Didactics and Movement Learning in Documents on Physical Education and Sport in Lower Secondary School in Italy

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Abstract In recent years, physical education and sport in Italian school is in evolution. In one hand the complex system of ministerial education is described in documents continuously updated and the school's secondary lower school has been reformed. In the other hand, new discoveries about how the mind works and the relationship to mechanisms of the movement have changed the scenario of scientific theories in educational psychology, so the role of physical activity in the learnings is focused by didactics. The aim is to identify if in ministerial documents on lower secondary school on physical education and sport if there is the new scientific basis of movement and the relating didactics. Method is made by two approaches that joins in a specific new integrated one. Theoretical-argumentative approach about scientific paradigms on motor control and its learning and historical-documentary approach about the ministerial documents on teaching activities. Deductive approach on motor control and learning paradigm applied on ministerial documents. Results do not carry out any particular aspects connected to the new neurological theories applied motor control and learning. All ministerial documents does not provide any reference of motor imagery, open loop, closed loop and didactics of movement. In conclusions the data are in opposite way to update regulation documents according to new scientific evidences. It may be useful to deepen further the study and deliver the results to the governmental experts for the necessary updates to fill up the vacuum.

Keywords: education, cognitive approach, ecological approach, dynamic approach, motor control

1. Introduction

In studies on cognition and learning, a new paradigm was outlined in recent years: the emphasis on abstract aspects of thinking, linked to formal rules and separated from the biological, cultural and material context, gives way to a vision that places the cognitive processes in a learning context, in a relationship of interdependence with assumptions of biological nature and cultural and material context.

"Situated", "distributed", "social", "embodied" are key words that explain how intelligent behaviour is a manifestation of biological bodies acting in a cultural and material environment given, modifying it (Hutchins, 1995; Lave, 1988; Maturana & Varela, 1987; Suchman, 1987, Varela, Thompson & Rosch, 1991). The traditional distinction between abstract and intuitive aspects of learning loses meaning, while are gaining ground the body and movement, claiming their central role in cognitive processes: the body is the necessary condition of experience and represents perceptual opening to the world, and the perception involves the movement.

The definition of motor learning to which this paper refers is that of Schmidt and Wrisberg:
"Motor learning is an internal process that reflects the level of individual ability and performance and could be evaluated according to the relative stability of the executions of a task." (Schmidt and Wrisberg, 2000).
In the context of sport and physical education the most common approaches to motor control and motor learning are: cognitive approach, ecological approach, dynamic approach.

The different approaches are distinguished by the position and the role they attribute to prescriptive mental structures: representations, knowledge, motor plans, and schemes in the production of motor skills. In the context of sport and physical education the most common approaches to motor control and motor learning are in three different scientific steps:

1. cognitive approach
2. ecological approach
3. dynamic approach

1.1 Cognitive Approach

The motor control theories developed in cognitive psychology have generated a significant amount of educational applications.

According to this formulation, processing of information from sense organs and proprioceptors allows the system to correct the movement at execution time (closed-loop motor control, Adams 1971). The closed-loop motor control assumes that the movements are sufficiently slow to allow correction during implementation, based on the data from the feedback.

In shorter time, or when motion is quicker of nerve impulses conduction, the movement is not susceptible of correction in progress and is programmed completely in the central nervous system due to the inability of the brain to process information and data below the threshold of two hundred milliseconds (Open loop motor control, Schmidt 1985, Keele et al. 1986).

The cognitive theory of motor learning is directly derived from the integration of open loop (motor programs) and closed loop (feedback) motor control models.

The processes allow the opportunity to compare in real time (closed loop) or later (open loop) obtained results and expected results, triggering a process of adjustment and refinement of movement and of motor program. The generalized motor program "is a motor program that defines a model (pattern) of movement; this allows flexibility to adapt in order to produce variants of the motor pattern adapted to the changed demands of the environment" (Schmidt and Wrisberg, 2000).

1.2 Ecological Approach

The ecological approach does not consider necessary to use prescribing mental structures: the action is directly available to those who act in their own environment. In other words, the central nervous system has properties of self-organization that do not require the use of a motor program. In the ecological approach the central nervous system is not regulated by specific laws, but it developed from the environmental influences on the neuronal groups that specialize on specific tasks. (Edelman, 1987).

For Gibson (1986), the subject is able to perceive what the environment allows him to make taking into account his physical abilities, according to his age, his size, his experience level. He called these phenomenon affordances (C. Fowler, grounding Turvey, 1978).

In the first approach, motor learning means to stabilize an efficient motor program according to special processing information. In the other approach, motor learning is to seek the adaptability of the movement as resulting by the diversity of the environment and the specificity of the individual (Carnus & Marsualt 2003).

