

# HOW DO STUDENTS LEARN? TEACHING STYLES AND NON-LINEAR DIDACTICS IN DIFFERENT CONTEXTS

## COME APPRENDONO GLI ALLIEVI? STILI D'INSEGNAMENTO E DIDATTICA NON- LINEARE IN CONTESTI DIFFERENTI



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### ABSTRACT

The teaching of motor competencies requires variation in teaching styles, determining different learning methods. Production styles promote the learning of executive variants of the motor task, according to a non-linear approach. The contribution presents a list of teacher behaviors and the teaching conditions for planning. Through action-research and microteaching experiences, the behaviors of the teacher for educational planning were identified and for qualitative learning.

L'insegnamento di competenze motorie richiede la variazione degli stili d'insegnamento determinando modalità diverse di apprendimento. Stili di produzione promuovono l'apprendimento delle varianti esecutive del compito, secondo un approccio non-lineare. Il contributo presenta una lista di comportamenti dell'insegnante e le condizioni della didattica per la progettazione. Attraverso esperienze di ricerca-azione e di microteaching sono state individuati i comportamenti dell'insegnante per la progettazione.

### KEYWORDS

Motor Learning; Non-linear teaching; Physical Education; Teacher training; Teaching Styles.

Apprendimento motorio; Didattica non-lineare; Educazione Fisica; Formazione dell'insegnante; Stili d'insegnamento.

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## Introduction

The contribution of motor experience to the growth of the person in developmental age is highlighted by numerous scientific evidence and good practices. The motor activities are not superimposable and do not have the same educational value.

It is the behavior of the teacher that promotes the necessary educational mediation, through the choice of the motor task and the methods of proposal, the adaptation to the needs of the students and the characteristics of the contexts in which the teaching process takes place (Bailey, 2006; Rudd et al.2020).

Teaching motor competencies in relation to the educational needs of children and young people and in different training contexts, in particular school and introduction to sport, requires the selection not only of a wide quantity and variety of motor tasks and organizational methods but also the use and interaction of teaching styles and strategies (Mosston & Ashworth, 2008), promoting different learning methods. With reference to neuroscientific evidence and on the basis of the related re-interpretations of learning-teaching processes (Gola, 2020), the need emerges to re-orient the educational and teaching process, highlighting teaching experiences and scenarios aimed at enhancing the mutual relationships between perceptual-coordinative, psychological and social factors and different learning methods.

The student-task-environment/space relationships, therefore, proceed and develop in the curriculum according to trajectories not completely predefined by the teacher and marked by cause-effect links (linear) but open and unusual (non-linear), not only in disciplinary sense, enhancing learning methods of free exploration, guided discovery of executive options, problem solving and semantic interconnections recurring in the various training contexts.

The teaching of motor competencies, therefore, requires the variation of teaching styles, in the lesson and in the learning unit, to promote the proposal of numerous executive variants of the motor task and the variation of the conditions present in the setting, favoring different methods of learning and response-execution by students (Pill et al., 2023).

In particular, the interaction and variation of teaching styles make it possible to differentiate educational communication and the setting in which the experiences take place along a continuum that proceeds from the proposal of motor tasks in which the centrality of the student's choices and decisions prevails teacher to the proposal of motor tasks and organizational methods in which that of the student prevails, as well as a frequent and systematic mutual relationship (Mosston & Ashworth, 2008; Invernizzi et al., 2019). In this way the following are promoted: a. personalized learning methods and times of the motor task; b. different motor response modes; c. factors of motor competence and mutual relationships are involved.

The following contribution, starting from the ecological-dynamic approach to learning and the characteristics of non-linear didactic (Magill & Anderson, 2014; Chow & Atencio, 2012), presents some teacher behaviors regarding reproduction teaching styles and production, selected during a cycle of action research and microteaching training activities, carried out with secondary school physical education teachers.

### **Motor learning: environments-spaces and variability of practice**

Analyzing teaching as a mediation of the relationships between the subject and the object of learning means conceiving a complex didactic competence that refers to interdisciplinary knowledge.

The teacher is required to know the relationships between the object of motor learning, through the analysis of the motor task and the organizational methods, the subject of learning, or the processes concerning the models of motor learning, implicated in contexts and concrete situations, the conditions and strategies for mediating learning, that is, the methods of proposing disciplinary contents, through teaching styles and didactics strategies, learning episodes, operational situations and educational scenarios (Klinberg, 1988; Pill et al., 2023).

