PHYSICAL LITERACY AND MOTOR LEARNING: TEACHING STYLES AND PRACTICE VARIABILITY

ALFABETIZZAZIONE MOTORIA E APPRENDIMENTO MOTORIO: STILI DI INSEGNAMENTO E VARIABILITÀ DELLA PRATICA

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Double Blind Peer Review

Citation
Monacis, D., & Moscatelli, F. (2025). Physical literacy and motor learning: teaching styles and practice variability. *Giornale italiano di educazione alla salute, sport e didattica inclusiva*, 9(2).

Doi:
https://doi.org/10.32043/gsd.v9i2.1424

gsdjournal.it
ISSN: 2532-3296
ISBN: 978-88-6022-510-8

ABSTRACT
The present contribution investigates the relationship between Physical Literacy and motor learning, emphasizing the impact of teaching styles and practice variability on skill acquisition. Moreover, the study explores the role of practice variability, analysing how structured vs. varied practice conditions affect skill retention, transferability, and adaptability. These insights contribute to refining pedagogical strategies for PE teachers aiming to foster long-term engagement in physical activity.

Il presente contributo analizza la relazione tra Physical Literacy e apprendimento motorio, ponendo l'accento sull'impatto degli stili di insegnamento e della variabilità della pratica nell'acquisizione delle abilità motorie. Inoltre, esplora il ruolo della variabilità della pratica, analizzando come condizioni di pratica strutturate rispetto a quelle variate influenzino la ritenzione, la trasferibilità e l'adattabilità delle abilità. Queste evidenze contribuiscono a delineare un possibile modello per gli insegnanti, per applicare strategie didattico-pedagogiche evidence-based.

KEYWORDS
Spectrum of teaching Styles; Motor Learning; Physical Literacy;
Stili di Insegnamento; Apprendimento Motorio; Alfabetizzazione Motoria

Received 30/04/2025
Accepted 28/05/2025
Published 20/06/2025

Introduction

The teaching of motor skills via different teachers-students communication approaches allows for more personalized interventions by modifying motor tasks in terms of their execution and organizational frameworks (Mosston & Ashworth, 2008).

In the past few decades, research and studies in physical education (PE) and physical activity (PA) raised significantly, expanding and broadening a deeper understanding of the topic across different educational settings. Emerging evidence has highlighted that adapting motor tasks to individual needs plays a fundamental role for designing successful learning trajectories (Hulteen et al., 2018).

On the other hand, there is still a need for further research, to be carried out with enhanced methodological rigor – focused on teacher-student interactions, group dynamics, and spatial organization to foster multiple and meaningful learning experiences.

The present paper discusses the potential use of the Spectrum of Teaching Styles on Physical Literacy promotion during childhood, defining some pedagogical and methodological implications for PE teachers.

1. A brief review about Theories of Motor Learning

Research on motor learning emphasizes the fundamental role of children's movement experiences, whether in formal (e.g., family, school, organized sports) and non-formal contexts (e.g., unstructured play areas) (Solmon, 2015).

Modern theories have progressed from previous models suggesting rigid and pre-defined stages of motor development associated with particular ages.

For example, Fitts and Posner (1968) characterized motor learning as a series of phases, moving from cognitive (understanding what to do), to the associative (learning how to do it), and autonomous (executing with effort) ones. Similarly, Meinel and Schnabel (1987) described motor learning as a progression from rough coordination to refined coordination, and variable availability, stressing the importance of both technical skill and movement automation.

Schmidt's schema theory (1975) presented the idea of a generalized motor program, suggesting that learning develops through the adjustment of movements to meet new environmental requirements.

The main theoretical approaches - behaviorist, cognitive, and ecological-dynamic - primarily differ in how they conceptualize the perception-action connection.

The behaviorist model (Skinner, 1938; 1963) views motor learning as a conditioned reaction to external stimuli, emphasizing observable behaviors over cognitive processes.

In contrast, cognitive theories depict learners as proactive processors of information, where perception initiates decision-making and intentional motor actions (Ausubel & Fitzgerald, 2004; Tallet, Albaret, & Rivière, 2015).

The ecological-dynamic perspective highlights immediate engagement with the environment, suggesting that perception directly guides action with minimal dependence on memory (Davids et al., 2012; Edwards et al., 2017).

According to this point of view, learning is influenced by ongoing interactions among the individual, the task, and the environment, where variability and adaptation are crucial factors.

