# VIDEO FEEDBACK IN LEARNING SPORT SPECIFIC SKILLS. COGNITIVE APPROACH VS ECOLOGICAL APPROACH

# VIDEO FEEDBACK NELL'APPRENDIMENTO DELLE COMPETENZE SPECIFICHE DELLO SPORT: APPROCCIO COGNITIVO VS APPROCCIO ECOLOGICO

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**Double Blind Peer Review**

**Citazione**

D'Anna, C., Pugliese, E., Forte, P., Ambretti, A. (2023). Video feedback in learning sport specific skills: cognitive approach vs ecological approach. Italian Journal of Health Education, Sports and Inclusive Didactics

**Doi:**
**https://doi.org/10.32043/gsd.v7i2.874**



gsdjournal.it
**ISSN: 2532-3296**
**ISBN: 978-88-6022-470-5**

**ABSTRACT**
The development of modern technologies allows us to analyse the learning of motor skills. This exploratory case study aims to understand the effectiveness of two different teaching approaches to teaching specific sports skills. The study (mixed approach) was carried out by comparing the different teaching choices in terms of content of the training, also through the use of technological tools. The gymnasts involved participated in a training period in which the effectiveness of the teaching-learning process was evaluated.

Lo sviluppo di nuove tecnologie consente di analizzare l'apprendimento delle abilità motorie. Questo studio di caso a carattere esplorativo mira a comprendere l'efficacia di approcci didattici all'insegnamento di specifiche abilità sportive. Lo studio (metodo misto) è stato effettuato confrontando le diverse scelte didattiche in termini di contenuti dell'allenamento, anche attraverso l'utilizzo di strumenti tecnologici. Le ginnaste coinvolte hanno partecipato ad un periodo di allenamento in cui è stata valutata l'efficacia del processo di insegnamento-apprendimento.

**KEYWORDS**
Aerobics gymnasts, Ecological Dynamic Approach, Integrated Approach, Sport-specific-skills, Video feedback
Ginnaste di Aerobica, Approccio Ecologico-dinamico, Approccio Integrato, Abilità Sport-Specifiche, Video Feedback

**Received 18/04/2023**
**Accepted 2/05/2023**
**Published 20/05/2023**

## Introduction[1]

The analysis of the processes underlying motor-sport learning is a very wide field of research that in recent decades has been the subject of scientific studies both experimental and theoretical. Motor learning is defined as an internal process that reflects the level of individual performance ability and can be assessed according to the level of stability of the performance of a task (Schmidt & Wrisberg, 2000).
The body is an active part of the learning process; it acts and interacts dynamically with the sophisticated and complex mental mechanisms during the various stages of evolution. What is acquired is also learned thanks to the body, which becomes a tool to express an activity, an abilities or skill learned over time (Handford, 1997). The body is thus the seat of maturation of specific activities that concern the motor registers that can be acquired during development. In this case we are talking about motor learning, defined as a set of processes associated with exercise or experience that determine a relatively permanent change in performance or in the potential of behaviour (Schmidt & Lee, 2012; Bortoli & Robazza, 2016).
In the field of motor activities, the main approaches to motor control and learning are the cognitive approach and the ecological approach (Pesce, 2002).
In general, the first paradigm is based on a cognitive approach, in which the athlete is considered at the centre of the teaching/learning process, not considering the variants that the environment can determine. The second approach is dynamic and differs from the first because it identifies in the environment information functional to the action. This approach is developed around an ecological-dynamic paradigm as it considers fundamental the complex relationship between individual, task, and environment in the design of a new motor learning (Renshaw & Chow, 2019).

