Motor activities teaching and complexity: a reversal of the classical description of the mechanisms of perception and action

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In the last decade we saw a heated debate on the implementation of complex learning theories in Physical Education. In the educational field there has been the difficulty to apply in the teaching practice a conception of the knowledge and learning which, on a theoretical level, has recognized the role of the body in movement, while it struggles, on the operative level, to define methodologies and tools usable in everyday's activities. The constructivist hypothesis in Physical Education has faced serious difficulties in educationally interpreting the nature of the motor experience. This paper focuses on the concept of action and on the reversal of the process of perception-action operated by the phenomenological tradition (Merleau-Ponty), which has been confirmed in more or less recent neuroscientific evidences (Berthoz, Decety, Jeannerod). In this perspective, the subject builds his world according to his

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basic needs and action tools. From this point of view, faced with insurmountable difficulties posed by a multidimensional reality, the typical activity of living beings proceeds through the reduction of the dimensionality of the problems, a reduction that addresses complexity simply acting ahead. In other words, the body in action solves local complexity. This idea leads to the disintegration of cognitivist methodological model, based on a concept of information processing that involves discrete, separate, non-overlapping stages of perception-action, and moves in direction of an approach to complexity that shifts from a descriptive level (identification and understanding of the phenomenon) to a pragmatic level (supporting its existence and development).

1 Introduction

In the last decade we saw a heated debate, as evidenced by an abundant scientific literature, on the implementation of complex learning theories in Physical Education (Carlomagno, 2012; Light, 2008; Rink, 2001).

In the educational field there has been the difficulty to apply in the teaching practice a conception of knowledge and learning which, on a theoretical level, has recognized the role of the body in movement, while it struggles, on the operative level, to define methodologies and tools usable in everyday's activities.

The difficulty of a valorisation of didactic corporealities (Sibilio, 2012) in everyday teaching has limited the recognition of the educational dimension of movement, setting the motor experience as a disciplinary domain of Physical Education and limiting the interdisciplinary and transdisciplinary potential of the movement.

The risk of disciplinary confinement was effectively stigmatized by Morin: the boundaries of the discipline, its language and its own concepts isolate the discipline from the relationship with the other and from the relationship with the problems that are on the border between the disciplines. The hyperdisciplinary spirit could then be structured as a spirit of ownership that prohibits, in its limited field of knowledge, any extraneous movement.(Morin, 1990; 2005)

In Italy, Physical Education, considering the Ministerial Regulations for the school system, had to interpret artificially the synthesis of theoretical constructs, often mutually incompatible, and teachers' assumptions on learning based on common sense, often in direct conflict with these constructs. With reference to international literature, this phenomenon does not seem to affect only Italy:

> "Although Physical Education teachers may not necessarily articulate clear beliefs about it, their practice invariably rests upon basic, unquestioned beliefs about learning. Their practice is typically based upon assumptions about learning that are deeply embedded in Western culture (B. Davis, Sumara, & Luce-Kapler, 2000) and that assume it to be an explicit linear and measurable process of internalizing knowledge". From this perspective, knowledge is conceived of as a preexisting, "out there" entity and learning as being a process of internally

> representing this reality in the mind of the learner reality (Varela, Thompson, & Rosch, 1992). In Physical Education, this is evident in the teaching of predetermined "fundamental" motor skills seen as being a prerequisite for playing games and sport."(Light, 2008).

The difficulty in the valorization of didactic corporealities is due, among others, to two peculiar factors:

1. the type of knowledge linked to Physical Education.
2. the descriptive and non-prescriptive nature of constructivist approaches.

As regards the first aspect, the knowledge codified in the form of motor responses was defined enactive knowledge.

> "Enactive knowledge is not simply multisensory mediated knowledge, but knowledge stored in the form of motor responses and acquired by the act of "doing". A typical example of enactive knowledge is constituted by the competence required by tasks such as typing, driving a car, dancing, playing a musical instrument, modeling objects from clay, which would be difficult to describe in an iconic or symbolic form. This type of knowledge transmission can be considered the most direct, in the sense that it is natural and intuitive, since it is based on the experience and on the perceptual responses to motor acts. […] Unlike the knowledge coded by symbol systems or in the form of images, on the enactive approach knowledge is not simply mediated by motor skills, but it is encoded in the form of motor responses and acquired in action" (Bergamasco, 2005).

