

Original Article

Motor learning and teaching method

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Abstract

The eight keys competences are defined at European level, which represent a combination of knowledge, skills and attitudes considered necessary for personal development. Generally, teaching methods and didactics is in relationship, and in physical education and sport (PES) they are connected by the same theoretical basis. Which means, the educational process of teaching/learning carries out directly the skills instead to follow the logical steps: knowledge/skills/attitudes such as in math, natural sciences, mother tongue, second language. For these subjects, the students before learn the theoretical concepts (knowledge) and then making the skills. In teaching methods of (PES), the teacher/trainer traditionally imparts the orders with tutorials by giving the indication to execute exactly the movement.

This methodology has the theoretical basis in the Cognitive approach where the mind is the center of learning action. This approach follows the Behaviorism and Cognitivist theories which suggest the exact and unique solution model of motor problem and have therefore a prescriptive nature. From another point of view, the teacher/trainer focus on environment educational setting and interpret learning as the research of motor solutions available of the each student/athlete relating to the context. It refers to another pedagogical paradigm for teaching methods:

Phenomenology and Gestalt theories and have therefore a heuristic nature. This teaching method has the basis in ecological dynamic approach and has the environmental as center of learning process. Results are two kind: A) Cognitive approach refers to motor control theory of Closed loop, Open loop and Generalized motor program and the main teaching tools are tutorials: 1) demand 2) sequence 3) timing 4) executive model of movement learning 5) intensive activity; B) Ecological dynamic approach refers to motor control theory of Motor imagery and Freedom degrees and the movement has learnt without teacher support in a setting learning environment aimed at several problem solving. Motor imagery could be applied in first person when he reads himself and in third person when he reads other people and Freedom degrees is made by three consecutive steps: Reduction, Exploration and Capitalization.

The teaching tools are the psychological group dynamic as circle time, cooperative learning, role playing, brain storming, peer education, tutorship, focus group and extensive activity. In conclusion, Cognitive approach is usually utilized in Sport to improve the performance whatever Ecological one is currently utilized in Physical education to increase the educative aim.

Key words: Cognitive approach, Ecological-Dynamic approach, intensive and extensive activity.

Introduction

The eight keys competences are defined at European level, which represent a combination of knowledge, skills and attitudes considered necessary for personal development and development, active citizenship, social inclusion and work by Recommendation 2006/962/ European Commission of the European Parliament and of the Council of December 2006 on key competences for lifelong learning, (OJ L 394, 2006)

- 1) communication in the mother tongue
- 2) communication in foreign languages
- 3) math skills and basic skills in science and technology;
- 4) digital competence;
- 5) learn to learn;
- 6) social and civic skills;
- 7) spirit of initiative and entrepreneurship;
- 8) awareness and cultural expression.

Generally, teaching methods and didactics is in relationship, and in physical education and sport (PES) they are connected by the same theoretical basis. Which means, the educational process of teaching/learning carries out directly the skills instead to follow the logical steps: knowledge/skills/attitudes such as in math, natural sciences, mother tongue, second language. For these subjects, the students before learn the theoretical concepts (knowledge) and then making the skills.

For teaching methods of PES, the teacher/trainer traditionally imparts the orders with tutorials and in the same way gives the indications to execute the movement. This methodology has the theoretical basis in the Cognitive approach where the mind is the center of action learning such as the Behaviorism and Cognitivist theories suggest and are therefore of a prescriptive nature and suggest the exact and unique solution model of motor problem and have therefore a prescriptive nature.

The cognitive approach refers at motor control theory of closed loop, open loop and generalized motor program and the main teaching tools are tutorials in the following steps: 1) demand 2) sequence 3) timing 4) executive model of movement learning, 5) intensive activity. In this perspective Schmidt and Wrisberg proposed that "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) and thus it has been trained with blocked practice in intensive activities as Schmidt and Lee subsequently affirmed. "An important question confronting the learner or instructor is how to sequence the practice at these various tasks during the practice session so as to maximize learning (...).... A commonsense method of scheduling such tasks would be to practice all trials of one task before shifting to the second, then to finish practice on the second before switching to the third. This is called blocked practice, in which all the trials of a given task (for that day) are completed before moving on to the next task. Blocked practice is typical of some drills in which a skill is repeated over and over, with minimal interruption by other activities. This kind of practice seems to make sense in that it allows the learners to concentrate on one particular task at a time and refine and correct it." (Schmidt & Lee, 1988, 2013).

