Performance Analysis and Its Didactic Applicability in the Motor-Sports and Educational Field

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ABSTRACT

In these times of great technological evolution, the human movement study, has transformed the application of scientific methods in different areas. In the motor-sports and educational field, the introduction of new technologies has radically changed the approach to the observation and the evaluation of body movement. The aim of the article is to investigate and study, through a theoretical-argumentative research, significant aspects of a procedure of investigation and evaluation based on a accurate observational study, with the use of new technological systems, the Performance Analysis as a key tool for the improving of future motor performances and didactics in the motor-sports and educational field. It was decided to discuss here three technologies, selected for the high degree of involvement in this specific are of research. The three technologies that are presented here are: (1) The calorimeter, (2) Focus X3 Software, (3) Darthfish Software. In team sports, and in group actions, an observer is not able to view and assimilate all the movements and gestures that most people perform at the same time, considering also a possible wide field of action. In this sense it is necessary to have an objective and accurate post-event feedback, in support of a teaching focused and aware of the movement, to optimize the motor gesture.

Keywords: performance analysis, didactics, new technologies, motor-sports activities

INTRODUCTION

New technologies have determined a change in methods in the evaluation of movement activities.

Understanding how human beings coordinate movements and evaluate the efficiency of their performances, has significantly impact the motor-sports and educational field. The growth of the sport phenomenon shows on one hand the development of physiological, technical and strategic abilities and on the other, with the increasing use of assessment tools that help optimize athletes' training, the easier achievement of performances and the avoiding of injuries. At the same time the data collected through technological devices allow the structuring of new transferable and didactic methods.

The evaluation in the motor educational field supports a didactics for the improvement of self body image and motor skills. According to the Italian educational ministerial guidelines, "... the concomitant aspects of physical education teaching are: the consciousness of corporeality as a means of expression of the person; the structuring of psycho-motor development of personality; the valorization of a privileged area for conducting formative s of life group experiences and social participation ..."

In order to encourage the self physical, psychological and intellectual development of the person, to have necessary conditions to define and conquer self identity in comparison with others and demand a specific role in the social, cultural and professional life, the Italian Educational Guidelines in 2003, define as part of the Italian school system duty "... the promoting of educational processes, employing knowledge (learning) and doing (skills), with a teaching that supports an harmonious development of student's personality, oriented in all directions (ethical, religious, social, intellectual, emotional, operational, creative, etc ...) and enabling the subject to act in a mature and responsible way ....".

The teacher, as the coach requires the acquisition of new skills in the use of integrated assessment tools, to support a more objective observation to improve teaching methods and training in the improvement process of motor skills.

One of the most important issue in educational and motor-sports training is the evaluation, that helps to detect the level of the learning achievement and whether if a skill of competences has been achieved or not, and if what is produced is a significant learning.

The procedures used to investigate, observe and acquire information about capabilities and skills that we want to be learned, are part of the evaluation process that, thanks to a technological development in the use of information and interactive technologies and more accurate accessible analysis

methods, facilitate the acquisition of objective feedback of an observed phenomena.

One of these procedures is the Performance Analysis, based on a accurate observational study as a key tool for the improving of future motor performances. The PA belongs to the physical education field and provides information during the assessment process, through which statistical and video information data are provided, to support the acquisition of objective, accurate, precise and reliable feedbacks, to help to improve individuals and teams/groups performances in sports and motor coordination in the educational field.

Founded during the last ten years and facilitated by the progress of the information technology and digital photography, the performance analysis is now recognized as a support to the improvement of motor performances at all levels. The function of "Performance Analysis" is to create valid and reliable records of performances trough systematic observations that can be analyzed to facilitate the motor training process and learning for future improvements.

This survey methodology refers to two distinct disciplines of sport science:

- *Notational analysis*, that uses specific tools to record different aspects of the performance during the its execution;

- *Biomechanics*, that studies the movements of the body during the motor practice.

The two disciplines use similar methods to collect data and both use information technology for the analysis, but the aspect that most link them is the use of observational measures during and after a performed motor event, to quantify performances in an accurate, reliable and valid way.