As concerns the second aspect, assuming that the descriptive nature is inside the constructivist approaches, it is important to emphasize how other theories of knowledge (especially the behaviorist and cognitivist theories, borrowed from the psychology domain), have shown, historically, a good contiguity with the practical problems of educators (Brent Davis & Sumara, 2003).

In the last century, Physical Education was included in the world of education with a prescriptive matrix within a behaviorist approach that has contaminated motor practice in different contexts. This behaviorist idea of teaching is immediately understandable because it focuses its attention to the relationship between teaching and observable performance, studying the teaching strategies capable of producing feedback that may increase the likelihood of a result or replicate or improve performance.

At the same time, the cognitive perspective in Physical Education, facilitating the analysis of the knowledge domains in their essential structure, allows to articulate the motor learning units based on these structures, promoting an

instructional design based on the individual characteristics and on the personal dimension.

> In the cognitive approach, "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 & Wrisberg, 2008).

The direct consequence of the cognitive theory in educational applications is a prescriptive approach: the aim of exercises will be to stabilize and refine motor program by reducing the variability of execution (Di Tore, Discepolo, & Di Tore, 2013).

2 Complex learning theories in Physical Education

The constructivist hypothesis in Physical Education, required in predominant form by Italian Ministerial Guidelines, has faced serious difficulties in educationally interpreting the nature of the motor experience. It perpetuates, so, a reductionism of bodily experience in the educational field, a disciplinar simplification of complexity inherent the meanings of body and movement.

In other words, constructivist approaches, on the one hand help the understanding of the phenomena that are of clear interest to educators, on the other hand are not immediately reducible to the institutional framework, nor do they offer recipes or tools.

This gap between theoretical models, explicitly required by the ministerial documents, and the daily experience of the teachers often results in the difficulty of dealing with the complexity arising from the teaching use of body and movement in educational contexts.

This seems rather ironic, considering how constructivist approaches have been defined precisely "complex learning theories".

> "the term *complex learning theories* may offer an useful description of the various forms of constructivism that can and have been used in Physical Education"(Light, 2008).

To detect and denounce this difficulty, with reference not only to the field of Physical Education, but to the whole educational context, were Davis and Sumara.

The analysis by Davis&Sumara begins by noting that the first obvious problem that concerns the attempts to translate the many theoretical constructivist

approaches in formal education is that these views are not born as sources of operational strategies. These approaches, in fact, have been developed as theoretical elaborations on human cognition and the related phenomena, presented as complex events through which biological predispositions, experiences and cultural backgrounds converge to create interpretations sufficient to maintain consistency within immediate situations (Light, 2008).

The conclusion for Davis and Sumara is clear:

> "Constructivist discourses, for the most part, are not educational discourses." (Brent Davis & Sumara, 2003).

In this consideration it seems to emerge that the theoretical concepts borrowed to the domain of pedagogy and teaching from related fields are reworked, absorbed and integrated by teachers to a pre-existing idea of knowledge.

In this spirit, several hybrid variations of constructivist perspective, impacting in the dense network of complexity in education and training, are often not able to establish a possible equilibrium between the reduction and the construction of meaning.

> "The concept of movement itself is in fact the result of the meanings that the specific individual knowledge related to it take for a person, their quantitative and qualitative dimension, and expresses critical and multidisciplinary factors of knowledge" (Sibilio, 2012).

We must consider, however, that the constructivist approach, in view of the specific characteristics and knowledge tools that everyone has, raises the multidimensionality of the term meaning in education, offering the possibility of a reconsideration of the educational potential of the movement.

> "This perspective seems to give way to a line of research that aims to interpret, in the constructivist conception of teaching, the possible meanings of "didactic corporealities" that, in teaching-learning process, express in non-verbal form conscious and unconscious intentionality. It is precisely the body through movement, gestures, facial expressions, his natural emotional component, which supports and integrates other forms of communication (such as writing and speech) contributing to the construction of meanings" (Sibilio, 2012).

According to Davis&Sumara, since 2000 the epistemology of complexity had a pragmatic development that opened to reflections strongly connected with our subject of study, moving from the axis of the description (identification and

understanding of the phenomenon) to the axis of the intervention (support its existence and development).