In this learning paradigm the teacher/trainer illustrates in greater details the Partial type, Varied, Randomized and Mental Training kind of exercise in an intensive form. The partial tutorial consists in making exercise a motor skill complex initially in a simplified form. Movements with a certain degree of difficulty, very complex, can be simplified by dividing the exercises in single parts or reducing the speed or requests for precision. For all forms of partial tutorial is the rule that is obtained of learning only as long as the techniques of partial tutorial, that is fragmentation, segmentation and simplification, does not adversely affect the deep structure of the motor program generalized. The tutorial randomized and that varied are other techniques of tutorial that find their justification in theory engine programs generalized. The theory of the programs motors has generalized methodological implications on direct choice of which provide information in the feedback. This choice depends on the type of error made by the athlete. The techniques of mental repetition consist in think about the aspects cognitive and procedural of the action, while the mental representation is to imagine the conduct of an action. (Raiola D'Isanto 2016ab).

From another point of view, the teachers focus on environment educational setting and interpret learning as the research of motor solutions available such as another pedagogical paradigm for teaching methods that refers to Phenomenology (Mearleau Ponty, 1962) and Gestalt theories and are therefore a heuristic learning. This teaching method has the basis in Ecological dynamic approach and has the environmental as center of learning process. This approach refers to motor control theory of Motor imagery and Freedom degrees and it does not require the tutorials, but it builds itself a setting learning environment aimed at several problem solving. The Motor imagery could be applied in first person when he reads himself the movement and in third person when he reads in other people the movement. Freedom degrees is made by three consecutive steps: Reduction, Exploration and Capitalization. In this approach, the main tools are to suggest to the athletes the psychological group dynamic such as circle time, cooperative learning, role playing, brain storming, peer education, tutorship, focus group and extensive activity. "Conceptual knowledge is embodied, that is mapped in our sensory-motor system.

This not just provides the structure to the conceptual content, but characterizes the semantic content of concepts according to the way we function in the world with our bodies." (Gallese & Lakoff, 2005). In ecological-dynamic 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). According to the ecological approach "learn" means being able to find progressively the mobility solution best for a given task in a given context. Emblematic is the expression, coined by Bernstein, "repetition. without repetition": practice does not mean always repeat the same solution to a given task, but repeat over again the process of solving the task itself. If learn movements means optimizing the process of solving tasks engines, resulting didactic implications different from those prescriptive own cognitive approach. In heuristic learning the teacher has to assist the student in research autonomous problem solutions (Tiziana, 2017, D'Isanto 2016, Di Tore et al, 2016, D'Isanto, Di Tore, 2016).

Results

They are synthesized in Cognitive approach and Ecological-Dynamic one as following. Humans have, in the brain, a series of motor programs, or sequences of commands that, in the central nervous system, coordinate the execution of movements. According to a first formulation, processing of information from sense organs, particularly proprioceptors, allows the system to correct the movement at timing execution. The closed-loop motor control theory (Adams 1968) assumes that the movements are sufficiently slow to allow correction during implementation, based on the data from the feedback. The movement is sufficiently slow when every

information on movement, scientific called feedback, could be processed by mind in two hundreds milliseconds and so it is used by the effectors.

The longer of the execution time, the wider the opportunity to use the motor control circuits based on feedback and comparison between memory trace and perceptual trace. Memory trace is the ideal motor program to take place and effect as well as is in the mind without errors while Perceptual trace is the real motor program that is effected with the errors (Adams 1975). Comparison is the process which the mind to determine the differences between to ideal motor program and real one to carry out the errors by the feedbacks. In other word, when movement is quick than of nerve impulses conduction (up two milliseconds), it 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 time threshold of two hundred milliseconds according to open loop motor control theory (Schmidt 1985, Keele et al. 1986).

Learning movement consists of developing cognitive structures, known as motor program, through information processing. These processes allow the opportunity to compare in real time, by closed-loop motor control, or later, by open-loop motor control theory, obtain results, triggering a process of adjustment and refinement of movement. Its structure is such that allows the performer to adjust the movement in order to meet the changing needs of the environment. In this way, the generalized motor program (Schmidt, Wrisberg 2004) joins the feedback and comparator between memory trace and perceptual trace, as occurs in closed-loop, and the innate properties of motor centralized program and the exceeding the limit of time threshold of two hundreds of milliseconds to elaborate, the perception, as occurs in open-loop.