Among the different motor learning approaches, particular importance is given to that relating to the theory of *dynamic systems* (Edwards, 2011; Magill & Anderson, 2014), in which the *perception* of stimuli is a process through which the individual selects and immediately discovers the environment, the information already present and functional to the action, to the motor response (Renshaw & Chow, 2019).

The variability of the students' motor responses will be conditioned by the organizational methods (large-small-wide-narrow field; heavy-light tool, number of players on the field, etc.) already present in the environment or intentionally proposed by the teacher, to encourage expected and predefined or unusual, original and creative motor responses (Magill & Anderson, 2014; Pesce et al., 2019). Varying the learning setting, therefore, means offering students numerous opportunities to perform executive variations of motor, spatial-temporal-quantitative-qualitative skills, adapted to different contexts and situations (games, expressiveness and dramatization, coordination activities with small tools, outdoor education, etc.) which may be similar but not identical.

The perception-action interaction is specific to each situation and the motor skill, adapted to the variable relationships between the *motor task* (goal), the *individual* (the person's motor repertoire) and the *environment* (playing field, equipped gym,

etc.), is the result of existing and mutually interconnected constraints (Newell,1986).

In particular, each action is systematically altered by environmental *constraints* and the motor skills possessed by the student; Therefore, it is not so much the degree of motor, technical-sports or mimic-gestural mastery that takes on particular importance, but rather the repertoire of skills and executive variants used.

According to the ecological approach or the theory of dynamic systems, therefore, learning arises directly from the interaction of the individual with the surrounding environment and the most significant aspect is precisely the direct connection between *perception-action* (Gibson, 1979; Newell, 1986).

The ecological-dynamic approach attributes importance to non-sequential and predefined learning, to the motor responses provided in unexpected, new or little-known situations.

The stimuli present in the external environment-space solicit, in fact, non-predefined motor executions, that is non-linear, thus soliciting motor imagination, the transformation and adaptation of the motor task. The *ecological-dynamic* approach, in fact, promotes *non-linear* learning, that is not predefined and closed but open to numerous responses and executive variations (Chow & Atencio, 2012; Pesce et al. 2019).

According to Schollhorn et al. (2012) different learning models imply different directions of development of the didactic process:

- traditional didactics approaches can be traced back to a *linear* determination of causality (e.g., motor task-organizational modality-effect on learning and the development of related motor abilities); in this case the teaching sequence is independent of the context in which it takes place, it is proposed according to standardized, successive and complementary degrees of difficulty and the curricular structure also follows a predefined path;
- the teaching processes, in addition to (instead of) following a linear path (cause-effect) directed towards the objective (a skill to be learned) through numerous *repetitions* and *corrections* and frequent recourse to memory, should follow an approach based on *variability* of the proposals, different and differentiated and on the autonomy of the student's choices;
- *learning* processes lead to behavioral changes when *teaching* processes deviate from a linear and totally predefined approach.

According to the dynamic systems theory approach, it is the variation of the situation that conditions different motor response possibilities; in this case the motor learning process does not follow a predefined and sequential path but a non-linear path (Chow, 2013; Schollhorn et al., 2012), that is, variable and open to interconnections between motor skills, executive and contextual variants.

## Teaching styles and non-linear teaching

In order to structure a teaching-learning process that enhances the motor competencies of each student, considers the opportunities offered by the activities carried out in different contexts and in relation to the learning methods that are intended to be encouraged, it is necessary for the teacher to carry out a selection intentional among various methodological options.

The students' learning methods are mediated by intentional didactic proposals from the teacher who, through the (preliminary) analysis of the motor task and the different modes of motor request, solicits motor responses from the students, according to predefined progressions of difficulty and intensity, or original, unusual, creative and transferable, open motor responses.

Considering that motor tasks are not superimposable and that the person learns according to different times and methods, through the interaction of production and reproduction styles (Mosston & Ashworth, 2008) learning paths are outlined that are not only completely predefined and sequential but also open and strongly attributable to the demands of the environment-spaces-contexts (Chow & Atencio, 2012; Edwards, 2011).

In particular, through *production* styles, non-linear didactic is proposed (Chow & Atencio, 2012) to learn motor skills, developed according to a dynamic-ecological approach to learning (Newell, 1986).