Through the pragmatic approach, Davis and Sumara believe that theoretical complexity has become a place of great utility for educators - who are also struggling with multiple levels of organization (individual students, classes, schools, school districts, companies), coevolving dynamics (teachers - students, knowledge - action) and complex associations (between people, between ideas). (Brent Davis & Sumara, 2012).

3 What happens in perception can be understood in terms of action

The motor learning approach that seems to better respect the complexity of Physical Education, avoiding analytical reductive temptations, is an approach which aims to stimulate the emergence of spontaneous solutions to motor problems (Di Tore *et al.*, 2013), studying "the interrelations between organisms and their environment [Umwelt]".(Angerman & Vogel, 1977).

In this vision it is of fundamental importance the relationship between the organism and its environment: there is no organism without an environment and no environment without an organism (Lewontin, 1982).

> "Any attempt, therefore, to naturalize and objectify the body, separating it from the world he inhabits, it appears as highly restrictive especially when it investigates the possibilities offered by communication and interpersonal dynamics. In this perspective, it is desirable that the teaching act responds to the stresses induced by a scientific vision that takes account of a conception of the movement of the body anchored to the need for knowledge of the world, without preconceived representations, but built into the interactive dynamic that is generated by to the experience" (Sibilio, 2012).

In such an approach, motor learning is a question of the adaptability of the movement, matching the diversity of the environment and the specificity of the individual (Carnus, 2010).

In this concept it is possible to retrace the central theme of Gibson's theory of perception (Gibson, 1986) which is based on the interaction between the actor and the surrounding environment, giving birth in so doing to the concept of affordance defined as a possibility of action dynamically emerging in the environment.

We refer here to the concept of affordance as developed by Norman:

> "...the term affordance refers to the perceived and actual properties of the thing,

> primarily those fundamental properties that determine just how the thing could possibly be used. [...] Affordances provide strong clues to the operations of things. Plates are for pushing. Knobs are for turning. Slots are for inserting things into. Balls are for throwing or bouncing. When affordances are taken advantage of, the user knows what to do just by looking: no picture, label, or instruction needed." (Norman, 1999).

Adopting this perspective, a certain point of convergence between motor learning and epistemology of complexity is represented by the concept of action, in the sense in which it was developed from the phenomenological tradition.

Based on the work of Merleau-Ponty (Merleau-Ponty, 1962), the world cannot be separated from the perceiver: You can know reality only in experiential learning.

Berthoz writes about the "reversal of the classical description of the mechanisms of perception and action [which] places the intentional and goal-oriented subject at the origin of the process. The subject builds his world according to his basic needs and action tools. This view has also been promoted by Bergson and Husserl" (Berthoz, 2008).

Local situation of the living being is the birthplace of a singularity that is finally stabilized through the change, in which something or some event make sense defined for a subjective agent (Petit, 2012).

Faced with insurmountable difficulties posed by a multidimensional reality, the typical activity of living beings proceeds through the reduction of the dimensionality of the problems, a reduction that addresses complexity simply acting ahead (Petit, 2012).

The living being, therefore, does not remain entangled in a hypertrophy of the description, but selects the level of analysis which is functional to action.

On the proliferation of descriptions, Matilde Callari Galli cites Umberto Galimberti:

> Men have never inhabited the world, but always and only the description that from time to time religion, philosophy, science gave of the world (Galimberti, 2006, translated by the author).

and writes about the pervasiveness of the description:

> In the reasons for the crisis of representation that we are experiencing, a prominent place must then be occupied by the proliferation of descriptions and their pervasiveness (Callari Galli, Ceruti, & Pievani, 1998, translated by the author).

Going beyond a descriptive approach to complexity (that Davis and Sumara

define complexity 1.0), the current pragmatic approach (aimed at supporting the existence and development of the phenomena) seems to find strong similarities with the behavior of living beings.

The body in action solves complexity.

Reference, here, is made to the complexity idea developed in the hard sciences.

According to Gell-Mann, universally recognized as one of the fathers of complexity, an adaptive complex system (such as, for example, a living being) receives a data stream, and identifies the perceived regularity in the data stream, compresses their description in a schema, and then uses this schema for the description, the prediction or the action(Gell-Mann, 1995b).

The length of the description becomes a measure of effective complexity once the regularity have been identified and it has been given a concise description. The effective maximum complexity varies with the length of this description, reaching high peaks only in the intermediate region between total order and extreme disorder (Gell-Mann, 1995a).

