

Teaching method to improve eye-hand coordination in volleyball serve

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ABSTRACT

Problem statement. One of the many problems that learning to serve in volleyball may require is an ineffective eye-hand coordination. In the school environment, two approaches are used to train this fundamental: cognitive and dynamic ecological. The objective of the study is to verify if a mixed approach is used, high school students will be able to improve the expectation of the service more than the other two types of approaches most used in schools. **Methods.** The sample is made up of 45 3rd high school students (average age of 16 years \pm 2.99). All students will be divided into three groups of 15 students each: the experimental group will train with a mixed approach; the control group 1 will perform a program based on the ecological-dynamic approach and the control group 2 will train following the logic of the cognitive approach. All the groups performed a manual eye coordination test and a one-way anova was performed to verify the improvements between groups and subsequently the Post Hoc Bonferroni. **Results.** The result is statistically significant ($p < .05$). All the groups had an improvement in coordination but, from the post hoc, it is noted that the experimental group had clearly superior improvements to the other two groups. **Conclusion.** The mixed group proved to be an effective method to improve manual eye coordination in the volleyball serve as the relationship and fun were placed at the centre, which, combined with the practice of the gesture, made the students more motivated to learn.

Keywords: Volleyball serve; Mixed approach; Cooperation; Learning; Relationship.

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INTRODUCTION

According to the F.I.V.B., the serve is "*the act of putting the ball into play, by the right back, placed in the service area*" (Lopez, 2013). To perform the serve in accordance with the standards, the serve must be performed within 8 seconds of the first referee's authorization, hitting the ball with one hand (or any part of the arm) after being released from the hands, and not touching the court at the time of service or during take-off. The characteristic of the volleyball hit compared to the other strokes that are performed in the game of volleyball is of a temporal type: it is the only gesture that is performed without haste; in fact, we decide when to execute it in 8 seconds. In fact, serve is one of the original volleyball skills that William G. Morgan introduced in the first rules written in 1897. However, it is best not to make the mistake of considering serving as a minor skill of the game. Even as one of the few techniques in volleyball where there is no interaction with the partner or opponent in its execution, most authors agree on the importance of volleyball serve as one of the fundamental skills in the game. Not surprisingly, during the evolution of our sport we have seen many variations and executions for this technical ability, simply in search of excellence. Volleyball serve is a skill commonly described as the first element of attack, essential for preventing a team from taking sides (Wise, 2002). The types of service from above are:

- Float hitting: performed with both feet on the ground, it is relatively easy to learn. It should be remembered that it subjects the shoulder to a great load and therefore it is necessary to prevent injuries to this joint with adequate physical preparation.
- Float jump stop: we highlight the three "*pivotal*" aspects for the correct learning of this fundamental: the launch, the take-off and the strike.
- Spin jump serve: in the serve with rotation, the ball is hit as in the dunk, with the whole palm of the hand and with the fingers that adhere completely to the surface itself, causing it to spin. The combined action of the speed of advancement and rotation produces a force that acts downwards and makes the trajectories more closed.

When performing service techniques, three conditions are required, namely:

- Strength in the arm muscles
- Speed in action
- High coordination, necessary to obtain adequate precision during the fundamental.

Hand-eye coordination is a cognitive skill complex and should guide our hand movements based on visual stimuli and feedback. Difficulties in hand-eye coordination can adversely affect the performance and / or learning of any motor gesture, especially in volleyball serve. Technique is a key determinant of performance; while for athlete training the crucial elements are both learning and technical improvement (Raiola et al., 2016b). Different teaching methods can be applied to improve the execution of the technical skill with respect to the place where it is verified. One of the most used in both schools and sports clubs is the cognitive, performance-oriented approach (Raiola, 2014; Raiola & Di Tore, 2017; Raiola & Tafuri, 2015). According to this theory, the human being has at the brain level, a series of motor programs, or sequences of commands, which, at the level of the central nervous system, coordinate the execution of movements. It can be opened or closed based on the speed of execution of the action, which requires the use of feedback or not (Schmidt & Wrisberg, 2000). The closed circuit is useful for relatively slow actions that allow correction during its execution with a comparator and high repetitions. The open circuit, on the other hand, is used for automated actions: motor control does not take place with the comparator but thanks to patterns, pre-established internal models based on previous experiences (Adams, 1968; 1971). In this case, we are talking about prescriptive teaching in which the teacher is at the centre of the action and prescribes exercises to the student with the aim of perfecting and stabilizing motor programs. The exercises can be partial, which can be simplified or