At the heart of this pedagogical framework is exploratory learning, with an emphasis on encouraging personalized motor solutions, guided discovery, and problem solving (Chow & Atencio, 2012, Chow, 2013).

From this perspective, providing children with the freedom to explore a designed learning environment (predefined scenario) will lead to the formulation of didactics proposals guided by spatio-temporal, quantitative-qualitative constraints which will result in the execution of non-standardized motor solutions (Rudd et al., 2020). Consequently, non-linear didactic involves a student-centred approach to physical education and motor activities in which teachers direct learning by modifying the constraints/variants of the motor task to promote relationships between functional motor skills task to be performed (Chow, 2013; Rudd et al. 2020).

In non-linear learning-teaching, the flexibility of the curriculum and the didactic process emerges. For example, a lesson can begin by proposing a didactic scenario, a prevalent motor skill and develops through different interconnected schemes and motor skills that are not predefined, not completely foreseen.

The execution variants are stages of motor learning, they underlie numerous motor abilities and represent the common thread of the didactics methodologies.

In the traditional didactic approach, on the contrary, each motor task is defined by the teacher and the learning process is predominantly reproductive, linear-sequential, with a strong commitment to memory.

This model takes up the behaviourist and cognitivist approach and a succession of motor tasks, from the easiest-facilitated-simple to the most difficult-complex, significantly involving memorization (Fig.1).

The execution variants can be solicited both from a reproductive and productive point of view. In terms of learning, productive learning is undoubtedly more effective, which follows a non-linear and ecological-dynamic approach.

Another aspect that characterizes the non-linearity of learning is the variability of practice, the manipulation of constraints and executive variants which involves cognitive processes and executive functions (Chow, 2013; Pesce et al., 2019).

Non-linear didactic is the basis for learning motor competencies and is encouraged with production styles. In fact, I learn to learn, I also continue learning independently.

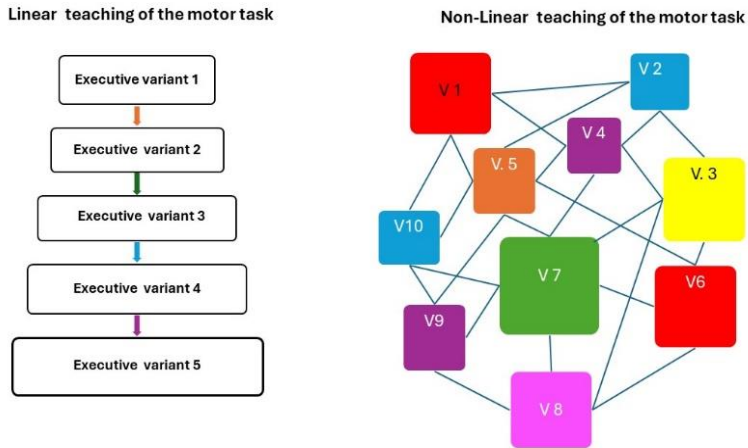
This type of didactic, as we stated before, falls within the productive teaching style, attributable to the ecological-dynamic approach of motor learning, since it activates the "affordances", that is the motor opportunities that the environment offers to the person-organism (Gibson,1979).

They arise thanks to the complementary relationships between an individual and an environment.

Information deriving from the environment guides the behavior of complex systems: affordances represent specific characteristics of the environment in which a motor activity takes place, perceived as significant for the individual. In this very radical perspective, Gibson (1979) rejects many traditional concepts, such as that of memory, proposing a new language (affordance) which, devoid of any mentalistic connotation, manages to express the relationship of continuity and harmony between person and environment.

Thanks to this theory, the need to study man in the context of his environmental reality emerged. From a theoretical point of view, however, it has allowed us to overcome the environment-organism dualism: the information is present in the environment and does not require further mental processing. According to the theory of affordances, perception invites action and action is a fundamental element of perception (Gibson, 1979; Sannicandro & Colella, 2023).

According to Gibson, the key factor for an adequate explanation of perception is the structure of the information already present in the stimulus, and not so much the processing of it by internal mechanisms.