The Constraints-Led Approach (CLA) (Renshaw & Chow, 2019; Renshaw et al., 2019) expands on this concept, suggesting that altering task, environmental, or performer constraints promotes self-organization and the discovery of efficient movement strategies.

Non-linear pedagogical models (Chow, 2013; Moy et al., 2019; Woods et al., 2020; Rudd et al., 2021) promote exploratory learning, with the teacher serving as a facilitator, encouraging students to engage in problem-solving and adapt via dynamic, open-ended tasks.

2. The Spectrum of Teaching Styles: Conceptual Foundation

In recent years, physical education has experienced a notable transformation in its curriculum and teaching methods, broadening the variety of activities available to students.

Nonetheless, although this growth has enhanced the variety of experiences, it has not consistently come with a greater comprehension of the motor learning processes at play.

Genuine advancement of motor skills relies not just on the variety of activities but also on the instructional approaches employed to support and enhance learning (Goldberger, Ashworth, & Byra, 2012; Pill, SueSee, & Davies, 2023).

Successful teaching demands deliberate variation and adjustment of teaching methods to provoke diverse cognitive reactions and learning routes (Chow, 2013).

Findings from educational neuroscience have emphasized the essential importance of structuring learning experiences, indicating that the quality and approach to learning affect brain plasticity and cognitive growth (Gola, 2020; 2021).

Therefore, teachers should concentrate not just on the content being delivered, but also on the design of motor activities to foster significant and enduring learning.

The "Spectrum of Teaching Styles" introduced by Mosston and Ashworth (2008) provides an important framework for tackling the intricacies of motor skill development and examining teacher-student dynamics.

The framework describes 11 unique teaching styles that vary from teacher-focused to learner-centered methods: Command (A), Practice (B), Reciprocal (C), Self-Check (D), Inclusion (E), Guided Discovery (F), Convergent Discovery (G), Divergent Discovery (H), Learner-Designed Individual Program (I), Learner-Initiated Program (J), and Self-Teaching (K).

Reproduction Teaching Styles		Production Teaching Styles	
Command Style - A	The teacher retains full control over all aspects of the task, including the level of difficulty, duration, number of repetitions, use of equipment, and execution method. Students are expected to precisely replicate a model or action demonstrated by the teacher, following exact instructions.	**Guided Discovery Style - F**	The teacher outlines the topic and the main concept and poses a sequence of questions to guide students' discovery of specific motor solutions. Students engage in exploration within a structured framework to uncover the intended motor response.
Practice Style - B	The teacher organizes learning situations, setting up activities that can be performed individually, in pairs, or in groups, such as circuits, paths, relays, and games. The teacher introduces motor tasks under simplified conditions appropriate to the learners'	**Convergent Discovery Style - G**	The teacher defines the learning objective and crafts questions that lead students to logically deduce a single correct motor solution. Students must reason through the problem, applying logic and sequential thinking

	stage. Parameters like task complexity, repetitions, duration, and tool use are determined by the teacher. Students practice independently and receive personalized feedback.		to achieve the desired outcome.
Reciprocal Style - C	Students work in pairs where one performs the assigned motor task while the other provides feedback based on criteria set by the teacher. They alternate roles, ensuring active participation in both performing and observing.	Divergent Discovery Style - H	The teacher defines the topic and asks open-ended questions that encourage students to generate multiple motor solutions to a proposed challenge. Creativity and multiple correct responses are encouraged.
Self-Check Style - D	The teacher gives students a checklist of motor tasks (e.g., rope jumping, ball throwing). Students work independently, performing the activities and evaluating their execution according to established benchmarks provided by the teacher.	**Learner Designed Individual Program Style - I**	The teacher chooses a general learning domain but allows students substantial autonomy in designing their own learning experience. Students decide what they wish to learn within the given framework and present their motor activities with teacher guidance.
Inclusion Style - E	The teacher selects a motor activity offering multiple levels of difficulty, encouraging students to choose tasks that match their skill level. Variations might include differences in distance, height, weight, or technique. Students adapt and integrate learned skills by selecting and	**Learner Initiated Program Style - J**	Students select the area of focus, such as small group games, and are responsible for organizing and implementing the activities. The teacher provides initial guidance regarding basic performance criteria and

	performing tasks aligned to their personal ability.		offers assistance as needed.
		Self-Teaching Style - K	Students independently determine both the theme and objectives of their learning, undertaking exploration and practice in a self-directed manner to gain new skills and knowledge.