1.3 Dynamic Approach

Motor learning, in this perspective, is defined as the construction of a new coordination, adapted to the needs of the prescribed task. This construction is not done from scratch: the novice, who faces for the first time a task, takes advantage of certain types of spontaneous coordination, which may refer to previously acquired behaviours, or relating to very general trends. On the basis of this repertoire will be realized the construction of new models of coordination. (Federal Sports Commission CFS, 2001).

Cognitive theory in educational applications is a prescriptive approach,

By contrast, in ecological approach to practice does not mean repeating the same solution to a given task, but repeating over and over again the process of solution of the task independently, without the prescription

of the teacher.

In the section dedicated to didactics will be discussed more completely the different implications of different educational approaches, in order to trace, in the existing legislation, practical or theoretical references to the various theoretical approaches and subsequent educational choices.

The idea that sensory and motor areas (and the intervening cortical regions, defined associative areas) possess autonomy and a typical processing of information has been reviewed under the demonstration of a broad convergence of sensory information and motor execution. A central role in this reversal of perspectives is due to the discovery of mirror neurons, early in monkeys and later in humans.

2. Motor Imagery and Learning

Before to talk about motor imagery, it is useful to introduce some new neurological aspects to better understand the other system of motor control. It is called Mirror neurons system. “Mirror neurons are for neuroscience what the DNA was for biology” (Vilayanur Ramachandran, in Iacoboni, 2008).

While recording the activity of certain neurons of motor area called F5 in grasping tasks in the brain of a monkey, a group of researchers (later known as the "Group of Parma of Giacomo Rizzolatti") has noted that they responded both when the monkey performed directly the movement of reaching the food, either when was another individual to perform the action (Gallese et al., 1996; Rizzolatti et al., 1996).

"Whenever we see someone perform an action, in addition to activation of the visual areas, there is a concurrent activation of motor cortical circuits that are normally active during the execution of these actions. In other words, the observation of an action involves the simulation of the same. The fact that the motor system is active not only during the run, but also during observation of actions, suggests that exists a relationship between control and action representation "(Gallese, 1996). The discovery of a same group of neurons involved in both perception and action dismisses the idea of specialized brain areas and implies interdependence between perception, cognition and motor system.

If processing of information from sense organs necessary for the implementation of a movement is (or at least begins) at the neural system responsible for controlling the movement itself, the body becomes a pivot of social and cognitive processes.

Operational tool to promote motor learning is motor experience, the set of environmental stimuli that elicit a motor response. The motor experience is defined by the educator who, with reference to desired motor objectives, prepares a series of exercises. The visual presentation of motor action is the largest and most powerful teaching tool at the disposal of the educator.

The motor imagery is defined as a dynamic state during which a subject mentally simulates an action (Decety, 1996), there is a reactivation of kinaesthetic memory allowing "revive" the motor experience. At neuroanatomical level, performing or imagining an action implies overlap of brain areas involved, with a narrower focus in the practice of imagination. In a study Lafleur et al. (2002), using PET, compared the cerebral activation of movements performed with the foot in the process of learning a new movement, both in physical performance that during a session of motor imagery. The results show that there is a parallel change in both experimental conditions, confirming the validity of motor imagery in learning motor skills.

3. Didactics of Movement

A clear need for those involved in facilitating the learning process in the field of motor activity is the definition of the criteria underlying the methodological and didactic choices.

Not infrequently this definition is based on empiricism or reiteration of established practices.
This approach is sometimes effective but not efficient: you will get results without knowing in detail the causes that produced them. A more effective system to select the criteria consists in placing, as a basis of activity, scientific theories about the movement, motor control and motor learning. However, structuring the

experience of motor learning on a scientific basis is often difficult due to the absence of supports that are able to translate theory into educational practices to be included in didactics.

Educational practice is still heavily influenced by the mind-body dualism of Descartes' memory. If the body has, on paper, a central role in the learning process tout court, paradoxically, in the experience of education in the field of sport still holds an opposition (the result of the aforementioned Cartesian dualism) between centre and periphery, between the nervous system and biomechanical aspects, including quantitative and qualitative aspects of movement.

Still, in the schools, educational physical activities pursue a goal of the development of motor skills, where prevails the quite subjective qualitative observation of form of the movement, which implies a low objective approach to teaching, where in sport is preeminent quantitative study (biomechanical and energetic).

If learning means to structure motor programs increasingly articulate and optimize the parameterization, the result is a teaching of motor activities prescriptive and directive, which is to order to the student practice mode to stabilize and improve the motor programming and minimize the variability in execution.

