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PROGETTARE AMBIENTI DI APPRENDIMENTO RICCHI DI AFFORDANCE PER GUIDARE GLI ALLIEVI NELLA REALIZZAZIONE EFFICACE DI UN COMPITO MOTORIO: UNO STUDIO PRELIMINARE

PLANNING LEARNING ENVIRONMENTS RICH OF AFFORDANCE TO LEAD THE LEARNERS IN THE SUCCESSFULL PERFORMANCE OF A MOTOR TASK: A PRELIMINARY STUDY

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Abstract

The theoretical framework that is emerging thanks to the most recent neuroscientific studies provides new methodological trajectories that can make more effective and functional teaching choices by teachers and coaches in the design of practical interventions. The traditional approach, that focuses on physical aspects of movement, does not always succeed in producing effective results. In addition, this approach has the limit of not being able to understand the problem of the executive variability of movement determined by the intrinsic complexity of learning functional or sports movement skills. Numerous studies carried out in recent decades according to the ecological perspective of Gibson emphasize the qualitative aspects of movement considering motor coordination as an organization emerging; this approach seeks to understand and analyse globally the ability of movement in its various forms and levels of complexity, focusing on the complex interaction between individual and environment and the circular relationship between perception and action. Starting from the Constraints Led Approach and acting on the manipulation of the task constraint, this research aims to test by a pre-experimental study the performances of a group of subjects before and after a specific sensorimotor training. The design of learning environments rich in affordances, multimodal inputs both with stabilizing objective and aimed at the exploration of movement and the demand for new auto-organizations, promoted in the learners greater control and balance management during the ability of walking backwards.

Il quadro teorico che sta emergendo grazie ai più recenti studi neuroscientifici fornisce nuove traiettorie metodologiche che possono rendere più efficaci e funzionali le scelte didattiche di docenti e degli allenatori nella progettazione di interventi pratici. L'approccio tradizionale, che si concentra sugli aspetti fisici del movimento, non sempre riesce a produrre risultati efficaci. Questo approccio ha, inoltre, il limite di non essere in grado di comprendere il problema della variabilità esecutiva del movimento determinato dalla complessità intrinseca dell'apprendimento funzionale o delle abilità di dei movimenti sport specifici. Numerosi studi, condotti negli ultimi decenni secondo la prospettiva ecologica di Gibson, sottolineano gli aspetti qualitativi del movimento considerando la coordinazione motoria come un'organizzazione emergente; questo approccio cerca di comprendere e analizzare globalmente la capacità di movimento nelle sue varie forme e livelli di complessità, concentrandosi sulla complessa interazione tra individuo e ambiente e sulla relazione circolare tra percezione e azione. Partendo dal Constraints Led Approach e agendo sulla manipolazione dei vincoli di compito, questo studio mira a testare mediante un'indagine preliminare le prestazioni

1 Author of paragraphs: *"Introduction"; "3. A preliminary study", 4. Results"and "5 discussion".*

2 Author of paragraphs: *"1. The affordances: definition and classifications, "2. Background", " Methodological procedures"and "Sensorimotor training".*

3 Author *edited the scientific review of the study.*

di un gruppo di soggetti prima e dopo un allenamento sensomotorio specifico. La progettazione di ambienti di apprendimento ricchi di affordance, input multimodali sia con obiettivo stabilizzante che finalizzati all'esplorazione del movimento e la richiesta di nuove auto-organizzazioni, promuovono negli allievi maggiore controllo e gestione dell'equilibrio durante la capacità di camminare all'indietro.

Keywords

Affordance, children, motor learning, motor skills, teaching.
Affordance, bambini, apprendimento motorio, abilità motorie, insegnamento.

Introduction

The scientific literature on motor learning in recent decades states that any targeted movement of our body, from basic movement skills to specific sports movement skills, must be studied as a complex process involving multiple aspects from biomechanical to physiological, psychological, social, etc. (Goodway & Branta, 2003). The action that the subject performs follows a non-linear logic, characterized by unpredictability and variability (Davids et al., 2003; Chow, 2013), the result of a series of complex mechanisms strongly conditioned by the surrounding environment, where the boundary between what is motor and what is cognitive is not definable (D'Anna et al., 2021, Balague et al., 2013).