Table 1. Spectrum of Teaching Styles

The Spectrum is classified into two primary types: reproduction styles (A–E), focusing on imitating existing models, and production styles (F–K), promoting creativity, exploration, and autonomy.

Recent research has investigated educators' self-views on utilizing various teaching methods (SueSee et al., 2018), indicating that how often they use these methods often links to their comfort and familiarity with specific techniques (Kulinna & Cothran, 2003; Cothran et al., 2005).

Studies involving seasoned PE educators revealed that Practice, Command, and Divergent Discovery styles were some of the most frequently utilized, whereas approaches fostering increased student independence, like Self-Teaching and Learner-Initiated Programs, were seldom employed (SueSee et al., 2018).

Wider studies have repeatedly highlighted the underuse of the complete Spectrum in PE teaching (Cothran et al., 2005), indicating a requirement for greater pedagogical variety.

3. Teaching Styles and Practice Variability

Dynamic systems theory suggests that motor learning thrives on guided discovery and trial-and-error experiences. Through active exploration, students, starting from simple and familiar movements, are encouraged to experiment, adapt, and gradually expand and refine their motor repertoire.

In this view, learning is not a passive absorption of skills but a dynamic process of discovering environmental affordances and responding with appropriate motor solutions. Tasks proposed by the teacher should therefore foster the exploration of movement variations, problem-solving, and the search for creative solutions (Colella, 2022).

To design teaching-learning processes that truly enhance students' motor skills—especially when working in outdoor environments—teachers must make intentional methodological choices.

The Spectrum of Teaching Styles (Mosston & Ashworth, 2008) provides a useful framework, illustrating a shift from teacher-centered approaches (reproduction styles) to student-centred methods (production styles), where learners take greater responsibility for motor decisions and problem-solving.

The deliberate modulation of execution variants in motor tasks, adjusted through the interaction of various teaching styles, becomes key to supporting individual learning (Mosston & Ashworth, 2008).

Choosing specific styles impacts how students learn, depending on the task demands, students' abilities, and the context (e.g., gymnasiums, outdoor parks, technological settings), as well as constraints like available equipment and environmental features.

Teaching style variation allows educators to:

- diversify access to skills and knowledge;
- promote meaningful integration of abilities, knowledge, and behaviours supporting motor competence;
- foster cognitive-motor and social connections crucial for interdisciplinary learning;
- personalize teaching interventions (Fig. 1).

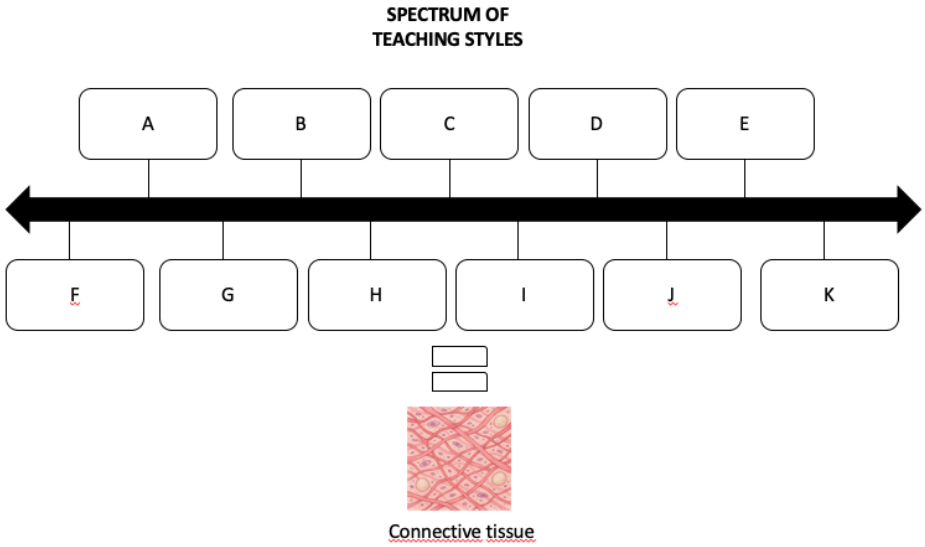

Figure 1. Connective function of the Spectrum of Teaching Styles

Notably, employing production styles empowers children to develop motor, cognitive, and social skills (Robinson et al., 2015; Lubans et al., 2008), stimulating non-linear learning through strategic manipulation of spatial, temporal, quantitative, and qualitative constraints (Renshaw & Chow, 2019).