"... Through the use of an objective system of observation, coaches, teachers and trainers can focus their attention on critical events in the performance of their athletes and students ... ... planning interventions based on the results of the analysis ...." (15).

The practical value of performance analysis is that, after the consideration of right performance indicators, it is possible to highlight positive and negative aspects of techniques in action during the execution of the movement, to point out also motor difficulties, facilitating a comparative analysis within individuals or groups.

Performance analysts require a unified approach, looking at the interactions between individuals and their specific skill elements. Of central importance is the need to pay more attention to the fundamental principles to provide accurate feedback, technical

points that a coach or trainer can look through a video and give simple considerations of events that in some way may increase the possibility of improving individual or group performances.

"... Even if there are many aspects of performance ... that can be analyzed, there is only a limited set of priority items that have a useful view of the performance improving ..." (15). These elements must be identified on the base of pre-determinate aims of what to observe and analyze, taking into account the context in which the performance is made in action.

The analysis of movement and therefore of the performance, is applicable in different scientific, educational, clinical, entertainment fields, enabling the measurement and description of different aspects of a locomotors actions, directing its aims to the improvement of motor performance, of deeper physiological examinations, the assessment of rehabilitation after injuries and the technological improvement of tools in use the educational field.

The aim of this work was to investigate and study, through a theoretical-argumentative research, significant aspects of the performance analysis in the motor-sports and educational field, analyzing the usability of some technological tools in use in this area, with similar characteristics of compatibility, integrability and teaching effectiveness, to support objective evaluation methods, significant for the didactics of movement activities and recognizing the performance analysis as part of the competences of coaches, teachers and trainers.

METHODOLOGY

The research has been conducted in two phases:

- The first to establish an epistemological framework of the Performance Analysis in the motor-sports science field, through theoretical argumentative researches of literature sources.

- The second to provide the identification and selection of technological tools in use in the performance analysis field, compatible and accessible into a didactics of motor-sports and educational activities.

Tools

The calorimeter: "... Since 1900 there are several laboratory methods for the measurement of indirect calorimetric data that allow to calculate the rate of consumption and the energy expenditure during exercises and rest time, while others, in the physiology of the exercise are more recent ..." (31).

Zuntz and Hagerman in 1800 were the first to deign a calorimeter, a sealed and isolated room where the heat generated from the subject's body

was calculated thorough changing elements of the chamber's air conditions.

During these years, technology has allowed to use innovative technological instruments, sophisticated and easy to use. The calorimeter today looks like an elastic band, an highly advanced multi-sensor device that combines the very latest in algorithm based artificial intelligence and miniaturization. until now wearable devices that measure and monitor energy expenditure, physical activity and sleep have had to rely on only a single measured parameter such as heart rate or movement. This new instrument includes several additional sensors that can identify the physiological changes from exercise that are not associated with movement. These include Heat exchange, Skin Temperature and Sweat allowing the algorithms to accurately identify both energy expenditure and sleep/wake states (independent of movement) making it a very accurate metabolic/physical activity monitor and an ideal sleep screening tool. An accelerometer tells if the patient is lying or sleep, detecting also the temperature and sleep assessment for the tracking of Circadian Rhythms for long term, in depth sleep research or clinical assessment.The calorimeter has been clinically approved for patients aged between 7 and 65 years. The collected data analyze and graphically display a report which clearly shows the subject's energy expenditure (calories burned), duration and level of physical activity, number of steps, and the sleep / awake states.

Software Focus X3: The Performance Analysis often identifies athletic techniques that need to be improved. Focus X3 is video analysis software that allows zooming in on these technical aspects in detail giving to the examiner the ability to display four images, at the same time, of the same performance from different angles, comparing them with good and bad examples of the performance. It is possible to annotate and make measurements on the images to create educational or motivational diagrams; Play the video with full control over speed and synchronizes clips, to identify specific; Select a key frame and use drawing tools to highlight the image and measuring angles and distances. The annotated images can be used to measure changes and improvements.

Darthfish Video analysis system: It's performance analysis video software used for technological evaluation of performative aspects of the movement.