The theoretical framework that is emerging thanks to the most recent neuroscientific studies provides new methodological trajectories that can make more effective and functional teaching choices of teachers and coaches (from this moment defined practitioners) in the design of practical interventions.

The traditional approach that focuses on physical aspects of movement, focusing the attention of practitioners on speed, lever lengths, accelerations, and then define the parameters of intensity and volume of the load, is an approach that does not always succeed in producing effective results. If on the one hand this perspective allows to define training protocols in a more standardized and linear way, on the other hand it has the limit of not being able to understand the problem of the executive variability of movement (Bernstein, 1976), determined by the intrinsic complexity of learning functional or sports movement skills (Davids et al., 2008; Davis & Sumara, 2006; Renshaw et al., 2010).

It is necessary to adopt an integrated and systemic approach to training, which can, by better combining the different approaches, guide practitioners in the analysis, in the understanding of movement and in the subsequent methodological choices (Bosch, 2015, p. 227).

Numerous studies have been carried out in recent decades in the wake of the ecological perspective of Gibson (1979), emphasize the qualitative aspects of movement considering motor coordination as an organization emerging from the peripheral constraints of the system rather than from central control structures. An approach of this kind seeks to understand and analyze globally the ability of movement in its various forms and levels of complexity, focusing on the complex interaction between individual and environment and the circular relationship between perception and action (Turvey & Carello, 1988; Kelso et al. 1990; Pesce, 2002). The ecological-dynamic theory provides in this sense some key fundamental concepts (Araùjo et al., 2017; Davids et al. 2012) for the methodological declination of non-linear pedagogy, promoting the manipulation of constraints aimed at the design of an effective learning environment.

The ecological-dynamic approach considers learning a process of change within individual dynamics (predispositions or intrinsic individual characteristics conditioned also by the subject's motor baggage). Changes in intrinsic dynamics occur when there is a competition between current co-ordination, predisposed (innate) by the system, and a new co-ordinative state (to be learned); this competition results in a consequent modification of the intrinsic dynamics resulting from an adaptation, itself the product of learning (Schoner & Kelso, 1988; Kelso &

Zanone 2002). The motor learning, "is a relatively permanent change in motor behaviour resulting from practice or past experience" (Gallahue et al., 2012, p.14).

The acquisition of a given movement or skill in a particular learning context, therefore, takes place through practice through the action of specific constraints - individual, environmental, and task constraints (i.e., rate limiters, affordances), which act and interact, according to a non-linear logic, favouring the explication of coordination emergencies, product of a process of self-organization in response to constraints (Newell, 1986). This constant process of self-organization is the result of a continuous and dynamic interaction between the subsystems of the individual (i.e., vision, hearing, muscular, skeletal) and the environment (Kugler, Kelso, & Turvey, 1982; Smith & Thelen, 1993; Ulrich et al., 1991) in order to adapt to change as new structures and different patterns of movement are Acquired (Kamm, Thelen, & Jensen, 1990).

This so-called emergency principle characterises complex systems, the results of which are not predeterminable or predictable, but follow a non-linear logic; non-linearity of learning is therefore more a norm than an exception (Chow et al., 2011).

The practitioners cannot ignore this nonlinearity of human learning, in which the variability of movement is seen positively in the perspective of multistability and dynamism that distinguishes non-linear systems. Noise in this sense can play a functional role through increasing the probability of system transition between multiple states (Chow et al., 2009; Chow et al., 2011). Increasing the possibilities of transition from one coordinating state to another allows the learner to acquire a better ability to adapt and adapt to stimuli or different learning situations. A child who is acquiring the ability to walk, for example, in supporting his body standing upright, using posture, balance and strength, develops the ability to manage the different subsystems, cooperating and sometimes competing with each other (Thelen, 1986) in relation to their individual characteristics. In the specific learning context, the characteristics of the environment (i.e., the surface of the ground, space and surrounding objects) can influence its ability in the path. The set of characteristics of the subject, the task (in this case the ability to walk) and the inputs coming from the environment can both favor and negatively affect the implementation of the task (Newell, 1984). Dynamic systems theory describes the different factors that affect the result of movement in terms of affordances and rate limiters. Affordances tend to promote or encourage positive change in development. The rate limiters, however, they refer a "an individual constraint or system that hold[s] back or slows the emergence of a motor skill" (Haywood & Getchell, 2009, p. 23).