**Fig. 1. Linear and Non-Linear Teaching Approach.**

The physical education and sports teacher becomes a facilitator and mediator of learning, his didactics competencies expand. This occurs through the selection of appropriate content that highlights effective teaching methods, stimulating exploratory behaviors and personalized and original discovery paths. Consequently, the need emerges to adopt different communication techniques and teaching methods to support the acquisition of motor skills and knowledge through a non-linear approach, useful for learning motor competencies in an effective and meaningful way (Colella, 2019). Non-linear teaching, through the variability of motor tasks, the manipulation of space-time constraints and the use of feedback, rather than a linear and predefined progression of how motor teaching-learning should take place, favors dynamic relationships in students between individual-environment-activity, executive variations and original and creative motor responses (Sannicandro & Colella, 2023) which fuel the student's perception of competence and the metacognitive process.

## Aims

The objectives of the following study are:  
 present a list of teacher behaviors to analyze the methods of communication and request for a motor task and which stimulate different methods of motor learning.  
 A further objective concerns the analysis of the student's behavior and the teaching conditions in which to carry out the proposed activities.

## Methods

An Action-Research pathway was proposed for 25 middle school's teachers in the Puglia Region, in which were identified teacher behaviors corresponding to the following teaching styles: reproduction (Mosston & Ashworth, 2008; Colella, 2019): *reciprocal*; *self-check*; *inclusion*; and production: *guided discovery*; *problem-solving*. Microteaching activities (Cagol, 2022) were designed to differentiate the modes of task request to promote learning processes and nonlinear didactics for teaching motor competencies.

In this study three reproduction styles and two production styles were identified, in order to identify similarities and differences. In subsequent phases, we will proceed with the practical implementation of predefined teaching scenarios.

## Results

Five descriptors of teacher behavior have been identified and shared for each *reproduction* teaching style and five for *production* teaching styles, for a total of 25 descriptors (Table 1,2). In relation to the shared descriptors, some teaching-learning scenarios have been planned to verify validity and effectiveness.

<b>Tab.1 Reproduction of Teaching Styles (Mosston &amp; Ashworth,2008)</b>	
<b>Reciprocal</b>	<ul style="list-style-type: none"> <li>a) Presents the motor task and communicates the objective;</li> <li>b) Specifies the execution modes: sets-repetitions; equipment; intervals;</li> <li>c) Set up organizational methods and operational spaces;</li> <li>d) Communicates the criterion skills to practice and indicates the feedback to be given to the companion(s);</li> <li>e) Arranges the organization of pairs and subgroups.</li> </ul>
<b>Self-Check</b>	<ul style="list-style-type: none"> <li>a) Presents the motor task and communicates the objective;</li> <li>b) Predisposes the organizational methods, operational spaces, and data recording sheets;</li> <li>c) Specifies the execution and organizational modes;</li> <li>d) Communicates the criterion skills to practice and compare the results with;</li> <li>e) Prompts the metacognitive process (personal reflection on the learning journey undertaken, difficulties encountered, progress made, and results achieved).</li> </ul>
<b>Inclusion</b>	<ul style="list-style-type: none"> <li>a) Presents the motor task and communicates the objective;</li> <li>b) Presents the execution and organizational modes, according to different levels of difficulty/intensity, increasing and reducing the number of execution variants and the use of equipment;</li> <li>c) Adapts the motor task to individual differences;</li> <li>d) Communicates the relationship between motor skills performed/required and related motor capacities;</li> </ul>

	e) Corrects the error directly and indirectly.
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<b>Tab. 2 Production of Teaching Styles (Mosston &amp; Ashworth,2008)</b>	
<b>Guided discovery</b>	<ul style="list-style-type: none"> <li>a) Communicates the objective, presents the motor task, and recalls previously acquired motor skills;</li> <li>b) Proposes a motor task and asks questions about possible spatial-temporal-qualitative-quantitative execution variants/use of equipment/space management, e.g., "In how many ways can you jump forward? How can you...? Let's try throwing in three different ways. - Let's all try to run like Stefano" ...;</li> <li>c) Proposes a motor task and encourages the discovery of analogies and differences with other tasks/equipment/activities, e.g., "Let's all try to roll like...; let's jump with the skipping rope";</li> <li>d) Requests the repetition of the motor task without repeating the same task;</li> <li>e) Communicates interrogative/descriptive feedback to the learner.</li> </ul>
<b>Problem solving</b>	<ul style="list-style-type: none"> <li>a) Communicates the objective, presents the motor task, and recalls previously acquired motor skills;</li> <li>b) Proposes the execution of a motor task and encourages open, divergent motor responses, e.g., in pairs: who can transport a ball without using hands and feet? Who can move forward without... touching the ground with their feet? How can you throw without...; Let's try throwing in all possible ways but without...; etc.</li> <li>c) Asks questions and encourages unusual, open motor responses;</li> <li>d) Asks questions and encourages motor responses through combinations of execution variants.</li> <li>e) Proposes motor tasks within space-time constraints.</li> </ul>

