THE DECLINATION OF THE DYNAMIC ECOLOGICAL APPROACH IN THE TEACHING AND EVALUATION OF MOTOR AND SPORTS EDUCATION INTERVENTIONS IN THE DEVELOPMENTAL AGE

LA DECLINAZIONE DELL'APPROCCIO ECOLOGICO DINAMICO NELLA DIDATTICA E NELLA VALUTAZIONE DI INTERVENTI DI EDUCAZIONE MOTORIA E SPORTIVA IN ETA' EVOLUTIVA

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ABSTRACT

The Physical Literacy (PL) process implies a reflective theoretical focus on the characteristics of complexity, dynamism, and embodiment inherent in the interrelationship between the individual and the environment. The theory relating to the dynamic ecological approach fits fully into this meaning, emphasizing the synergies between the individual and the environment and the role of emerging constraints. The purpose of this study is to investigate the effects of a didactic intervention, based on these principles, on the physical performance of a sample of 9 children aged between 4 and 8 years (average 6.22 ±1.79).

Il processo di Physical Literacy (PL) implica un focus teoretico riflessivo sulle caratteristiche di complessità, dinamicità, e di embodiment insite nell'interrelazione tra individuo-ambiente. La teoria relativa all'approccio ecologico dinamico si inquadra a pieno titolo in tale accezione, enfatizzando le sinergie tra individuo-ambiente e il ruolo dei vincoli emergenti. Lo scopo di questo studio è quello di indagare gli effetti di un intervento didattico, fondato su tali principi, sulle performance fisiche di un campione di 9 bambini di età compresa tra i 4 e gli 8 anni (media 6,22±1,79).

KEYWORDS
Physical Literacy; Ecological Dynamic Theory, Motor Learning, Assessment of Motor Skills.
Alfabetizzazione fisica, Teoria Dinamica Ecologica, Apprendimento motorio, Valutazione delle abilità motorie.

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Introduction

Physical literacy (PL) is a state of education of an individual's abilities and his ability to integrate and enhance them. Among the most accredited definitions of PL elaborated over the years in scientific literature is that of the IPLA (2017): "Motivation, trust, physical competence, knowledge and understanding to value and engage in physical activity throughout life".

The lines of research relating to the topic of Physical Literacy (PL) represent the focus of various scientific and academic debates, as well as of international educational and training policies, which, in fact, have not been shaped and substantiated in the declination of teaching methodologies aimed at formalizing and implementing meaningful movement and play experiences for children (Rudd et al., 2021; Shearer et al., 2018). On the contrary, physical activities that direct children's movement opportunities towards increasingly structured proposals and specific sports are widespread and practiced, which are characterized by training based on the specific technical performance model, characterized by prescriptiveness and repetitiveness that eclipse heuristic learning and inductive facilitators of the development of the child's psychomotor components (Whitehead, 2019; Coppola & Papa, 2015). In line with several studies present in the scientific literature (Davids et al., 2016), it is important to emphasize that among the objectives of physical literacy, not only qualitative and quantitative improvements should be mentioned, but also participation in physical activity and sport for throughout life (Davids et al., 2023). A key goal for scientists, researchers, teachers and physical educators is to support children in developing and maintaining meaningful engagement in play and physical activity through the development of functional motor skills (Davids et al., 2023; Rudd et al ., 2020).

Recent studies in the literature demonstrate that the acquisition of skills across a broad range of motor skills is essential to promote enjoyment and engagement in a range of different sports, physical activities and exercises in order to support healthy lifestyles and active throughout life (Robinson et al., 2015). In order to avoid sports hyperspecialization in children, a teaching methodology that considers the complexity of the motor learning process becomes fundamental (Romano et al., 2022; D'Anna et al., 2021a). This requires a complex, dynamic and embodied understanding of the individual-environment relationship, and the Ecological Dynamics Theory precisely emphasizes this relationship as well as the role of emerging constraints (Renshaw & Chow, 2019; Davids et al., 2008).

The theoretical framework of Ecological Dynamic Theory highlights the essential relationship between the learner and the environment as a key foundation of practical design and theoretical principle on which to consider the processes of competence acquisition. The Ecological Dynamic Theory offers the possibility to understand sports performance and how these can be improved in practice, through four fundamental principles:

- the individual relational environment represents the fundamental level of analysis of the understanding of performance and learning in sport (Pinder et al.,2011)
- behaviours emerge from tendencies of self-organization in several subsystems (Pol et al., 2020);
- interaction constraints model these emerging behaviors;
- the design of action opportunities (*affordances*) in learning contexts can guide the individual to use actions to explore the available perceptive information (D'Anna et al., 2021b).