Affordances and rate limiters are seen as constraints. Constraints "shape" and determine the nature of the movement and both can favour or not specific patterns of movement (Newell, 1984; 1986).

Recognizing and selecting these constraints on an ad hoc basis, both with a stabilizing and destabilizing objective, becomes in this sense a fundamental aspect for practitioners, that must effectively understand and then design the different teaching proposals to better manage the different variables that influence/control the acquisition and development of specific skills.

Studies have shown that learners undergoing numerous stimuli with strong movement variability can acquire and develop the ability to bring out new movement solutions, that often present themselves as atypical and creative compared to previous movement solutions that emerged in similar learning contexts (Davids et al., 2006; Schollhorn et al. 2006).

The Constraint-Led-Approach (CLA), based on the studies of Newell (1986) and Davids et al. (2008), promotes a methodological approach guided by constraints by reassessing the continuous interaction between decision and action, perception and cognition in motor and sports learning (Davids, Araújo, Vilar et al. 2013). "This deeply integrated relationship between cognition, perception and action needs to underpin learning design in sports coaching and physical education" (Correia et al., 2019, p. 118).

In the continuous search for effective didactic proposals that can favour the self-organization and the improvement of the coordination, guiding the students in the research, exploration and discovery of the best solutions of movement, educators/coaches try to implement landscapes rich in affordances, that is, all that information (from the psychophysical variables to those social) that the subject can grasp from the environment.

The hypothesis of the present study develops in this direction in the awareness that "the environment itself, in the context of an action, provides a series of affordances that the sensory-motor process must learn to grasp, greatly simplifying the normal perception-movement cycle" (Wonder, 2012, pg.35). Physical education coaches and teachers become real designers of learning environments (Correia et al., 2018), able to "guide" the student in the processes of self-organization (Rudd et al., 2020). This contribution aims to highlight the enormous potential of the CLA for the design of effective learning environments and to verify, through a preliminary study of an almost experimental type, whether the implementation of landscape rich in affordances, through multisensory stimulation, it favours the improvement of the coordination control and the acquisition of specific motor tasks.

1. The affordances: definition and classifications

The concept of affordance was introduced by Gibson (1986) to describe the opportunities for action provided by the environment for an animal. Affordances are opportunities for action, describe the environment in terms of behaviours that are possible at a given time in each set of conditions; capture the close coupling between perception and action and allow perspective and moment-by-moment control of the activity that is characteristic of the dynamic and unpredictable behaviour of situation sports (Fajen et al., 2009). Perceiving a affordance, according to Gibson (1986), means perceiving how one can act in the face of a particular set of environmental conditions. In fact, in 1988, Don Norman, an expert on human-machine interaction (HCI), defined affordance as a possibility of perceptible action, that is, actions considered possible by those who should perform them. The affordances have some main characteristics: they are *real* (it is not necessary that the affordance is conceived by the performer through a constructivist and cognitive elaboration, but can be perceived directly); they are *specific* (they are defined in relation to the ability of a given performer to act); they *capture the reciprocity between perception and action* (they describe the environment in terms of how the performer can act); *allow for future control* (perceiving affordances allows performers to control their behaviour in a prospective way); *they are significant* (they describe what a performer may or may not do in relation to a given environment); *they are dynamic* (affordances arise and dissolve with the movements of performers or when changes occur in the environment) (Fajen et al., 2009).

