A comparison between ecological-dynamic and cognitive approach to improve accuracy in basketball shot

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Abstract

BACKGROUND *The shot is a fundamental skill in basketball that requires high accuracy, because is the tool by which players translate their team's offensive actions into points. Basketball is one of the most practiced situational sports in physical education hours in schools. However, it is still mostly teaching according to a traditional, prescriptive-based model. The aim of the study was to compare prescriptive teaching with ecological-dynamic learning for improving shooting accuracy in a group of 3rd year high school students.* METHODS *The sample is made up of 32 students (16 ± 0.72) divided into 2 groups: Group A, consisting of 16 students who were administered a training protocol based on the ecological--dynamic approach, and Group B, consisting of 16 students, who followed a cognitive approach. The undershot test was administered in and out to test the students' level of shooting accuracy. A t test for paired dependent samples and for independent samples were performed to compare two groups and to verify which of them had the greater improvement. Data were analyzed using SPSS.* RESULTS *The results were statistically significant in group A ($p < 0.05$); infact, group A had a greater improvement in shooting accuracy than group B.* CONCLUSION *The ecological-dynamic approach was able to improve accuracy in shot more than the cognitive approach in a group of high school students.*

Keywords: *teaching, learning, approach, shot, basket, physical education.*

INTRODUCTION

The shot is a fundamental skill in basketball that requires high accuracy, because is the tool by which players translate their team's offensive actions into points (Raiola & D'Isanto, 2016). It is also the most personalized fundamental because each student is different, the muscle districts change, and consequently intervene differently in the coordination of the gesture. Each student must find his own style according to his own characteristics. The procedure of teaching the shot is very important because the technical gesture must be as fluid and correct as possible. We must consider, however, the mental limits because many times the students tend to throw the ball quickly, often making mistakes. This denotes a poor ability to manage emotions. Fundamental to scoring points, shot is the fun part of this sport. The main factors involved in shooting are technical, physical and mental. We can in fact distinguish the sensitivity of the fingers in the phase of reception or collection of the ball, balance, coordination, shooting mechanics, strength, given by the thrust of the lower and upper limbs, the gaze, psychological factors such as responsibility and autonomy. We can say that the shot is a gesture of absolute precision. Basketball is a team sport where you cannot rely solely on individuality to win. You win as a team and above all by communicating between players and between coach and players. In basketball, offensive and

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defensive collaboration systems require effective communication between players and a quick and correct understanding of game situations (Altavilla & Raiola, 2015).

There are several educational messages that sport conveys through its rules (Altavilla et al., 2020; D'Elia et al., 2020; Raiola et al., 2020). Basketball is one of the most practiced situational sports in physical education hours in schools. Sports education is probably the most implemented and researched pedagogical model around the world (Farias et al., 2018). Currently, one of the most used schools is the cognitive, performance-oriented approach (Raiola, 2014; Raiola & Di Tore, 2017; Raiola & Tafuri, 2015). However, different teaching methods can be applied to improve the execution of the technical skill with respect to the place where it is verified. In fact, the ecological-dynamic approach should prevail in schools, and the cognitive approach in sports clubs. Cognitive approach follows a prescriptive teaching, in which the teacher is at the center of the action and prescribes exercises to the student with the aim of perfecting and stabilizing motor programs. The exercises can be partial, simplified or segmented (Wightman & Lintern, 1985), varied, randomized, mental training. The other kind of approach is defined as ecological-dynamic and it is based on discovery. Unlike the previous one, the action is directly available to those who act in their environment (Raiola, 2012). The motor sense system possesses self-organizing properties that make the use of a motor program unnecessary (Edelman, 1987). This approach is based on Bernstein's theory of the three degrees of freedom: freeze, release, and capitalize. Most importantly, it uses instructional practices such as peer tutoring, tutoring, brainstorming, role-play, circle time, cooperative learning, to maximize exploration (Raiola & Di Tore, 2012). The most effective active teaching methodologies are realized in a flexible learning environment that gives space to the interests of students and their experiences. Learning comes from the laboratory experience, which places the student at the center of the process, enhancing his skills and his relational experience. Even in teaching a skill, such as the shot in basketball, these methodologies in a school setting could be very functional.

