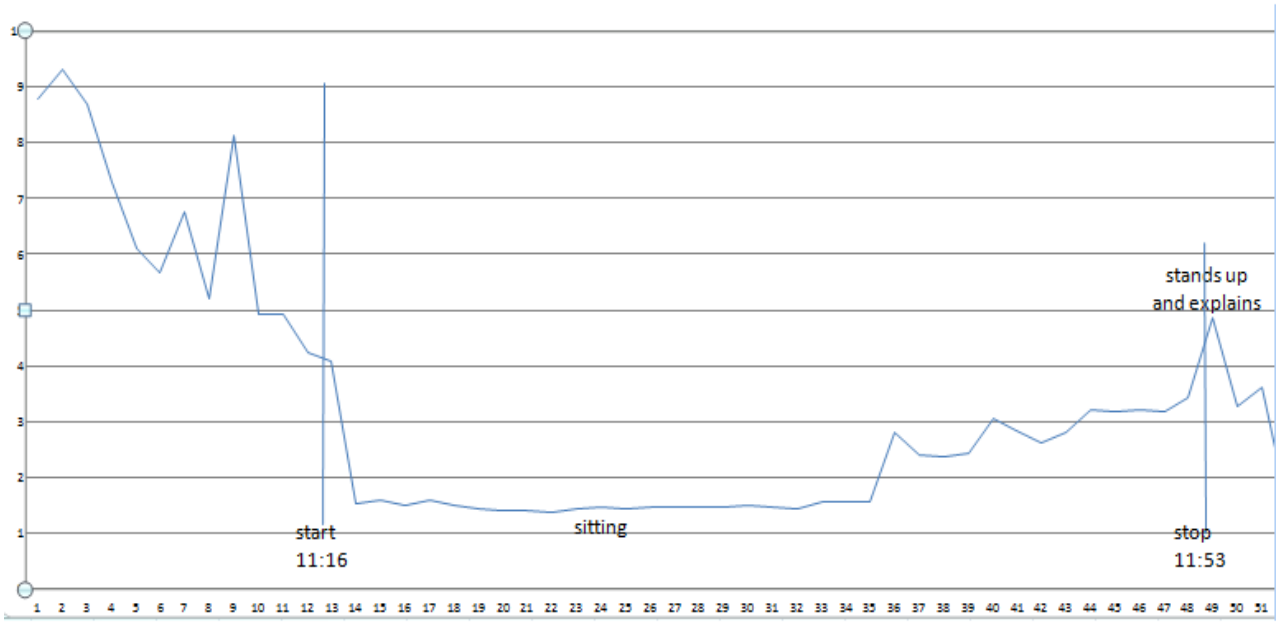

Figure 1. *Energetic expenditure during lesson.*

We didn't take into account all the values detected by the Armband: we focused on the relation between time (X axis) and energetic expenditure (Y axis).

The blue line shows the different levels of caloric expenditure related to the different types of activities during the phases of the lecture.

The period I focus on lasts about 40 minutes (11:16-11:53 am).
Here is also a describtion of the lecture to point on evidence the different moments and activities the Professor did during it.

- At the beginning he talks to students about the functioning of the Sense Wear Armband and he explains the purpose of the experiment; he asks for the participation of two voluntary students; he's standing in front of the class and walking.
- At minute 2:50 he takes the textbook and explains how the lecture will develop.
- At minute 3:21 he sits in front of the students relying on the first row of desks, and he starts the explanation of the chapter of the day.
- At minute 3:55 he explains the reason why he chose to adopt the method of making a lecture by sitting, following the text step by step.
- At minute 4:15 he looks for pages to read in the text underlining the topic.
- At minute 4:20 the explanation begins.
- During the explanation, at minute 6:02 he has 4 seconds of silence, than he introduces the pedagogical and organizational dimension of the didactic action.
- At minute 6:14 he refers to the present connecting what he's talking about to their activities, he changes tone in voice.
- At minute 7:12 he introduces another content.
- At minute 7:36 he starts to read aloud a few lines on the pages introducing clarification of terminology.
- He continues explaining fluently contents in the book for few minutes.
- At minute 11:16 he closes the book to deepening a concept - the *institutional analysis*; he closes eyes, he seems to make an effort to find the right words and articulate speech as well as possible.
- At minute 14:00 he refers to our current society.
- At minute 14:44 he introduces the topic of the evolution of school during the past century; he explains deeply with historical information.
- He describes the evolution of school in Italy for few minutes.
- At minute 18:17 he focuses on an interesting concept: programs for school in 1985; he's making an effort to recalling information to explain to students.
- At minute 20:47 he refers to the our time, always bringing out differences among time.
- From minute 23:00 to 25:00 he recalls information about Programs for Nursery School
- At minute 25:00 he stands up and continues walking while explaining