In outdoor learning contexts, teachers utilizing guided discovery and problem-solving approaches encourage students to creatively modify and adapt movements-even reworking previously learned skills to fit new scenarios.

This process supports students' autonomous and flexible learning pathways, enhancing their ability to manage environmental constraints consciously (Chow, 2013).

Following Bernstein's (1967) principle of "repetition without repeating," learners achieve goals through varied approaches rather than rote repetition.

By contrast, when teachers adopt reproduction styles characterized by narrowly defined tasks, students tend to produce closed, sequential motor responses that depend on tightly linked skill progressions.

Conversely, open-ended tasks framed through strategic questioning invite multiple motor responses, facilitating a non-linear learning environment where students build numerous logical and motor connections (Chow, 2013; Chow et al., 2007).

Therefore, non-linear teaching doesn't happen randomly in outdoor activities—it can and must be deliberately facilitated by the instructor to encourage discovery, problem-solving, self-awareness, and enjoyment, resulting in deeper and more individualized motor skill development.

Motor skill education encompasses more than just choosing tasks and setting goals; it also necessitates modifying communication and interaction methods to facilitate learning.

Educators' deliberate application of various teaching methods can influence students' cognitive, physical, and social involvement, focused time, and cross-disciplinary connections.

Specifically, guided discovery and problem-solving approaches focus on the uniqueness of students, taking into account the active interaction among learners, tasks, and environmental limitations (Chow, 2013; Chow & Atencio, 2012).

From the viewpoint of non-linear pedagogy (Chow, 2013), learning and motor performance are influenced by new environmental challenges and their relationship with individual traits.

Therefore, non-linear teaching methods that highlight variation and flexibility in tasks and styles ought to be encouraged to assist children in building extensive motor repertoires and various learning strategies.

The potential benefits of non-linear teaching include:

- task personalization (adjusting duration, intensity, and difficulty);
- promoting autonomous selection of motor responses, enhancing originality and creativity;
- fostering interdisciplinary learning connections;
- promoting inclusion and differentiated instruction through scaffolding strategies adapted to each child's performance level.

From this perspective, motor learning is conceived as a complex and emergent process, deeply influenced by the ongoing interaction among tasks, individuals, and environments.

Each motor activity lesson-regardless of the setting-offers specific learning opportunities that can serve as entry points for achieving disciplinary and transversal educational objectives.

Regarding motor competence development in primary education, it is important to recognize that:

- Learning follows non-linear trajectories;
- There are multiple ways to perform a motor task, and children must discover their own solutions;
- Motor skills can emerge through environmental modifications (changing tasks, altering rules);
- Effective teaching relies on fostering divergent thinking and open-ended problem-solving, rather than providing fixed instructions.

Students must adapt their motor skills to different environments, whether in gyms, outdoor spaces, or playing fields. Moreover, acknowledging and valuing individual differences is essential when planning motor learning activities. Encouraging the generation of diverse motor responses-through the use of production styles-enriches students' repertoires of problem-solving strategies.

This motor flexibility depends on the quantity and variety of motor experiences offered, including team games, expressive movement, dramatization, and gymnastics, and-critically-how these experiences are structured.

Unlike sports training, which often focuses on the repetitive mastery of specific skills or tactics, physical education and introductory sport activities should prioritize movement variability, allowing students to engage in "repetition without repetition" (Pesce, 2002; Ceciliani, 2016; Chow et al., 2007; Chow, 2013).

Altering task execution, equipment, or spatial arrangements can create novel learning scenarios that enhance motor adaptation. Each choice of teaching style directly connects disciplinary content with student learning pathways.

Teaching styles thus offer varied routes to learning, particularly production styles that encourage creative, transferable motor performances and lay the foundations for future skill acquisition.

Although no single teaching method guarantees success, non-linear pedagogy offers a comprehensive theoretical framework for researchers and educators seeking to design effective, personalized learning experiences enriched by intentional environmental and methodological choices.

4. Teaching Styles and Physical Literacy: Which Relationships?

Physical Literacy (PL) and the educational significance of motor and sport activities serve as essential cornerstones of the motor and sport sciences because of the ever-evolving interdisciplinary theoretical and practical connections.