With this in mind, in cognitive psychology has been developed huge amount of results on the strategies and techniques to structure the exercise in order to obtain optimal learning outcomes. The main ones are: the partial practice, the randomized and the varied techniques (Lee et al. 2001). The partial exercise is an ability to perform complex motor initially in a simplified form. Complex movements can be simplified by dividing it, segmenting or reducing the speed or requests for executive precision (Wightman & Lintern, 1985).

For all forms of partial practice the rule is that you get a facilitation of learning only on condition that the partial exercise technique, i.e., fragmentation, segmentation and simplification, does not alter the deep structure of the generalized motor program. The deep structure of the program is instead altered if you change the interaction between the effectors, if you alter the functional phases of movement.

The varied and the random practice are other techniques of exercise that find their justification in the theory of generalized motor programs. The theory of generalized motor programs has direct implications on the methodological and educational choice of what information to provide with the feedback. This choice depends on the type of error made by the student (Schmidt, Wrisberg 2000): If the execution was wrong because the relative duration of each stage of the functional motor gesture is different from the one desired, means that it has selected the wrong motor program.

If instead the student was wrong to run because the movement is altogether too broad or too short, but the duration of the phases is correct, it means that you have selected the correct program, but has attributed to the variable parameters values are not adequate. In general it is well first of all to provide feedback to correct the mistake of selecting the program (e.g. "Slow down the swing phase" and / or "accelerate the phase of detachment") and only secondarily the feedback to correct errors in parameterization (e.g. "do the launch faster, shorter, taller"). If the selected motor program is the right one, the feedback related to the variable parameters is very beneficial for learning, because it enhances the formation of the motor pattern, which helps the student to discover the rules that allow him to perform with precision, the first glance, variants of a given motor gesture never performed before.

According to the ecological approach, learning means to be able to gradually find the best solution motor in a task in a given context. A prime example is the term coined in the theory of degrees of freedom by Nikolai Bernstein, "repetition without repetition": practice does not mean repeating the same solution to a given task, but repeating over and over again the process of solution of task. If learning movements means optimizing the solution process of motor tasks, resulting educational implications are other than prescriptive cognitive approach; in heuristic learning, the teacher must assist the student in autonomous finding of motor solutions.

If the learning task is too complex, you should not impose constraints pointing to the learner to simplify the motor task, but you have to apply constraints to the environment (for example, how when you apply

supplementary wheels to the bicycle of a beginner, rather than trying to facilitate the coordination of motor cycling action with partial practice).

The condition for each teaching strategy to be effective and to facilitate learning is that the unitary structure perception / action approach postulated in ecological approach is not altered. Ecological approach is to find time by time the best solutions to motor tasks; executive variability is not seen as a limiting factor, but as an inherent property, indicating non-linear interaction of the system with the constraints imposed by body from the task and the environment during the search for solutions (Davids et al. 2001).

Since the dynamic-ecological approach is more recent than cognitive approach, it has not yet created a mole of educational effects similar to that of the cognitive one.

Moreover, since according to the ecological approach-dynamic motor learning is mainly heuristic, would be a contradiction to provide educational information detailed and prescriptive. Therefore the solution is far away, but still needs to take a road that is reasonably adherent to the ecological dynamic theory.

The teaching strategies to enhance learning heuristics, i.e. to stimulate the emergence of "spontaneous" solutions to the problem, are managed by a single principle: taking advantage of the variability in execution implementing a process of finding motor solutions that passes through the continuous variation of motor gestures. That happens if it is constantly changing the learning environment, avoiding ordering specific tasks, requiring the executive process of correcting and letting free to express the learners in the delivery of the task.

Until today, in the neurosciences, more space has been given to the study of motor control rather than to the study motor learning.

There is still a lack of scientific material on the neurophysiological changes accompanying the acquisition of complex motor skills from which can be derived applicatives for physical educational activities. The results of neuroscientific research are particularly useful for their educational implications not only in the field of motor sport and education, but also in the field of adapted physical activity. In this field the choice of a particular theoretical model rather than of another, and their educational implications, is complicated by the fact that there are multiple objectives of learning: learning new skills, re-learning movements compromised by degeneration of sensory-motor function, etc.

4. Methods

The methodological approach is complex. Integration of different types of research into a single model with an ecological model. In one way it is the historical and documentary research that analyzes the methodological and teaching contents of physical sport and motor activities in primary school and lower school obtained from laws and ministerial papers. In the other way it is the theoretical and argumentative research that analyzes methodological and didactic patterns of physical and sport activities according to the main pedagogical, psychological and physiological theories. Finally, comparing all the data to argumentative deductions.

5. Results

The programs for middle school (now called lower school), dated May 11, 1963, are composed of an extensive and general introduction which highlights the significance of a truly unique school and the role that it must generate in training young people in a democratic society.