According to the perspective of Ecological Dynamic Theory, creative motor solutions emerge from the coupling perception-action in the interaction with environmental constraints (Gibson, 1979; Orth et al., 2017). The structure of the physical environment, the biomechanics of the body, perceptual information and the demands of the task determine the constraints within which the motor system can act by influencing the repertoire of available actions (Seifert et al., 2018). Moving creatively thus reflects an individual's ability to adapt in a unique and original way (Hristovski et al., 2011).
Newell (1986) defined constraints as "*features or boundaries that shape the form of a complex system adaptive to the search for functional states of organisation*", that is, sources of information that can act on different time scales and identify a characteristic of the environment that acts as information that shapes/guides the organisation or re-organisation of an overall adaptive system, and identified three types of constraints: task, performer and environment. Especially when referring to the constraints of the task, these are very specific and related to the context of the performance, in fact, include the game rules, equipment and objectives; for constraints of the performer or the organism, the personal characteristics of each individual are understood, that is, the structural and functional aspects of the individual himself (genetic, height, weight, patterns of thought, previous experiences); and, finally, the environmental constraints that are instead more generic and global, in fact, consist in the physical variables of the natural

environment (light, temperature, etc.) and socio-cultural, historical variables, values, beliefs, habits.

Having briefly defined the theoretical framework underlying the design idea of this study, it is good to bring back the focus on the role of physical literacy and the skills that physical teachers and educators should have to support the students of the third millennium. In primary school, physical education is a ubiquitous resource in order to teach physical skills and promote the physical literacy (Giblin et al., 2014). But the very recent inclusion of the teacher specialized in Italian primary school (Law n. 234/2021) has revealed how, in the absence of a guide based on scientific evidence, physical education programs are extremely variable and very often only focus on the development of simple movement skills (balance, coordination, core stability, flexibility, proprioception) rather than on combining movement skills (balance and stability of the core- poise, fluidity, precision, dexterity and balance) and especially combine the complex motion capabilities (bilateral coordination, limb coordination, eye-hand coordination, control of accelerations/decelerations, rhythmic movements) (Whitehead, 2010).

As for the design and the planning, the evaluation of the interventions of physical literacy, suffers from the lack of explanatory guidelines, this is because the batteries of tests traditionally used for the evaluation of motor skills are born to test the impairment of motor development (Cools et al., 2010; Schoemaker et al., 2012) focusing on the product (M-ABC) or the process (TGM-D) but even those that focus on the process are unlikely to measure the complexity of motor learning processes because they are highly influenced by the evaluator's experience, subjectivity in scoring and poor, almost nothing, consideration of the role of constraints, especially environmental ones (Giblin et al., 2014). It is clear that these batteries do not allow to make assessments about the ability of individuals to evaluate a task, combine and adapt the complex motion capabilities to the execution environment and interact with affordances; all intrinsic characteristics to physical literacy objectives.

Methods and Materials

Participants

The sample consists of nine children aged between 4 and 8 years (average 6,22 ±1,79 years). In relation to the characteristic differences in the levels of psychomotor development in this age range, it was decided to divide the sample into two subgroups: the first consisting of five children aged between 4 and 5 years and the second group composed of four children aged between 6 and 8 years (Tab.

1). All participants signed the consent forms for approval, which was in accordance with ethical principles in the Declaration of Helsinki.

Procedures

Allparticipants have attended and practiced for a whole year sports a course of introduction to the sport, focused on the motor variability through the game and the polysportivity that provided two weekly meetings lasting 75 minutes each, although the incoming and outgoing tests were performed after a six-month trial period of the proposal (November-April). The proposed activities have focused on the experimentation of two didactical-educational projects: *Joy of Moving* (Pesce et al., 2015) and *BoingKids*; which are well suited to implement the characteristics of a physical literacy proposal that considers the complexity of the motor learning process. The Dynamic Ecological Theory, in fact, applied to the design of learning environments to encourage physical literacy is evident in the principles that make these educational-didactic proposals: practitioners as environment designers; affordance driven practice design; manipulation of constraints; co-adaption and collaboration; managed chaos; dexterity and degeneracy; variability of the practice; polysportivity; multilaterality.