More precisely, the body in action resolves complexity in a process of perception-action which, according to the most recent findings of neuroscience, is reversed with respect to the cognitivist paradigm. Leman (Leman, 2008) summarizes:

> "what happens in perception can be understood in terms of action" (Berthoz, 1997; Decety & Jackson, 2004; Jeannerod, 1994; Prinz & Hommel, 2002).

Berthoz is more explicit:

> "we base on the action, not on the representation, our conception of the activity of the body. The perception does not represent the world, but constitutes it as Umwelt. The action does not just react to the event, she precedes it with simulation or emulation[...] Our notion of action is much richer than current sensorimotor theories that continue to subordinate it to the category of movement" (Berthoz & Petit, 2006).

Just in the words of Berthoz we can find the one that sounds like a final overcoming of all cognitive hypothesis:

> "The brain is not a computer, it must take the consequence of rejecting (rather than develop superficially) a functionalist conception of thought in terms of symbolic computation which would report purely logical analysis independently from biological realizations" (Berthoz & Petit, 2006).

From the educational point of view, this leads to the disintegration of cognitivist methodological model, based on a concept of information-processing that underlies the perception-action stages as a discrete, separate and non-overlapping stages.

This model, which is still dominant in the practice of Physical Education teaching, results in a fragmentation of the action, divided into sequential stages, according to the practices of the partial exercise, randomized exercise and varied exercise.

Conclusion

> "The body's role in any learning forms a prominent theme in complex learning theory. For researchers in the Physical Education field, the prominence of the body and its senses provides a promising means of reconceptualizing the teaching of Physical Education and its place in the curriculum" (Light & Fawns, 2003).

The need to consider the possible complementarity of theoretical approaches to decline in Physical Education and tiles on the plane of complexity, proposes a new function of research about the methods and teaching of motor activities in the educational environment, a line of investigation that can gather the traditions of educational science and the science of motion.

> "This integrated and interdisciplinary approach required for the study of educational dimension of motor experience, and consequently of its educational implications, has been in recent decades an original scenario of educational research, which required the growth of scientific expertise that combine methods, protocols and tools from psycho-educational, historical-philosophical, biomedical and methodological–didactic areas" (Carlomagno, 2012).

The teaching research with a realistically critical approach is probably the heuristic way that interprets at best the complexity of the study on teaching and on the movement teaching methods and the many variables which intervene during the movement teaching activities.

The work of Alain Berthoz, with particular reference to *Simplexity: Simplifying Principles for a Complex World and to The Brain's Sense of Movement*, can offer a scientific perspective to this critical approach.

> "Berthoz does though is to create a more solid ground to stand on. His basis includes neurological studies related to sensing, perceiving, and moving, studies of sensory physiology, the psychology of perception, studies of movement itself,

> and the relation of all of this to phenomenal experience" (Ginsburg, 2011).

The reversal of the classical description of the mechanisms of perception and action, in Berthoz's words, is the preferable model for studying the functions of the nervous system.

> "Unlike language they (such studies) lend themselves to analysis of human and animal behavior as well as to the neural mechanisms that underlie them, across the multitude of species that evolution has produced" (Berthoz, 2000).

In the perspective of teaching, this trans-disciplinary approach should also include the methods and tools of educational research.

The methodological complexity demanded by the heuristic activity in the motor field requires a research based on the interpretative methods and techniques used by the educational research, which have to be shaped according to the main issues of the teaching of the movement (Aiello & Sibilio, 2010).

REFERENCES

Aiello, P., & Sibilio, M. (2010), *The teaching research focused on the movement: heuristic approaches and elements of complexity*. Journal of Physical Education and Sport, 29(4), 5.

Angerman, H., & Vogel, G. (1977), dtv-Atlas zur Biologie: Band.

Bergamasco, M. (2005), *Multimodal Interfaces: an Introduction to ENACTIVE systems*. Paper presented at the Eurographic.

Berthoz, A. (1997), *Le sens du mouvement (Vol. 223)*: Odile Jacob Paris.

Berthoz, A. (2000), *The Brain's Sense of Movement*: Harvard University Press.

Berthoz, A. (2008), *Neurobiology of "Umwelt": How Living Beings Perceive the World*: Springer.