### 1. Prescriptive approach Vs Ecological-dynamic approach

The theories on motor control developed in the field of cognitive psychology have generated a wide number of educational applications. According to these theories, the human being has at a cerebral level, a series of motor programs, or sequences

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[1] [1] The study is the result of a joint collaboration between the authors.
Cristiana D'Anna wrote the paragraph "*6. Timing of the research*" and edited the *scientific review of study.*
[1] Elisa Pugliese wrote paragraphs "*2. Object and research design*", "3*. Sample*", *"4. Methodological procedure".*
[1] Pasqualina Forte wrote paragraphs *"Introduction" and "1. Prescriptive approach vs ecological dynamics approach".*
[1] Antinea Ambretti wrote the paragraphs *"5. Tools*" and "*7. Expected results and conclusions".*

of commands that, at the level of the central nervous system, coordinate the execution of movements. In a shorter time, that is, when the movement is faster than the conduction of the nerve impulses, the movement is not susceptible to correction during execution and is programmed completely at the level of the central nervous system (Schmidt, 1975; Keele et al. 2018).

The cognitive theory of motor learning comes from the integration of open circuit motor control (motor programs) and closed circuit (feedback/affordance). Learning movements consists in developing cognitive structures (motor programs) through information processing processes (Adams, 1971).

The generalized motor program is a motor program that defines a model (pattern) of movement; this flexibility allows to adapt it to produce variations of the motor pattern adapted to modified demands of the environment" (Schmidt & Wrisberg, 2000). Its structure is such that it allows the performer to adjust the movement to cope with changing needs of the environment.

The direct consequence of cognitive theory in educational applications is a prescriptive approach: the structuring of increasingly articulated motor programs and the optimization of their parameterization. The aim of the exercises, according to this approach, is to stabilize and refine the motor program while minimizing the executive variability. If learning movements means structuring increasingly articulated motor programs, the result is a teaching of the motor activities of the prescriptive type, which consists in prescribing to the athlete how to exercise to stabilize and improve the motor programming and minimize the variability of the execution.

The prerequisite for any educational facilitation strategy to be effective and facilitate learning is that the unitary perception/action structure postulated within the ecological approach is not altered (Chow et al., 2019; McMorris, 2014).

In the ecological approach, since the best solutions to motor tasks are found from time to time, the executive variability is not seen as a limiting factor, but as an inherent property, index of the non-linear interaction of the system with the constraints imposed by the organism, the task and the environment during the search for motor solutions (Davids et al., 2003; Button et al., 2021).

The perspective changes completely in the ecological-dynamic approach. This teaching approach, in fact, does not consider it necessary to resort to prescriptive mental structures: the action is directly available to those who act in their own environment. The motor sense system has self-organizing properties that do not require the use of a motor program (Edwards, 2011). In the ecological approach, the central nervous system is not regulated by specific laws but develops from environmental influences on neuronal groups that specialize in specific tasks (Edelman, 1987). In this approach, learning is defined as attention education (Gibson, 1986). Learning means optimizing perceptual processes and developing the ability to dictate appropriate stimuli. For Gibson (1986), the subject can perceive what the environment allows him to do kept of his physical, motor

abilities, according to his age, his size, his level of experience (Fowler & Turvey, 1978).

In the two approaches, the perception of the context is different, and the learning process is defined differently. The first is to stabilize an effective motor program according to a particular information treatment. In the other, it is about seeking the adaptability of movement.

Learning, in the ecological perspective, is defined as the construction of a new coordination, adapted to the needs of the prescribed task. This construction is not realized from scratch: the novice, who faces for the first time a task exploits some types of spontaneous coordination, which can refer to previously acquired behaviours, or still be implied by very general mating tendencies. It is based on this repertoire that the construction of new models of coordination will have to be realized, copying the diversity of the environment and the specificity of the individual (Carnus & Marsualt, 2003).

In the ecological approach to practice does not mean to always repeat the same solution of a given task, but to repeat continuously the process of solution of the task itself. Teaching in the ecological approach is aimed at stimulating the emergence of spontaneous solutions (heuristics) to motor problems, then exploit the executive variability, which is to implement a process of search of motor solutions that passes through the continuous variation of the motor gestures (Woods et al., 2021).

Since the ecological-dynamic approach is more recent than the modern cognitive approach, it has not yet created an amount of educational relapses similar to that of the cognitive approach; moreover, because according to the ecological-dynamic motor learning is predominantly heuristic, it would be a contradiction if detailed teaching indications were provided, of a prescriptive type, comparable to those of the cognitive approach. Teaching strategies to enhance heuristic learning, that is, to stimulate the emergence of "spontaneous" solutions to motor problems, are based on a single principle: exploiting executive variability, which is to implement a process of search of motor solutions that passes through the continuous variation of the motor gestures (Otte et al., 2020).