Below are two examples of activities proposed during the meetings:

- "*Tidy My Room*" is a content in the Play Games proposed in the program *BoingKids*. To set the game should be divided the workspace into two areas of equal size, these are the rooms. Each group should be asked to stay in a different room. Inside each room the children find seven small balls, seven mediums sized, seven large and three very large, plus forty bags of beans (or sand) around the room. It is important that each room has roughly the same amount of equipment. The aim of the game is to keep your room in order and mess up that of the other group. The result in terms of motor learning is to identify and implement the best movement to achieve the objective.
- "*La Bola*" is another motor proposal, contained in the program Joy of Moving; it is a game that develops in the child the coordination, power, agility and anticipation. This is possible through the note to the bola, or a rope, that the educator/teacher rotates while the children are arranged in a circle. The aim of the game is not to get hit by the rope that the teacher makes turn as low as possible, at first the rope is shortened to give the opportunity to children to understand timing.

Measures

Two different tests were conducted on the sample, depending on the division into subgroups, both being part of the test battery proposed by the educational-didactical approach *Joy of Moving*. Specifically, the motor test for the group of children aged 4-5 years includes a time course built in a space of 24 m. The test consists in running a path that has a series of difficulties: jumps, runs, use of the balls and various translocations, for a total of seven "motoring problems" to be solved. For the evaluation it is necessary to verify the continuity in the overall execution of the path and the success of some tasks. As for the subgroup formed by children aged between 6 and 8 years, the motor test always includes a time course but with execution and use of different materials, to assess locomotor abilities and body stability and object control (Pesce et al., 2015). The test consists of different modes of translocation and control of objects. After setting up the route and verbally illustrating it, only once, the children were asked to perform it in the shortest time possible without making mistakes. In order to conduct the assessment, the execution time of each child must be recorded, plus seconds of penalization in relation to the mistakes made.

Analysis

Descriptive statistics were used for the analysis of data. Was conducted a T test to paired samples through the SPSS23 software by placing the p value at 0.05%.

Results

4 anni	**5 anni**	**6 anni**	**7 anni**	**8 anni**
1	4	1	2	1

Table 1: Distribution of the sample by age

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Test_JoM_PRE	2,2222	9	1,09291	,36430
	Test_JoM_POST	2,8889	9	1,69148	,56383

Table 2: Paired Samples Statistics

	Paired Differences	t	df	

	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				Sig. (2-tailed)
				Lower	Upper			
Test_JoM_PRE - Test_JoM_POST	-,66667	,86603	,28868	-1,33235	-,00098	-2,309	8	,050

Table 3: Paired Samples Test

The results of this study show a statistically significant difference between pre and post intervention in the reference sample. As shown in Table 3, the value of "t" is not included in the "95% confidence interval of the difference" and therefore it is possible to affirm the existence of a statistically significant difference, highlighting improvements in the test results between the one presented before of the process and that carried out at the end of the experimental period. From Table 2, it is possible to highlight that the average of the test scores is higher in the post-experimentation, this is a datum that further confirms the results obtained in the test for the 4–5-year subgroup; getting a higher score equals improved performance.

Discussion

In relation to the relatively low number and the relative homogeneity of the sample and the impossibility of repeated detections makes this a pilot study. The results are, therefore, rather suggestive than conclusive, and open up the field to the need for further investigation. Among the strengths, it is worth mentioning the ecological and complex character that intends to give children significant motor experiences. Furthermore, in line with the principles on which the dynamic ecological approach is based, it was decided not to use motor tests validated by the literature (such as TGM or M-ABC) but rather a motor path, diversified by age group, at inside which each child can show his own process of solving the task and not just the achievement of the objectives; however it was not considered the selected test better than others but, the closest to a greener assessment. In the light of these results, it emerges that an ecological approach to physical literacy is crucial for designing movement experiences that consider the complexity of the motor learning process and, at the same time, allow to avoid sports hyperspecialization in children and the consequences associated with it. The methodologies used underline the importance of designing and building play environments with

representative characteristics of a dynamic ecological approach, in order to favor the development of physical literacy, interconnected to the physical-motor, cognitive and socio-relational and emotional aspects of children.