Our interest was focused on understanding if it was possible to detect any energetic expenditure even in situations of intellectual activity, reducing all forms of movement and physical activity, so as to have data not dependent on movement.

For this purpose, the Professor decided to sit for a period of time while he was teaching, so to reduce as much as possible the influence of any physical effort that might obviously have lead to an increase in energetic expenditure. The Figure 2 shows the energetic expenditure of the period during which the Professor was sitting.

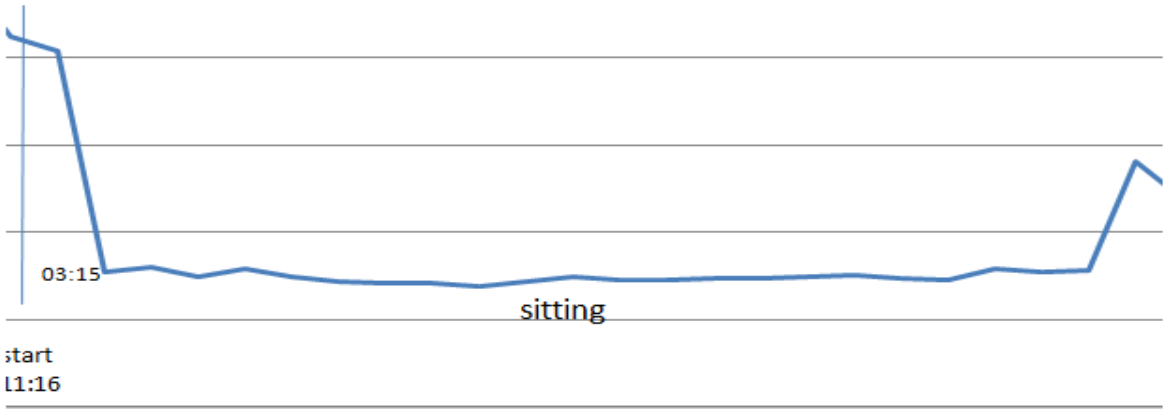

Figure 2. *Energetic expenditure while the professor was sitting.*

DISCUSSION

As shown by the Figure 1, didactic mediation develops as a succession between dynamic and static moments, with different levels of energetic expenditure; this is an obvious fact because the Professor does several different activities during the lecture. The blue line of the energetic expenditure is not linear, but it shows maximum and minimal point.

An interesting thing we noticed after a first experience is the following: there are some moments during the activity of didactic mediation in which, despite of the absence or reduction of movements, there can be revealed little changes in the energetic expenditure. This is quite significant comparing to the fact that in other daily activities such as eating, sleeping or others the caloric expenditure detected was less.

During the period from minute 03:15 to 21: 20, the Professor was sitting but yet we can see small differences in energetic expenditure related to specific points (see Figure 2).

We asked ourselves what kind of cognitive activity was the Professor doing during those moments to justify those changes. May they be related to the happening of cognitive processes?

By watching the video, we noticed that those peaks referred to moments when the Professor was concentrated in activities such as browsing the book to search for specific pages, making examples to clarify concepts, explaining concepts searching an adequate terminology, recalling information connecting them to the present, describing a state of affairs of the past, recalling details about School in the past.

The following Figure 3 shows in detail the cognitive activities related to the different moments.