This study stems from the need to understand what the most effective teaching strategies for learning may be and acquiring executive proficiency in a group of gymnasts at an early stage of learning specific sports skills. Which of the two approaches can be the most effective for a coach in terms of performance quality? In gymnasts in the initial stages of learning complex skills what is the best approach to take? What content in terms of part practice and overall practice can be most appropriate in gymnastics?

## 2. Object and research disegn

In the light of the theoretical framework briefly highlighted, the case study, currently being implemented, has been designed, with the aim of analysing and understanding which educational approach can be most effective for learning specific sports skills in young aerobics athletes. The research has been designed assuming that the integration of the two approaches (prescriptive and ecological-dynamic) can improve the acquisition of sports skills not only from the point of view of the quality of the movement and its stability in terms of motor competence, but can also be useful for the management of time variables, often reduced during periods of preparation for competitions, and the representativeness of the task, that in the integrated approach allows a choice of the contents of the more functional training with respect to the specificity of the motor task required by the discipline in a competition context.

Some studies have shown that viewing a video segment showing an expert gymnast performing the same skill produces positive effects on the perception of the technical gesture; at the same time the comparison between own performance and the video of expert gymnast increases the awareness of their mistakes (Boyer et al., 2009).

To this end, an exploratory research design has been designed that compares, also using some technological tools, two different teaching approaches.

Two groups of gymnasts underwent a training period of eight sessions. One subgroup (Gr1) was trained with prescriptive approach while the other (Gr2) was subjected to the same number of training sessions, but adopting an approach that involves the integration of Prescriptive Approach and Ecological Dynamic Approach.

The qualitative and quantitative research involved the adoption of a series of tools for teaching and evaluation purposes. These include the use of video modeling (presentation to the athlete of a video clip that shows the performance of an experienced athlete performing the skill- mature model) and video feedback (presentation to the athlete of the video clip showing his performance of the skill object of technical study). The functionality of the two tools is mediated by the different teaching style of the technician that is in full coherence with the different educational approach chosen by the specific survey subgroup and implemented during the practice (training sessions).

## 3. Sample

The case study involved 4 gymnasts of 8 years (M= 8.32 + 0.38) of the category "National Development", enrolled for the Italian Federation of Gymnastics (FGI), in the discipline of aerobic gymnastics.

A criteria-based sampling was used (Goetz & LeCompte, 1984), as athletes were identified based on the level of competitive experience, competition category, gender. About the level of experience, it was decided to select the gymnasts in the first year of federal competitions.
The parents of the gymnasts were informed about the purpose of the research and how to search for it, allowing participation in the planned activities.

## 4. Methodological procedure

The case study included the testing of a training period of eight sessions to collect and analyse data to verify, through a comparative approach, the effectiveness of the integrated approach to learning specific sports skills in young gymnasts.
To this end the gymnasts were divided into two subgroups, each consisting of two gymnasts. For group 1 (Gr1) the eight training sessions are organized educationally in the contents, methods and means adopting a prescriptive approach with proposed exercises with practice for parts mediated by a predominantly directional teaching style. The technician shows the exercise using the freeze frame technique to emphasize the details of the specific sport skill, the exercise is then performed by the athlete, breaking down the gesture into several parts, so that the athlete can focus on a specific body segment.
For group 2 (Gr2) the eight training sessions are organized educationally in the contents, methods and means adopting an ecological-dynamic approach with some moments of integration of the prescriptive approach, with the implementation of learning environments that propose the global practice of specific technical gesture and that act on the manipulation of the constraints of the individual, the task and the environment (ecological-dynamic); the communicative style in this second group is integrated, as the overall practice and the search for the executive variability of the teaching proposals also associates, in some precise phases of the training, the prescriptive style with the addition of verbal corrections that the technician imparts. The technician in this case focuses attention on the totality of the gesture and makes the athlete participate in what he perceives in the vision and in the subsequent realization of the technical gesture.
Each training session lasts 90 minutes and consists of four phases:

1. Warm-up;
2. Phase dedicated to joint mobility;
3. Technical and teaching phase aimed at the acquisition of the three elements of difficulty through the prescriptive approach for the first group, and through the integrated approach for the second group;
4. Cool down and stretching.