All of these three motor control theory, Open-loop, Closed-loop and Generalized motor program, are the basis of the cognitive approach. Cognitive approach is used by prescriptive style teaching and has its basis on the preeminent role of the voluntary and determined movement on the environment. The direct consequence of the cognitive theory in educational applications is a prescriptive approach, with a teacher who directs the structure of motor programs, with increasing complexity, and the optimization of their parameters. The aim of the exercises will be to stabilize and improve motor program by reducing the variability in execution through the repetition method and other didactics such as exercise varied, segmented, randomized and idea motion training.

The ecological approach, opposite approach of to cognitive one, does not consider necessary to use prescribing mental structures: the action is directly available to those who act in their own environment, the self-organization that do not require the use of a motor program (Edelman, 1987). In this approach, learning is defined as an education of attention (Gibson, 1986). Learning means to optimize the processes of perception and develops the ability to dictate the specific stimuli (Gaetano et al. 2016). The perception of the context is different and the learning process is defined differently. This approach considers evolution of behaviour of complex systems, where a complex system is a set where the body moves, composed of multiple interacting factors made by body segments. In the dynamic perspective learning is to build and stabilize a new state not included in the initial coordination dynamics of the system.

Teaching, in ecological approach, is designed to stimulate the emergence of spontaneous solutions, called heuristics to motor problems, taking advantage of variability in executive search process that implements a mobility solution that passes through the continuous variation of sport skills. Mainly, the basis of this approach is the freedom degrees theory or Bernstein's problem by Nikolay Alexdrovic Bernstein (1967) that introduces, for the first time, the interaction of single movement in the holistic vision. His research showed that most movements, like hitting a chisel with a hammer, are composed of smaller movements by three steps to learn the movement. Any one of these smaller movements, if altered, affect the movement as a whole (Bernstein 1967). The three steps are: reductions freedom degrees, exploration freedom degrees and capitalization freedom degrees.

The first one consists to immobilize one or plus articulations to execute by repetitions the same action, the second one occurs when in consequence to immobilize one articulation to explore other movements to aim the same outcomes or to give freedom some of articulations that before are immobilized. The last one is when it organizes the whole movement with the feedbacks by reduction freedom and exploration degrees to perform the movement by repetitions which are differently among them because one movement is different to others. For this reason, Bernstein called this phenomenon "repetition without repetitions" (Bernstein, 1991). Later, this motor control system has been considered as motor imagery (Lotze & Halsband, 2006). The knowledge of structural and functional organization of the motor system has evolved and deepened in recent years, gradually abandoning the idea of a brain where the processing of sensory information was entrusted to different and dedicated cortical areas, according to a model in which sensory and motor information are very interdependent (Latash, 2004). A central role in this reversal of perspectives is due to the discovery of mirror neurons, early in monkeys and later in humans. It is motor imagery theory.

There are two types of motor imagery: in first-person and in third-person. In first person mode, the subject imagines himself to perform an action but not in the sense of seeing himself as an external or reflected image, in the sense to see what he would see, if he performed a movement and at the same time feel emotions, excitation, stress and changes of arousal. In third person mode, the person sees himself or another person as an external image, as with the use of a camera. The most effective for learning is that first-person. Numerous studies have shown that the performance is optimized through the cognitive process of motor imagery.

Finally it could be synthesized the different mode to teach in the following pictures



Frontal relation for all frontal relation for each Circular relation for all

And in the following schemes:

Teaching methods Teacher role	Prescriptive teaching Invasive	Heuristic learning Defiladed
Tools	Blocked practice Random Practice feedback techniques mental training	Adapted environment, psychological dynamic (circle time, cooperative learning, role playing, problem solving, peer and tutor education ...)
Motor Control theory	Closed loop, Open Loop, Generalized Motor Program	Reducing degrees of freedom: Reduction, Exploring and Capitalizing Motor imagery: 1) First person 2) Third person Environment (Phenomenology Gestalt)
Key concept	Mind (Behaviourism Cognitivist)	
Activity manner	Intensive	Extensive
Context	School	Sport
Scientific method	Reductionism	Complexity
Priority in sport	Technique	Technique and tactics

Conclusion

The moving body and the process of perception and action have been object of attention that goes beyond the disciplinary boundaries of PES in school activities. However, the teaching practices common in schools and sport association as educational aim have the same theoretical epistemological basis, related to personal epistemology of teachers and trainers.

The new inter, multi and transdisciplinary framework that acknowledges the centrality of the body and of the movement can not be taken without mediation in teaching and training practices and, in this particular case, involves all the traditional educational system, from teaching methods to assessment.

However also if Cognitive approach is exclusively applied in sport activity for high performance it is useful the relocating to the center of the teaching/trainer activity the unitary structure perception/action, postulated within the ecological approach.

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