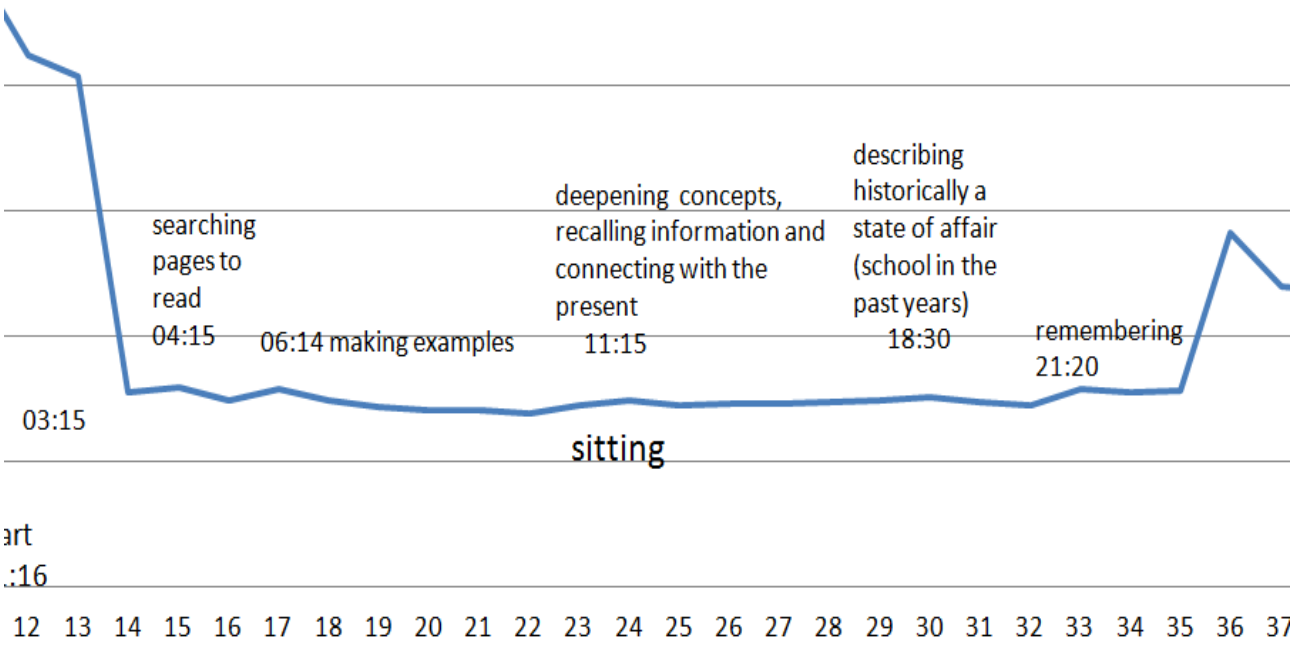

Figure 3. *Cognitive activities while the professor was sitting.*

CONCLUSION

Our aim with this experiment was to detect and, eventually, measure bodily activity during learning and cognitive processes: testing the Sense Wear Armband on a Professor during University lectures, we tried to detect the energetic expenditure of a subject involved in intellectual activities, reducing as much as possible the amount of movement.

We have worked on some first results that showed us moments in which a bit of energetic expenditure seemed to appear even in absence of any physical activity.

Watching video recordings we identified those moments with activities such as remembering, deepening concepts, searching for a correct terminology…

What is interesting for us is that in all these moments the Professor was really making an effort: it wasn't a physical effort, but a mental one.

So as to say that a minimal but not negligible component of metabolic activity seemed to be involved even in essentially intellectual and mental activities.

As I've introduced, two volunteers students have been involved in the study. We thought that it could give interesting information since the setting in our University is particular: desks are arranged in rows very close together with chairs fixed to the ground, students sit very close almost "elbow to elbow" with one's another, and they are practically immobilized, forced in a very limited space, with a limited freedom of movement and therefore a reduced activation at the physical level. We're waiting to have all the data and graphics so to analyze them.

We think it would be interesting to understand if there can be revealed any relation between the energetic expenditure of the Professor and the one of the students during the same lecture.

As I said before, these are the only data that we were able to analyze. Unfortunately, Sense Wear Professional Software is now no longer available for us. So, At the moment it is impossible for us to export new data and work with graphics.

The experiment described here is only the first step of a challenge that we would like to deepen. We hope to move forward as soon as possible.

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