The elements of difficulty have been selected according to the reference category that has been taken into account (category national development, 8-11 years), the Code of Points of the federation provides that this category performs three elements called "compulsory" such as: Push up (group A, floor elements), Air turn

(group B, airborne elements), Straddle Support (group A, floor elements). This decision, provided for by the FGI, excludes the third group (group C, standing elements) that provides for the execution of elements in upright position for which the Push Up (group A) has been replaced with the Vertical Split (group C).
In the first working session, each athlete was filmed while performing the element of difficulty, to obtain a technical assessment in the entrance, before the start of the experiment through the acquisition of some video input (T0). Each element of difficulty being studied was recorded twice, for a total of six videos for each athlete.
The incoming and outgoing videos of all skills were evaluated by two judges who obtained the qualification of FGI Race Officers. The evaluation criteria are those of the international scoring code but in order to verify its reliability the practice of inter-observation between the two evaluators has also been adopted.
The judges were not informed about the training arrangements. Their evaluation is carried out individually through analysis of the captured videos.
From the video analysis will be collected the following data: n. 2 scores for each element of difficulty, for each gymnast, both incoming and outgoing.

- n. 2 Air Turn element T0 e T1
- n. 2 Straddle Support element T0 e T1
- n.2 Vertical Split element T0 e T1

## 5. Tools

Research has included the use of a series of tools for both educational and evaluation purposes.
In particular, the following were used:
- a *digital camera* to record gymnasts;
Jumping performances have been taken from a HERO4 Black camcorder. This is a HD video camera that offers an amazing slow-motion mode up to 240 frames per second. To this study, high resolution 4K30 and 2.7K60 video mode and high frame rate of 1080p90 were used, which allowed to record 90 frames per second. Athletes did their performance in a calibrated space. The camera was placed on the sagittal plane to the athletes on a fixed plane with the Go-pro locking instrument. The videos, that have been realized, have been analysed through the Kinovea ver. 09.5 Video analysis software.
- *Kinovea software* to analyse video;
Video analysis is a method of evaluating the movement that can be particularly useful in sports. Using video analysis software (KINOVEA), the operator can visualize and process the desired parameters, objectifying and realizing a scientific and reliable study of the gesture taken into account or on a given sequence of actions.
- *video file of difficulty elements* performed by elite athletes;
The videos of the performance performed correctly to be shown to participants was extrapolated from the Site of the Fédération Internationale De Gymnastique.

- *check list with technical indicators for the evaluation of sport-specific skills* (an example is shown in Table 1).
- *evaluation of the implementation of the difficulty element by applying the code* of point (e.g.: figure 1).
- *Outgoing questionnaire to detect the perceptions of athletes*. The self-completed questionnaire aimed at acquiring qualitative data regarding the satisfaction and perception of the effectiveness of what has been experienced in training. The questionnaire uses a 5-point Likert scale to assess how much he liked the procedure, how easy it was, how useful it was, etc.

| | |
|---|---|
| Hold the position for two second | |
| Hold the position without swinging | |
| Hold position without touching floor | |
| Straight legs | |
| Raise both legs and hips | |
| Legs parallel to the floor | |
| Legs straddled at minimum width 90° | |
| TOTAL | /7 |

Table1: check list technique used for the evaluation of the difficulty elements in T0 and T1.

## 6. Timing of the research

The research started in March is still being implemented. The nine working sessions include the following phases:

I. In the first session, the athletes are shown videos of the skills to be performed, the technician through the still image and through the verbal explanation, emphasizes some fundamental characteristics of each skill. The athletes were then filmed twice for each skill thus acquiring the video input.