The various definitions of Physical Literacy illustrate how scientific inquiry often advances through fragmented studies and isolated experiences, typically concentrating on the development of cognitive, emotional, social, or motor skills individually, thereby constraining the comprehensive approach to children's educational processes.

In the area of research methodology within sports and sports sciences, the disconnection among various domains (physical, cognitive, psychological, emotional, etc.) becomes increasingly evident during specific learning experiences related to contextual (where) and methodological (how) implications, necessitating regular and essential updates of scientific frameworks. Promoting health across various age groups through motor and sports activities in diverse settings—and based on different organizational approaches—requires manoeuvring through a complicated network of biological, social, environmental, and contextual influences that are interlinked and evolve over time (Stodden et al., 2021). Scientific methods, nonetheless, do not exert a considerable and beneficial influence -immediately applicable - on the growth paths of these elements, which continue to be (still) somewhat separated in scholarly circles and are typically unique to each field (e.g. physiology, developmental psychology, etc.). The interrelations among various aspects of motor behavior and the particular socio-cultural and environmental settings in which children reside and acquire experiences provide meaning and guidance to the PL. Nonetheless, the various methods necessitate robust connections between methodological and practical aspects for the ongoing training of educators.

The Sports for Life Canada Physical Literacy Association (2014) describes Physical Literacy as "the combination of motivations, self-awareness, motor abilities and knowledge necessary for lifelong physical activity", highlighting these categories:

- Affective Domain: encompasses an individual's personal motivations, the enjoyment experienced during the engagement in physical exercise, the self-assessment concerning his/her abilities, and the aspiration to engage in physical activity throughout one's life;
- Physical Domain: pertains to a person's capacity to acquire various motor skills across various degrees of intensity and managerial challenge. A skilled child from a motor perspective can explore and engage actively in various activities (such as team sports, individual sports, fitness, gymnastics, etc.);
- Cognitive Domain: encompasses the capability to identify, differentiate, and explain the essential features of human movement, recognizing the advantages

and impacts on health, mitigating risks to guarantee the secure practice of physical activities in various settings;

- Behavioral Domain: pertains to the individual understanding of the advantages of regularly engaging in motor activities, considered a vital component of personal lifestyle (Fig. 2).

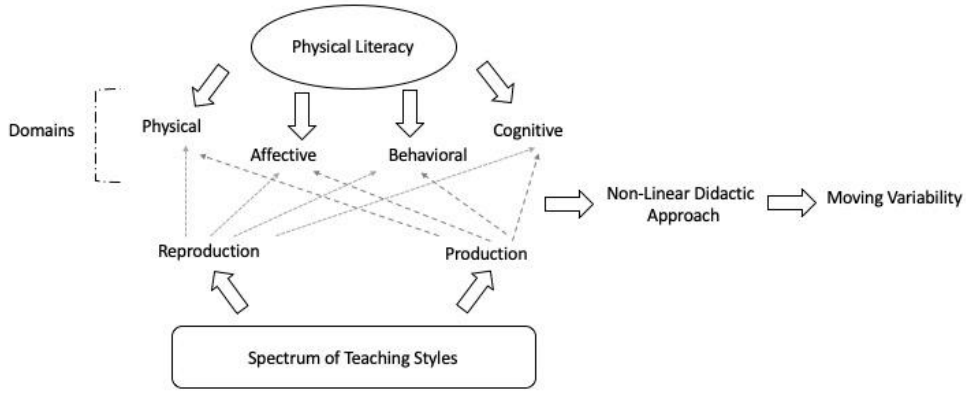

Figure 2. Association between Spectrum of Teaching Styles and Physical Literacy

In conclusion, the Spectrum of Teaching Styles model helps PE teachers in facilitating the improvement of chances to practice, experiment, and acquire fundamental motor skills across various environments: education, recreational activities, and family settings. Furthermore, PL literacy encompasses the cultivation of understanding and behaviours that, influenced by factors like enjoyment, motivation, and self-perception, allow for the adoption and sustaining of active lifestyles in adulthood. This can be accomplished via organized physical education, sports, or activity programs tailored to individual requirements and various age categories, grounded in solid methodological and teaching principles (evidence-based pedagogy) that acknowledge the essential and inescapable importance of motor activity for children's personal development

Author contributions

Domenico Monacis is the author of the Introduction, paragraphs n.1-2.
Fiorenzo Moscatelli is the author of paragraph n.3.
The fourth paragraph is the result of the joint work of both authors.

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