## Conclusions

Teacher training in physical education requires not only the analysis of disciplinary fields and thematic nuclei (MIUR, Indicazioni Nazionali, 2012), contents and organizational methods, but also knowledge of teaching methods to promote learning motor competencies. Physical education and the practice of physical and sporting activities in developmental age carried out in various educational contexts, formal and non-formal, has recently received a significant boost to its development, for reasons attributable to health promotion, sports orientation, development of interpersonal and social relationships, socio-cultural inclusion. The development of

knowledge regarding the methods of educational relationships in scenarios or in other motor and sports settings has not received the same impetus.

It is a question of method and not just content.

For some years now, in fact, we have been witnessing a significant expansion of the *places* and *contexts* of didactic and, particularly with regard to sport, this is a real extension and wide diversification of the opportunities already offered by the formal context. of the school, aimed at children and young people.

The demand for training in this direction is continuously increasing and diversifying, even if it is not always possible to detect an equivalent development in the quality of teaching and the educational process of the child and young person, even in the presence of fruitful and well-identified educational paths.

Not infrequently, in fact, it is possible to detect a discontinuity in the didactic choices and related methodologies compared to those proposed at school which, if on the one hand generate apparent diversification, on the other constitute limits and constraints for the development of specific and correlates of motor competence, that is, self-perception, motivation to learn, metacognition, interpersonal relationships, factors necessary for the growth of the person and for the continuation of sports practice, based on correct lifestyle habits, at different ages .

Teacher training is a long process that requires continuous relationships between scientific evidence, generalized good practices and activities carried out in contexts. Microteaching (Cagol, 2022) allows us to prepare a setting for mutual observation of the teacher's behavior, in order to encourage participatory reflection on the choices made, relating to motor tasks, organizational methods and the teacher's behavior in the gym.

The behaviors of the teacher and the student identified and emerged from the study allow us to reconstruct the process, that is the cause-effect relationships between teaching intentionality and motor responses of the student and the class group (Pieron, 1996).

The variation in teaching styles promotes different learning methods; Production styles in particular favor experimentation, discovery and problem solving, that is non-linear learning, open and transferable to different educational contexts and fruitful disciplinary interconnections.

In accordance with the theory of dynamic systems which involves the development of individual-task-environment/context/space relationships and the manipulation of space-time constraints to acquire motor competencies, the variation in teaching styles allows the proposal of both motor tasks in sequence, attributable to the progression of difficulty, complexity and intensity, and open to different modes of motor response from the student (Gibson, 1979; Edwards, 2011).

In the first case (Tab.1), a linear didactic and a methodological reproduction approach emerges (Chow & Atencio, 2012; Rudd et al., 2020).

On the contrary, through motor tasks proposed, mainly, with production teaching styles, the following are promoted (Tab.2): a. the learning of numerous executive variants, mutually interconnected, in (even) non-pre-ordained form, capable of generating links between motor skills; b. the pupil's motor responses and a (consequent) non-linear learning are promoted, i.e. not completely predefined, closed and sequential but open and creative, reticular, in order to encourage unusual, original and transferable motor responses-executions also in other contexts training; c. reciprocal relationships emerge between motor skills and knowledge.

In this way, the development of mutual interconnections between motor skills and related motor abilities, the development of the metacognitive process and the transferability of learning are promoted.

Non-linear learning, provided it is methodologically encouraged (Tab.2), determines open educational paths and different connections (operational, logical, semantic), with particular reference to:

- ✓ relationships between spatio-temporal-quantitative-qualitative executive variants (and skills-abilities);
- ✓ relationships between executive variants and teaching styles (which guide the directions of learning);
- ✓ relationships between executive variants and alphabets (mathematics, geography, drawing, etc.);
- ✓ relationships between executive variants and training contexts.

In this way it is possible to appreciate a profound subject-environment-task interconnection: the acquisition of motor skills is the result of functional relationships of adaptation between organism and environment which becomes the generator of a flow of information/situations, functional to learning motor competencies, that is, it becomes a *generator* of the variability of motor practice.

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