Berthoz, A., & Petit, J.-L. (2006), *Phénoménologie et physiologie de l'action*: Odile Jacob.

Callari Galli, M., Ceruti, M., & Pievani, T. (1998), *Pensare la diversità. Per un'educazione alla complessità umana*: Meltemi.

Carlomagno, N. (2012), *Corpo, movimento e didattica: emergenze formative e sviluppi professionali. I nuovi profili professionali motorio-sportivi nei contesti educativi per l'età evolutiva*: Pensa Editore.

Carnus, M. F. (2010), *Analyse didactique clinique de l'activité décisionnelle de deux enseignantes en éducation physique et sportive (EPS)*. Education et didactique, 4(3), 49-62.

Davis, B., & Sumara, D. (2003), *Why aren't they getting this? Working through the regressive myths of constructivist pedagogy*. Teaching Education, 14(2), 123-140.

Davis, B., & Sumara, D. (2012), *Fitting teacher education in/to/for an increasingly complex world*. Complicity: An International Journal of Complexity and Education, 9(1).

Davis, B., Sumara, D. J., & Luce-Kapler, R. (2000), *Engaging Minds: Changing Teaching in Complex Times*: Taylor & Francis.

Decety, J., & Jackson, P. L. (2004), *The functional architecture of human empathy*. Behavioral and cognitive neuroscience reviews, 3(2), 71-100.

Di Tore, P. A., Discepolo, T., & Di Tore, S. (2013), *Natural User Interfaces as a powerful tool for courseware design in Physical Education*. Journal of e-Learning and Knowledge Society, 9(2).

Galimberti, U. (2006), *Parole nomadi*: Feltrinelli.

Gell-Mann, M. (1995a), *The Quark and the Jaguar: Adventures in the Simple and the Complex*: St. Martin's Press.

Gell-Mann, M. (1995b), *What is complexity*. Complexity, 1(1), 16-19.

Gibson, J. J. (1986), *The ecological approach to visual perception*: Taylor & Francis.

Ginsburg, C. (2011), *Alain Berthoz Mind and Motion: The Brain's Sense of Movement* Cambridge, MA: Harvard University Press, 2000. Journal of Consciousness Studies, 8(11), 9.

Jeannerod, M. (1994), *The representing brain: Neural correlates of motor intention and imagery*. Behavioral and Brain sciences, 17(02), 187-202.

Leman, M. (2008), *Embodied Music: Cognition and Mediation Technology*: Mit Press.

Lewontin, R. C. (1982), *Organism and environment*. Learning, development and culture, 151-170.

Light, R. (2008), *Complex learning theory—its epistemology and its assumptions about learning: implications for physical education*. Journal of Teaching in Physical Education, 27(1), 16.

Light, R., & Fawns, R. (2003), *Knowing the game: Integrating speech and action in games teaching through TGfU*. Quest, 55(2), 161-176.

Merleau-Ponty, M. (1962), *Phenomenology of Perception: An Introduction*: Routledge & Kegan Paul.

Morin, E. (1990), *Carrefour des sciences*. Paper presented at the Actes du colloque du Comité national de la Recherche scientifique interdisciplinaire.

Morin, E. (2005). Educare gli educatori. Edup Roma.

Norman, D. A. (1999), *Affordance, conventions, and design*. interactions, 6(3), 38-43.

Petit, J. (2012), *Complexité-Simplexité - De la simplexité au champ phénoménal:* La réponse du vivant à la complexité. Retrieved 30/05/2013, from http://www.jeanluc-petit.com/sites/default/files/seminaire_complexite-simplexite_23-24.05.12.pdf

Prinz, W., & Hommel, B. (2002), *Common mechanisms in perception and action: Attention and performance XIX*: Oxford University Press Oxford:.

Rink, J. E. (2001), *Investigating the assumptions of pedagogy*. Journal of Teaching in Physical Education, 20(2), 112.

Schmidt, R. A., & Wrisberg, C. A. (2008), *Motor learning and performance: a situation-based learning approach*: Human Kinetics Publishers.

Sibilio, M. (2012), *Il corpo e il movimento nella ricerca didattica. Indirizzi scientifico-disciplinari e chiavi teorico-argomentative*: Liguori.

Varela, F. J., Thompson, E. T., & Rosch, E. (1992), *The Embodied Mind: Cognitive Science and Human Experience*: MIT Press.