However, in schools, physical education is still mostly taught according to a traditional model, based on prescriptive teaching (Raiola, 2013). Based on direct observation, it was found that a group of 3rd year high school students had difficulty with the technical act of shooting a basket. The aim of the study was to compare cognitive and ecological-dynamic approach for improving shooting accuracy in students.

Hypothesis of the study are as follow:

1. H_0 – The null hypothesis assumes that students that follow a program based on ecological-dynamic approach do not improve their accuracy in basketball shot, unlike those who follow a program based on cognitive approach.
2. H_1 – The alternative hypothesis assumes that students that follow a program based on ecological-dynamic approach improve their accuracy in basketball shot, like those who follow a program based on cognitive approach. Being that there is a notion that the ecological-dynamic approach is often a waste of time and does not lead to improvements in skill acquisition this study may change the minds of many teachers who think this way.

METHODS

Participants' characteristics

The sample is made up of 32 Italian male students (age, Mean ± standard deviation [SD] = 16 ± 0.72 years old) belonging to the 3rd years high school. Students were randomly divided into two groups: Group A, consisting of 16 students, was subjected to the ecological-dynamic approach and Group B, consisting of 16 students, to cognitive approach. The students

included had no basketball experience and scored low on the undershot test. The study adhered to ethical code of the Declaration of Helsinki and written informed consent was obtained from all participants. Data were stored and processed anonymously.

Test procedure

The undershot test (tiro da sotto), an Italian test realized by Mondoni (2000), is designed to assess the technical skills of children in the execution of the sporting gesture. The subject is placed at 1 m along the bisector of the right angle formed by the backboard and the axis of the basket perpendicular to it. He starts shooting from the side corresponding to his strong hand. Once the first shot has been made, the subject must quickly retrieve the ball, return to the starting position on the dribble and shoot again from the same side until he makes 5 baskets. At this point he moves to the other side to shoot 5 more baskets. Measure the time needed to make 10 baskets (5 on the right and 5 on the left) from the moment the subject starts shooting. Have the subject perform a test only and record it. To carry out the test, a basketball for the boys category, the basket at a regulation height (305 cm) and a stopwatch to calculate the time of the test were used. The test was proposed in entry, to verify the ability in the execution of the fundamental technique, in exit, following practical exercises.

Training protocols

Group A: ecological-dynamic approach. The exercises proposed to the students were focused on practical exercises aimed at a heuristic learning of the gesture through various strategies such as: problem solving, discovery learning, circle time. The exercises proposed during the 4 weeks following the entrance test, all took place in the gym during the 2 curricular hours of physical education per week, and lasted about 45 minutes. A detailed description of the type of activity proposed is shown in **Table 1.**

Table 1. Structure of a typical lesson using ecological-dynamic approach.

Phase 1: Autonomous research of the solution (problem solving)	We made the students freely execute the basket shot without giving any information, seeing how the boys tried to execute it according to their previous experiences. The students will perform the gesture independently, they will test themselves and we will intervene only to give suggestions to improve the execution or any feedback of reinforcement in order to make the student understand the adequacy of his execution.
Phase 2: Altering time and game parameters and cooperative learning	We have structured drills in such a way as to bring the students indirectly closer to the model of the technical gesture, implementing changes to the environment in order to make them more likely to succeed according to different strategies: • We shoot the basket • We use balls of different sizes • We use balls of different weights The activities were carried out in small groups or in groups of two, cooperatively.
Phase 3: Circle time	It is not a real exercise, but it is a fundamental part for the children who, gathering in groups in the center of the gym at the end of the hour of physical education, discuss the results obtained in the execution of the exercises and their experience in practicing them. Circle time develops life skills, especially interpersonal skills.