Fajen et al. (2009) identified three classes of affordance: *affordance body-scaled, action-scaled affordance, affordances in social-context.* Body-scale affordances can be described in terms of the relationship between certain body sizes and certain environmental properties (i.e. leg length and step height). For example, a child perceives whether he can climb a staircase considering not the objective height of the step but the subjective height, in relation to his own body size (body scaling) (Haywood & Getchell, 2009). Action-scaled affordance are constrained by the performers' ability to take decisions on different categories of action and in the action guide itself. Affordances in social-context are the interactions between the human behaviours of performers involved in the environment; three categories of social affordance can be described: perceiving affordance for other people (i.e. what actions another person can perform in a given set of environmental conditions), perceive affordances for a joint action (i.e. what actions can the percipient and another agent/s perform cooperatively), perceive affordances from other people (that is, what actions another person offers to those who perceive).

2. Background

The vision of ecological dynamics, as briefly highlighted, emphasizes the capacity of self-organization of systems; intentional actions are understood as dynamic-functional solutions of movement that emerge, continuously, when a performer interacts with a series of constraints related to the task and the environment (Davids et al., 1994; Seifert et al. 2018; Button et al., 2020a), through the exploration, invention and adaptation of the possibilities of action (Rudd et al., 2020). In other words, what is "acquired" is a functionally adaptable and evolving adaptation between an individual's capacity for action and the constraints of the environment in which he or she resides (Davids et al., 2012).

Affordances are opportunities to act that manifest themselves in the form of performative behaviours (Gibson 1979), exemplified by spaces, objects, obstacles, inclinations, surfaces and even other people. Such calls for action are available everywhere and are directly perceptible by an individual as they gradually tune into the surrounding information that specifies the functional and interactive properties of the environment (Bruineberg & Rietveld 2014; Fajen et al., 2009). This tuning process is embedded, which means that it involves the entire perceptive (visual, tactile, auditory, and proprioceptive) system that works to detect information in the environment that in turn specify the functional properties of an affordance. Therefore, information emerges from the continuous interactions between individuals and environments, with the perceptive system that progressively refines itself towards the regulation of stable and functional movement solutions to achieve the objectives of the task set (Handford et al. 1997; Renshaw & Chow, 2019). It is important to note that availability is dynamic, changing rapidly with (exploration)action (Hacques et al., 2020) and longer times with development. Children achieve qualified behaviours through continuous exploratory activity that allows them to find available information and use opportunities to act effectively (Hacques et al., 2020). A logic of ecological dynamics means that children learn to move and discover information, gradually refining this exploration to detect richer and more reliable information to support the action.

Empirical research has shown that people can perceive a variety of affordances with impressive accuracy (Cornus et al., 1999). Hove et al. (2006) found that hockey players perceive which hockey bats are better for power shots than precision ones differently from non-players, even after beginners have had a short experience with the action in question. Ramenzoni et al. (2008a, 2008b) in a specific study on basketball, have shown how the affordance typical of this sport -block a pass from stop, pull, dribble or block a pass while being in motion- can be accurately perceived for themselves and for others.

Recent studies have experimented with the educational implementation of landscape of affordances for the development and acquisition of task motors. A study by Homayounnia Firoozjah et al. (2019) analysed the influence of affordances in the environment on children's motor development and showed that a wide range of stimuli presented in the physical environment as sports activities, equipment and toys leads to improved motor development of children.

Geuze (2018) in a research that studies the different types of affordances in motor development and learning of children with coordination disorder, demonstrated the role of constraints as a key in development and motor learning leading to a correct understanding of the concept of growth.

Homayounnia Firoozjah et al. (2018), investigated the effects of environmental affordance on visual perception and balance in children with intellectual disabilities, in an almost experimental study involving 50 children; Those belonging to the experimental group followed a specific program that included environmental affordance and exercises for the development of motor skills. The results obtained showed that environmental affordance is effective in improving motor skills such as visual perception and balance in children with disabilities, stressing that it is necessary, during the design of activities, pay attention to the environment and affordances that this offers. A similar study has been conducted by Homayounnia Firoozjah et al. (2019), investigating this time, the influence of environmental affordances on the motor development of children with intellectual disabilities aged between 6 and 9 years. Participants were divided into two groups (experimental and control). The results showed that affordances had a positive impact on the upper body: there were significant improvements in coordination, agility, balance, response rate and power; while no significant impacts have been recorded in the motor-visual variables, speed and dexterity.