Anyway, there are no elements on motor control system or didactics method to teach the movement as well as the neuro-scientific research.

The field of knowledge is divided by areas and the body and movement area is enhanced at least as other fields. The teacher's role is slightly active tending in some cases to director of operations.

However, new programs have no more a list of exercises, but the general educational objectives, and leaving

to professionalism of the teacher procedures, methodologies, time and materials, evaluation and remain free of reference parameters.

Despite this innovation, the document is incomplete about the new discoveries on motor control system and there are no scientific elements on neuroscience applied to movement and the learning process through the body

The document 2004, Attachment A - National Guideline for the Programs of studies of the first cycle of education National Guidelines for Personalized Programs of the Educational Activities in the first cycle of education, Specific Learning Objectives, Recommendation to put into practice the National Guidelines for Personalized Programs of the Educational Activities is a mere list of objectives to be achieved in the form of motor skills and there is no single reference to teaching. Basically, it does not refer to any element related to the theories of motor control or to the recent scientific discoveries. It is a very innovative regulation tool to teach properly to a new discoveries on individual learning process. It takes in light the relation between the teaching and the learning in an unicum. It writes in double column, where there is specified knowledge and ability in motor and sports science, as a sort of a new scientific paradigm of physical education and sports in primary and lower school.

The document 2007, The Guidelines for the curriculum of the first cycle of education, does not indicate a specific item on motor control and does not address to new scientific scenarios on movement in the light of the discovery of mirror neurons or the other two motor control system theories. It widens the sense of continuity of teaching action without indicating specific teaching methods. It resumes the contents of the document Guidelines for preschool, primary and school. These contents are contextualized in a disciplinary process that goes from childhood to the end of the first education cycle, 14 years old.

Revision of the educational organization in the document 2009, regulated directions for the first cycle of the school does not explain the innovation in new rules, but it postpones to a new experimental study the final revision and does not hint anything. It recommends to trust in two last documents: 2007, the Guidelines for the curriculum of the first cycle of education and 2004, National Guideline for the Programs of studies of the first cycle of education National Guidelines for Personalized Programs of the Educational Activities in the first cycle of education, Specific Learning Objectives, Recommendation to put into practice the National Guidelines for Personalized Programs of the Educational Activities. Thus, ultimately, there is no trace of a scientific specificity about body and movement nor there is a cultural content on the theories of motor control.

As for preschool (Raiola, 2011a) and primary school (Raiola, 2011b), also in documents related to first grade secondary school (and so in the whole first cycle of education, preschool included) there are not elements and/or methods to establish the application of motor control system in its three scientific ways and forms: closed loop, open loop and motor imagery. The big vacuum is the absolute absence of psychological and pedagogical aspects on movement that could have the theoretical aspect of new discoveries.

6. Discussion

In the analyzed documents do not appear to be guidelines which may be of guidance and support to teachers in their school activities. The importance of an effective support to the development of the sensory-motor integration ability seems one of most important aim that every school system should follow. However, it may happens that the educators support the sensory-motor development of the student by obsolete methodologies, like the use of exercises based on the simple repetition of actions involving the visual and motor ability (Di Tore et al., 2011). “The teaching process in the motor field should fix methodological strategies based on some ontological considerations. [...]. It is necessary an epistemological consideration to assume clear ontological positions to deal with the teaching of the motor activities in the educational field (Aiello & Sibilio, 2011)”. So on physical activity forms the crux of any major physical education programs at school levels. Regular physical activity and the attitudes toward it can only be developed in the school years. As children make the transformation into adults, many developmental changes occur (Pethkar, Naik &

Sonawane, 2011).

This method is inefficient because "these abilities cannot be considered like a muscle to train but like a knowledge that must be taught. (Beery, 2000)."

By results set forth above, appears as the documents are free of cultural references on learning motor and motor control, and this results in a total lack of knowledge of general and specific aspects of human movement, motor control and psychological aspects. The unique formulation and overall knowledge is useful for the holistic approach, but not realizes the goal of basic knowledge in a specific field.

The identification of a specific epistemological structure, and the resulting educational applications, constitutes an essential step if the physical education at school wants to see recognition of its autonomy and centrality.

From the disciplinary structure, flows a deepening of the paradigm of the discipline respect to the structuring of a coherent theoretical framework and the definition of procedures and methodologies in education.

"Amendments in the national curriculum and changes in physical education teaching methodology seem crucial. Apart from gaining competences pertaining to a particular graduate's profile, development of creative skills, and shaping the proper attitude and behaviour seem vital" (Buchta, 2011).

A detailed review of the psycho-pedagogical principles at the basis of ministerial documents is needed, with the purpose to insert clear links to the theories on motor learning, motor control and human movement.

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