Group B: cognitive approach. On the other hand, the exercises proposed for the second group included a prescriptive teaching of the technical gesture, in particular focused on the varied exercise. Therefore, the students have performed more movements belonging to the same class, going to perform the same technical gesture (shooting basket) through multiple executive variants of the

same generalized motor program. In this way, they enhanced learning because they exercised the parameterization of the technical gesture. The training sessions centered on prescriptive teaching included, according to the didactic strategy of the varied drill, the exercises shown in **Table 2.**

Table 2. Structure of a typical lesson using a cognitive approach.

Refining accuracy	The boys under instructions from the coach are placed at different distances from the basket, first at 1 meter, then 3 meters and finally 5 meters.
Variation of execution time	The teacher establishes the time within which the students must make the shot at the basket: a reduced time (1–2 seconds) will therefore lead the students to have to make the shot faster, without having the opportunity to prepare adequately for the execution of the shot; a longer time (5 seconds) will allow the students to prepare adequately before the execution and to have greater concentration at the time of execution.
Variation of shot direction	The teacher will place marks on the floor from which the children must shoot at the basket explaining in detail to the child how to make the shot towards that direction indicated by him.
The type of exercise is always focused on the continuous repetition of the motor gesture.	

STATISTICAL ANALYSIS

After verifying normality of the data with Shapiro Wilk Test and homogeneity of variances with Levene test, a t-test for independent samples was performed to compare the two groups, A and b, before and after 4 weeks, to verify if there was an improvement in accuracy thanks to the two metodological approach, ecological-dinamic and cognitive, and a t-test for paired samples to verify the improvements of each group. Statistical significance was set at $P \leq 0.05$. To qualitatively interpret the magnitude of differences, effect sizes (d) and associated 95% confidence intervals (95%CI) were classified as small (0.2–0.5), moderate (0.5–0.8) and large (>0.8) (Cohen, 1988). Data analyzes were performed using Statistical Package for Social Science software (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY).

RESULTS

Before starting the experimental study, the test execution time of group A and B were very similar, so this means that they started at the same level. After 4 weeks, the time to complete 10 baskets decreased in both groups, albeit more so in group A. A detailed description of undershot shot test time administered pre-post 4 weeks is shown in **Table 3.**

Table 3. Undershot test time of A and B groups

	Groups	N	Mean	Std dev.	Error std mean
Pre	A	16	69.62	10.93	2.59562
	B	16	69.81	7.67	1.91968
Post	A	16	58.68	5.37	1.34387
	B	16	65.56	7.65	1.62788

A result not statistically significant was found before starting the experimental study between group A and B (p=0.969). After 4 weeks, the result was statistically significant (p=0.003). A detailed description is shown in **Table 4.**

Table 4. T-test for independent sample

	t	df	Sign (two tails)	Difference in mean	Error std. mean	Confidence interval 95%		d (95% CIs)
						Lower	Upper	
Pre-test	0.039	30	0.969	0.12500	3.22837	–6.46822	6.71822	0.01 (0.02; 0.44)
Post-test	–3.227	30	0.003	–6.81250	2.11092	–11.12358	–2.50142	0.07 (0.01; 0.27)

Regarding the difference between pre-post each group the result was statistically significant in group A (p=0.002) but not in group B (p=0.117). A detailed description is shown in **Table 5.**

Table 5. T-test for paired samples

		Mean	St. dev	Error st. mean	Confidence interval 95%		t	gl	Sign. (two tails)	d (95% CIs)
					Lower	Upper				
A	Pre-post test	11.25000	12.24473	3.06118	4.72525	17.7747	3.67	15	0.002	0.91 (0.12; 0.98)
B	Pre-post test	4.31250	7.40017	1.85004	0.36923	8.25577	2.33	15	0.117	0.41 (0.01; 0.59)