3. A preliminary study

Objective

Starting from the CLA model and acting on the manipulation of the task, this study aims to test the performances of a group of subjects before and after a specific training (sensorimotor training), in order to understand whether the design of learning environments rich in a multi-input mode and therefore affordances can effectively guide students to the achievement of the task set.

Participants

The sample consists of 13 subjects aged between 5 and 14 years (mean age 9,9 ± 2,32; mean height of 142,3 ± 16 cm; mean weight of 32, 9 ± 8,85 Kg). Two groups were formed, an experimental group of 4 subjects and a control group of 9 subjects; all practising regular sports activities.

Tool

The tool used in this preliminary study is the N.1 test (It.1) of the KTK test (Kiphard & Schilling, 2017) which was performed in two wais: standard protocol and with multisensory variations. The KTK test is a performance test that examines the size of the movement "total body control" in children between 5 and 14 years old, created primarily to determine the level of development of total body control in children. This test includes four items: walking backwards (WB), hopping for height (HH), jumping sideways (JS) and moving sideways (MS). Each test is administered following the instructions given by the protocol, only the first test was used in this study; the procedure is explained in detail below.

Test 1 consists of walking backwards on three different equilibrium axes of different width (6 cm, 4,5 cm and 3 cm); three tests are repeated for each axis. The test begins when the child leaves the starting platform with both feet and ends when he rests his foot on the ground or arrives at the end. The evaluation is carried out by counting the number of steps taken (the maximum is 8) and the results of the three tests are added together.

In addition to the standardized test of the KTK, it was considered appropriate to test the performances of the students in five variations of the task: fix a tennis ball placed frontally, placed laterally at 45° *on* the right and 45° *on the* left (visual input); rotate the head of 90º on the transversal plane alternately to the right and left after each step (vestibular input); verbal encouragements and suggestions by practitioners (verbal input). The test with the variations of the task was performed only on the axes of width 6 cm and 4,5 cm.

Methodological procedures

The research has provided a pre-experimental design to two groups that included the administration of an entrance test (PreTest), following by a period of 3 weeks of sensorimotor training and a re-test (PostTest) with the repetition of the same items administered in the PreTest.

Parental permission and the consent of the subject were obtained for all subjects by informed consent, and, through a questionnaire have been collected anthropometric data and general information on the sport practice.

The sample was divided into two groups (experimental group, ES and control group, CG), both groups performed the test 1 "Walking backwards" of the KTK test and then, only with respect to the equilibrium axes of width 6 cm and 4,5 cm the tests were performed according to variations explained in the section "Tool". Only the experimental group (ES), between PreTest and PostTest, has undergone a multisensory proprioceptive training (see section "Sensorimotor training"). The control group (CG) performed the test only once.

Sensorimotor training

The group, after the PreTest, performed a sensorimotor training and then repeated the test (PostTest). ***Senso***rimotor training was designed based on studies in literature (Granacher et al., 2010; Oliver & Di Brezzo, 2009; Pau et al., 2012; Wälchli et al., 2018) and was performed for three weeks (3 sessions of 30 minutes per week). Each session included circuits and balance games; specifically, heating exercises were provided: walking on the tips, on the heels, with the arms along the body, with the arms extended forward, outwards, upwards; walking backwards, walking making various movements of the head; and a part that varied in each session in which they were used the proprioceptive tables, the balance boards, the speed ladder and were proposed balance games also in competitive form (i.e. 1 vs 1).