Conclusions

Over the past 25 years, the focus of contemporary theories of learning and motor development has shifted to the design of learning environments. Learning environments that must be able to foster adaptability; encourage students to challenge themselves in solving motor problems to find solutions that lead to creative behaviors (Orth et al., 2017); live significant movement experiences that can subsequently enrich sports specialization in a targeted sport (Savelsbergh & Wormhoudt, 2018; Coppola et al., 2021). The privileged setting in which to carry out physical literacy interventions is the context of primary school in which each student will be able to develop and enrich their motor repertoire.

In the light of the theoretical reference framework and the results obtained in this study, consistent with the results of other studies conducted in the scientific literature which highlight the need to provide young students with significant movement opportunities (Rudd et al., 2021; Davids et al., 2016), the centrality of planning motor activities and experiences is evident that follow the principles of the individual-environment, where the environment represents a primary factor in determining motor behavior (Seifert et al., 2018). It should be emphasized that the environment should not be understood only as a space for action but also and above all as a context within which children carry out their activities; the presence of others, motorsport teachers and educators, is also implicit in this vision. This new vision of physical literacy therefore also brings with it the need to consider the new skills that teachers and educators should master:

- Manipulation of constraints: it is the most accessible and effective way to direct a student to search, discover and exploit the possibilities of action (Affordances) useful for solving motor tasks (Roberts et al., 2019). The constraints can be manipulated so as to allow the student to identify the best possible movement solution depending on the learning phase they are in; this manipulation of the constraints can be defined as "didactic" (for example, assigning specific areas of the field to each player involved in a football match in order not to have situations where all the components are around the ball at the same time). Constraint manipulation can also be used to eliminate movement solutions that the student has identified but which are considered ineffective by the teacher; in this case it will be sufficient to insert several constraints (for example changing

the game equipment) which will lead the student to undertake a new resolution process and to identify a new movement solution (this method is also called "error amplification"). Constraint manipulation can also be used to create new motion solutions, not just modify or delete learned ones. In order to achieve this goal, it is necessary to match the constraints of the task and the subjects' ability to act, for example to use small basketballs for children. Ultimately, the manipulation of constraints is essential to create variability so that students are adaptable and flexible so that they can use different motion solutions to achieve the same goal under ever-changing conditions (Gray, 2021). We can summarize this statement with the term "dexterity", defined by Bernstein (1967) as "dexterity is the ability to find a motor solution for any external situation, i.e. to adequately solve any emerging motor problem";

- Movement variability: Motor variability is inherent in neurobiological systems, playing a functional role in adaptive behaviors of humans (Davids et al., 2003; Caballero Sánchez et al., 2016), characterized by improvements in movement performance during interactions with environmental contexts (Krakauer et al., 2011). Humans must use motor variability to drive adaptive behaviors in changing environments (Caballero et al., 2019). Movement variability becomes an exploration tool in order to promote learning (Barbado Murillo et al., 2017), therefore, the teachers' goal is to enable their students to develop the ability to select in the variation repertoire the best motor strategy for a given condition. Representative Learning Design: Educational activities should be designed in such a way as to guide students in the discovery and use of affordances in environments that represent and simulate movement problems; in fact, in this ecological perspective, the motor behavior is better understood when it emerges from the mutual relationship between the performer and his performance environment (Rudd et al., 2021; Otte et al., 2021).
    - Co-design of practice: An important concept in ecological theories is that of co-design of practice; teachers and learners work together to co-design information-rich learning environments that urge the realization of affordances (Rudd et al., 2021). This co-planning will support the development of actions, perceptions, cognitions and self-regulation in training environments that facilitate personalized skill development (Otte et al., 2020).
    - Repetition without repetition (Bernstein, 1967): Not always repeat the same solution of a given task but repeat the solution process. To encourage repetition without repetition, teachers should include problems in the activities, challenges and choices that learners face in order to adapt

movement solutions in a variable way and perceive different and relevant affordances/opportunities for action (Otte et al., 2021).

In conclusion, the Ecological Dynamics Theory consider that motor learning and development are deeply entwined processes of development and change involved in re-organising movements to achieve performance functionality, regardless of the specialised nature of activities that are undertaken (Davids et al., 2023); this creates the need to make the teaching-learning methods typical of physical education as responsive as possible to these characteristics of the physical literacy process, also detaching from the teaching tradition handed down in the textbooks, and basing themselves on the scientific and theoretical concepts discussed.

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