The software allows to calculate: angles, distances, increase the reality of the video, enter data from other technologies, auto trace the trajectories of points of interest, compose a stroboscopic image of the movement, compare the actions of two actors who perform the same movement.

This device can be used in the assessment of muscle imbalances in the prevention of accidents, the analysis of fitness tests, in the evaluation of performance techniques and can be used as a video quality analysis system in the laboratory of the movement.

The video analysis software can be used as a platform on which integrate data from other technologies such as: heart rate monitors, tachometers, dynamometers, EMG, GPS and ergometers.

DISCUSSION

New technologies have radically transformed the access to culture, learning processes, educational roles and mechanisms of social inclusion for their unique effectiveness and interactivity, flexibility and accessibility characteristics. The need of adaptability to technological an informatics tools in the motor-sports filed comes from the analysis and evaluation of the benefits that derive from the use of different software and tools in relation to specific characteristics of the observed phenomena.

Historically, for many years, the analysis of movement, especially in sports, consists essentially in the observation, with the use of cards, filled by an "technical" observer, during the competition. These observations were often made with personal symbols that made the records compact and not easy to be read.

At an intermediate stage, with the advent of computers, the process has gone from a increasingly sophisticated data processing to technical surveys carried out with shooting techniques of manual analysis. Data records presented different difficulties in this automatic system, but with the introduction of technological software, with modern methods of analysis, things became much easier and more reliable.

Very complex systems are in constant development and require a structured interaction between the subject observed and the environment in which it moves.

The general characteristics of these systems are:

1. Larger size and characteristics of the state space where the subjects observed are represented;

2. Explicit research capabilities of an object;

3. Ability to multi-part description of the interaction between multiple subjects observed;

4. Defining the time of primitive actions;

5. Ability to follow the intent;

6. Description of physical-mathematical models of the phenomenon;

7. Motion tracking on large surface areas and its trajectories.

The purpose of the Performance Analysis is to provide measurement tools necessary to allow the feedback process, capable of assume video system characteristics, through the post-event analysis, of biomechanical and computer systems or the use of notational systems in-event.

"... Researchers found that human observation and memory are not reliable enough to provide accurate and objective feedback of high-level athletes' performance ..." (31).

In team sports, and in group actions, an observer is not able to view and assimilate all the movements and gestures that most people perform at the same time, considering also a possible wide field of action. In this sense it is necessary to have an objective and accurate post-event feedback, in support of a teaching focused and aware of the movement to optimize the motor gesture. "... The biomechanical and notational analysis is both involved in the improvement of performance motor-sports performances. They have recourse to extensive use of video analysis technology ... They have theoretical models based on indicators of performance, subject to the theoretical developments of Artificial Intelligence and strong connections with other sciences and disciplines related to Information Technology ..." (31).

Computer systems and manual systems provide the same type of data, both in an intrinsically process and are used for the same purpose: the analysis of movement, tactical assessments, evaluation techniques and statistical processing. The recent developments in computer technology, regarding video systems, have transformed the approach of analysts' performance analysis and, consequently, the process of coaching and training.

To ensure accurate reliable data, is required special training and a study of the analysis and of the evaluation of certain applications, so that the results obtained can be used.

The main advantage of this method of data collection is that the performance is shown in its entirety and stored in a PC, able to create a database, where the results obtained, when manipulated, can be analyzed and evaluated and the derived information can be usable for different purposes.

Conclusion

With the introduction of the performance analysis in the motor-sports and educational filed,

coaches, teachers and trainer need an excellent preparation about technological and evolutional aspects referring to movement, to achieve better results in the motor system teaching, optimizing timing and improve the effectiveness of the motor-sports didactic aimed to improve bodily-kinesthetic performance in sports and educational environments.

The instruments used for the evaluation of movement are essential for an effective performance feedback and through the use of technology; performance analysis can identify and measure a series of performance indicators that have a real relationship with the final outcome of the performance results for each type of motor situation, to improve the body's abilities.

The improvement of these skills can reinforce self-efficacy sense in relation to the outside world, developing the acquisition or reinforcement of skills.

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