4. Results

Data analysis

The data were processed with SPSS23 statistical files. A descriptive statistic (mean, ds, min, max) has been performed for each item of the tests provided, comparing the following data: test item 1 KTK (Tot_pretest_ktk_it1), the total of KTK item 1 varied (n.5) on axis 6 cm (Tot_pretest_ktk_it1convincoli_6cm), the total of KTK item 1 varied (n.5) on axis 4,5 cm (Tot_pretes_tktk_it1convincoli_4.5cm); test item 1 KTK (Tot_ Posttest_ktk_it1), the total of KTK item 1 varied (n.5) on axis 6 cm (Tot_posttest_ktk_it1convincoli_6cm), the total of KTK item 1 varied (n.5) on axis 4,5 cm (Tot_posttest_ktk_it1convincoli_4.5cm). A two-way repeated measures ANOVA was performed to assess the sensorimotor training effects. The results are summarised in Table N.1.

Tab. 1: Descriptive statistics of the PreTest and PostTest results

		Mean	Std. Deviation	Minimum	Maximum
Totale PreTEST_KTK_It1	Control group	33,889	13,2895	7,0	51,0
	Sperimental group	35,000	22,7743	16,0	66,0
	Total	34,231	15,7382	7,0	66,0
PostTest_KTK_It1	Control group	34,000	12,1244	7,0	48,0
	Sperimental group	44,500	17,3301	27,0	68,0
	Total	37,231	14,0899	7,0	68,0
Tot_PreTESTKTK It1_taskconstraints_6cm	Control group	24,444	9,6580	4,0	40,0
	Sperimental group	33,250	7,0887	23,0	38,0
	Total	27,154	9,6250	4,0	40,0
Tot_PostTESTKTK It1 taskconstraints _6cm	Control group	25,000	9,0416	5,0	40,0
	Sperimental group	36,750	4,7170	30,0	40,0
	Total	28,615	9,5877	5,0	40,0
Tot_PreTESTKTK It1taskconstraints_4.5cm	Control group	17,889	9,4133	4,0	35,0
	Sperimental group	22,500	10,6615	11,0	33,0
	Total	19,308	9,6124	4,0	35,0
Tot_PostTESTKTK It1convincoli_4.5cm	Control group	18,333	3,8406	14,0	24,0
	Sperimental group	29,250	8,3815	18,0	37,0
	Total	21,692	7,4093	14,0	37,0

5. Discussion

The path is one of the fundamental abilities that the child acquires during his development, as he learns to manage the force of gravity, the limitations imposed by body growth and the variations of the ground on which he rests>> (Meraviglia, p. 79). In a traditional perspective, the child acquires sufficient strength and balance to reach the autonomous path through a series of stages of development -crawling, crawling, walking- and each stage reflects the maturation of the nervous system. In this way the maturation of nerve structures and their connections allows the child to maintain intentional control of limb movements (Forssberg, 1985; Mcgraw, 1935; Mcgraw, 1945) and influences its strength and balance by increasing the efficiency and speed with which perceptual information and motor signals are integrated and processed (Zelazo, 1998; Zelazo et al., 1989). This vision, however, is not sufficient to explain the daily experience of children in locomotion and in the ability to balance because it does not consider the environmental factors and the various possibilities of solution of a motor task offered to the child by the environment. A more modern view of the development of locomotion focuses, instead, on the ability of the child to adapt his motor decisions to changes in the environment and to changes in the proportions of his body (Meraviglia, pg. 80-81). The choice to adopt the test of the journey by moving backwards on surfaces of variable amplitude and to make changes to the ability by manipulating the constraints of the task is due to this more ecological vision. The walk backwards is an automated motor pattern from the subjects that make up the sample, the clearly evident differences resulted from the variation of the inputs and therefore from the manipulation of the task that for some of the subjects has acted as affordance stabilizing, therefore, has rendered them more efficient and effective; while for others it acted as destabilizing affordance, making motor skills more complex and less manageable.