DISCUSSION

The results show that in group A, that followed an ecological-dynamic approach, there was a significant improvement in the accuracy of the basketball shot, in fact, students decreased the time in which they performed the test, which consisted of shooting the ball 10 times in the basket. Also in group B, that followed a cognitive approach there was an improvement in accuracy, but it was not considered significant by statistics. Both methodologies proved to be effective, however group A, which followed lessons based on the ecological-dynamic approach, had a significantly greater improvement than the group that followed lessons based on the cognitive approach. Possible explanations for the results obtained can refer to the fact that, especially in school contexts, leaving students free to explore all the possibilities of movement and execution of gestures can bring many advantages over the cognitive approach, which is, however, used mainly in sports contexts where the coach conducts the activity in a highly intense and often too incisive and aggressive way.

From the national indications for the curriculum of the secondary school (Viscione et al., 2019), and in particular from those addressed to the high schools, it follows that in the second two years the action of consolidation and development of knowledge and skills of students will continue in order to improve their motor and sports training. At this age the students, also favored by the complete maturation of the frontal cognitive areas, will acquire an increasing ability to work with a critical and creative sense, with the awareness of being actors of every bodily experience lived (Raiola et al., 2015). In these years, students through the knowledge and practice of different sports activities, discover and enhance personal attitudes, skills and preferences by acquiring and mastering first motor skills and then the specific sport techniques, to be used in an appropriate and controlled way. In our case, students practiced improving shooting accuracy in the discipline of basketball. On the one hand, problem solving, cooperative learning, circle time, and altering the rules of play and space were used. On the other hand, varied practice. Both

variations resulted in a significant improvement in shooting accuracy. What made the difference was motivation. The motivational climate refers to the teacher's ability to promote an adequate situational structure of the environment (Sgrò et al., 2019). The students who focused on repetition of the gesture, showed themselves bored and did not conceptualize enough. Students who used instructional practices, on the other hand, showed more motivation and working in pairs motivated each other, and therefore had greater improvements because they were not bored and practiced throughout the lesson. Therefore, to overcome the boredom elicited by repetition, it is important to focus on the instructional practices. Physical education has broad pedagogical value and should be used to its fullest extent (D'Elia, 2019; D'Elia, 2020; D'Isanto, 2016). The physical activity stimulates growth through relationship in the group (Altavilla & Di Tore, 2016) and also the educational value and the learning opportunities that occur within it (Raiola et al., 2016; Di Tore, et al., 2013). Only with the repetition of the gesture, this is not possible. For this reason, the ecological-dynamic approach is more complete at the educational level.

The study has some limitations, such as sample size and lack of reliability test. Future researchers are encouraged to compare the cognitive approach with the dynamic ecological for learning sport skills from various sports. The results of this study have important implications for teachers who believe that the ecological-dynamic approach is just fun and does not actually lead to improved technical gestures.

CONCLUSIONS

We can affirm that by following the guidelines of the ecological-dynamic approach and focusing on a heuristic learning of the gesture we could appreciate important improvements already after four weeks, compared to the prescriptive teaching, based on the repetition of the gesture. The usefulness of the study proposed here is therefore in showing how ecological-dynamic approach has allowed children to obtain important improvements in the improvement of a technical skill on which they were initially lacking, resulting in fact more appropriate than the cognitive approach focused on prescriptive analytical strategies. This can also be explained by the fact that ecological-dynamic approach is particularly suitable for students who already have a good predisposition to the task, as in the case of the subjects analyzed in our study. Despite this, cognitive approach is certainly not a methodology to be excluded, as it has, however, brought improvements in our students, but in the case mentioned it was certainly not the most effective strategy. It is important to emphasize that there is not one methodology that is better than another (Pesce et al., 2015), but simply that we need to know all of them in order to understand which is the most relevant according to the situation, the students and the context we are dealing with.

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