II. The seven training sessions are characterized by the use of video feedback with verbal explanation and corrections by the technician who uses the practice for parts for 2 gymnasts; while for the other 2 you use an integrated approach showing the videos of your performance and then using the technician's report for corrections, but the practice of the element takes place in a global way using the manipulation of constraints (individual, environment, task).

III. In session IX, the output videos (T1) of the skills that were trained during the sessions were captured. The competition officials hired evaluated the videos of all abilities (T0 and T1) assigning the scores from the check list and following the deductions that the executing judge attributes according to the code of the scores of aerobics.

IV. For educational purposes at the end of all video acquisitions, the gymnasts were involved in a reflection and self-assessment session

through the comparison of incoming and outgoing evaluations, both through the video and through the analysis of scores detected by check list. Finally, the self-completed questionnaire allowed the results of the gymnasts' perceptions and judgements with respect to what they had experienced.

| | | |
|---|---|---|
| *PHASE I*<br>*n. 1 Training session (I)*<br>*Video assessments T0* | Acquisition of input video assessments of all sport-specific skills (T0) and related qualitative-quantitative assessments | *T0* |
| *PHASE II*<br>*n. 7 training sessions (II-VIII)* | *Gr1 Prescriptive approach:*<br>Proposals of exercises with practice for parts mediated by a directive teaching style. | *Treatment Period Gr 1* |
| | Gr2 Integrated approach**:**<br>Proposals of exercises with global practice of specific technical gesture and with manipulation of the constraints of the individual, the task and the environment (ecological-dynamic); the communicative style integrates the two approaches. | *Treatment Period Gr2* |
| *PHASE III*<br>*n. 1 training session (IX)*<br>*Video assessment T1* | Acquisition of the output video assessments of all the specific sports skills (T1) and related qualitative-quantitative assessments.<br>Input video comparison with output video<br>Outgoing questionnaire administration | *T1* |
| *PHASE IV*<br>*Debrifing* | Debriefing with the gymnasts | *Video modeling*<br>*Video feedback*<br>*Questionnarie T1* |

Figure. 1 Timing and phases of the research process

## 7. Expected results and conclusions

There is still little scientific material on neurophysiological changes that accompany the acquisition of complex motor skills from which they can derive application fallout for the teaching of motor and sports activities. The most promising scientific field for this integration is cognitive neuroscience (Gazzaniga, 2006).

Neuroscientific research can play a key role in terms of application, as it could start from cognitive and/or ecological scientific theories to analyse and expand the criteria of methodological-educational choices.
Based on this, it is hypothesized that the athlete can achieve an optimal level of performance (in this case, as a code of points FGI), in which the gymnast to achieve a level of proficiency ("mastery") of that specific sport skill in the shortest possible time, addresses a technical problem closely connected with the teaching that is implemented in the period of preparation/ training. To this end, it is therefore important to make workouts effective both for a competitive goal and during technical preparation.
The strength of the present work certainly concerns the age group and the relative technical (initial) level that allows to understand which of the two teaching strategies can be more effective for the acquisition of skills: the opportunity to work with competitive gymnasts of the same age and the first year of competitions, allows to understand in the initial stage of learning specific sports skills as gymnasts respond to different stimuli, how they adapt and self-organize the movement. Certainly, at the beginning it allowed to start a first trial from which to draw elements of analysis and reflection to deepen and replicate on a larger sample, comparing the results between gender and various categories of competition.
A critical point is surely linked to the limited time of experimentation, as nine training sessions cover a period not long enough to induce stable adaptations and therefore may prove to be too short to verify which of the two approaches is better for acquiring and learning a skill performed with proficiency/mastery.
Interesting aspects related in future perspective to the present work, could be to expand the reference sample, experiment with different approaches on other technical skills of high complexity and prolong the time of comparison of the two approaches, adapting them both in view of a future competitive goal, both in the process of acquiring new skills in technical preparation.
The integration of multiple tools during the technical preparation of athletes, such as video modeling and video feedback, in addition to the conventional use of content, methods and training means may be effective in increasing the execution of a skill (Kok et al., 2020) that has already been learned at the basic level and increase the athlete's awareness of both their mistakes and their strengths.

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