The encouragements provided during one of the tests varied, although they are presented as partially prescriptive input as they suggest to the subject what to do for a better performance, broaden the panorama of affordances and, in general, this study has proven effective, confirming that even partial integration of the two approaches (ecological-dynamic and prescriptive) can be advantageous especially in the age of development. The values of this specific variation of the task, in fact, show a tendency to improve the performance in the Post-test, because probably the verbal input (social affordances), added to the multi-modality of the other sensory inputs provided by the task varied, guide the subjects in maintaining the external attentive focus.

The decision to re-propose the manipulation of the task, further widening the panorama of affordances, also for the axis of width 4,5cm has been guided by the objective of soliciting new self-organizations of the movement in the subjects increasing the complexity of the task.

The experimental group undergoing sensorimotor training has been able, in the many and repeated learning experiences planned, to experiment opportunities for research, exploration and discovery of new, creative and personal solutions of organization and control of movement thanks to the training aimed at recognition, selection and effective use of affordances. This figure is confirmed by the increase in the differences between the two means (PreTest and PostTest) of the experimental group despite the increase in the difficulty of the task in the smaller axis test (4,5cm). The ability to grasp the affordances of the environment is in fact the crucial event of locomotion as an adaptive function, even more so if moving back. Action becomes possible and really effective even in conditions of unpredictability of the environment only when a close correspondence between the physical abilities of the child and the salient characteristic of the environment is established (Gibson, 1979; Warren, 1984).

Analysing the results that emerge from the descriptive statistics (Tab.1), the average value of the data of the PreTest KTK It.1 is very similar in the comparison between the two groups; in the Post-test, however, the difference between the averages increases. In general, a higher SD emerges in the experimental group with an intra-group age heterogeneity. As for the test varied on the 6 cm axis, the data show a higher average already at the start for the experimental group that performs better than the CG; the DS in the PreTest is very similar between the two groups. The data change considerably in the same test performed at the end of the trial: the average of the EG grows by more than three points while that of the control group does not change; the SD of the experimental group, instead, it reduces to confirm the lower intra-group variability while remaining constant in the control group. The difference between the two groups in the variated test is confirmed by the ANOVA which shows a statistically significant p value ($p=.34$).

The results of the test varied on the 4,5cm axis demonstrate very similar values in the comparison Pre and PostTest for the CG, which in general does not change the performance while, instead, the comparison of the experimental group averages in the pre and PostTest shows an improvement of about 7 points. The SD in the CG decreases, this is probably related to a greater confidence with the test; while, of the experimental group, as already happened in the test varied on the axis by 6 cm, it is reduced. In full coherence with these data the p value ($p= .07$) shows a very significant difference.

Conclusions

As widely highlighted, affordances-rich learning environments with unpredictability and dynamism along with information-to-information functional matching processes movement are key aspects in the learning of movement skills and are key elements of non-linear pedagogy.

This approach promotes in this sense the personalization of learning by focusing on the need to adapt and model educational design through the principles of representativeness, attentional focus, functional variability, information-movement coupling and constraints manipulation (Chow et al. 2013) to guide the student in the selection, modification and appropriate readjustment of their movements.

In this regard, it is clear that there is a need to promote educational quality through specific training which can provide practitioners with professional skills in order to be able to design effectively. This study, in line with the CLA, has implemented a pre-exsperimental study focusing more attention on the manipulation of the task; the creation of landscape of affordances, through the solicitation of multimodal inputs, both with a stabilizing objective and with the aim of providing input aimed at the exploration of movement and the request of new self-organizations, has promoted in the students greater control and management of balance during the walking backwards.

In the awareness of the critical points of the research (reduced sample, limited training period, heterogeneity of groups), it should be noted that the customization of the training took place in the treatment period, to which the control group was subjected, has improved the performance of all subjects in the different tests planned in the PostTest, demonstrating the effectiveness of targeted and personalized didactic interventions that offer stresses and stimuli in response to individual characteristics and peculiarities.

In order to realize a personalized teaching, it is essential to provide practitioners with the ability to be able to modify in a non-linear perspective the didactic proposals also in the course of the action and to know how to integrate, where necessary, the ecological dynamic approach with the prescriptive approach in response to the needs of the individual, the task and the environment promoting in embodied perspective significant learning.

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