segmented (Wightman & Lintern, 1985), varied, randomized, mental training. The other type of approach, based on discovery, is defined as ecological-dynamic, which does not consider it necessary to resort to prescriptive mental structures. In this case, the action is directly available to those who act in their environment (Raiola, 2012). In other words, the motor sense system possesses self-organizing properties that make it unnecessary to resort to a motor program (Edelman, 1987). It is based on Bernstein's theory of degrees of freedom to learn a motor gesture. It is mainly focused on the use of educational practices such as circle time, cooperative learning, role play, peer education, focus groups, brainstorming and so on (Raiola & Di Tore, 2012abc). It is important to find a collaboration between competition and collaboration in educational terms (D'Elia et al., 2020) according to the epistemology of physical exercise and sports sciences (Raiola; Raiola, 2019). There are various studios that have tried to improve serve in volleyball (Forte et al., 2019; Ngadiyana, 2020; Raiola et al., 2016).

Based on direct observation, it emerged that a group of high school students had difficulties with hand-eye coordination, which could negatively affect performance and / or learning of the serve in volleyball. In the school, it is possible to apply different teaching methods to improve the execution of the technical skill, which vary according to the goal, students, context, and teacher. The objective of the study is to verify whether with a mixed training, characterized by a mix between the cognitive and dynamic ecological approach, the students are able to improve coordination in the volleyball serve.

METHODS

Design and participants

The present study was designed to assess the effects of three types of teaching methods on manual eye coordination to improve serve in volleyball. The sample is made up of 45 3rd high school students (age, mean \pm standard deviation [SD] = 16 \pm 2.99 years old) and is divided into three classes, made up of 15 students each. Specifically, we have:

- An experimental group (S.G.) that performed a mixed training, characterized by the union of the dynamic ecological approach (in the warm-up and in the final phase of training) and the cognitive approach (in the central phase of training), based on techniques of partial and varied exercises.
- A control group 1 (C.G.1) that was subjected to an ecological-dynamic learning method, based on constraints imposed by the environment, by the rules of the game, by tools and instruments. During this type of training, the boys experienced and learned the volleyball serve in the form of a free and structured game; independently and / or in pairs to encourage cooperation and the development of problem solving or the autonomous search for novel solutions to the resolution of a motor problem, in this case.
- A control group 2 (C.G.2) that was subjected to a prescriptive teaching method, more in use in schools according to the literature. The didactic activity will consist in prescribing to the student modalities of exercises aimed at stabilizing and perfecting motor programming and minimizing the execution variables. Specifically, the partial exercise technique was used.

Test procedure

The assessment tool administered was a practical test to assess the students' level of eye-hand coordination. The test is an important procedure as it is used to measure performance (Aliberti et al., 2021) and, therefore, to verify the improvements resulting from activity training (Aquino et al., 2019; Marra et al., 2019ab). The test consists of kicking a ball from below and towards a target with one hand and trying to catch it with the other. Each throw made, which hit the target placed about 2.5 meters away, and taken correctly, earns one point to the student. There are 20 throws to be performed, for a total of 20 points. The test equipment is very simple:

it consists of a wall, tennis balls, scoreboards, ribbons for the creation of boundaries and delimitations, as shown in Figure 1.

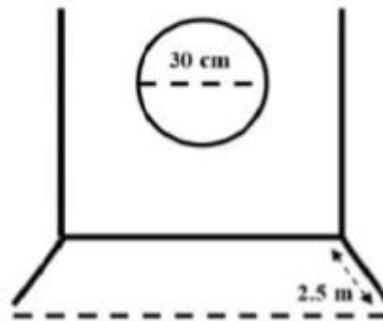


Figure 1. Eye-hand coordination Test.

Training protocol

S.G. protocol using mixed approach

Mixed approach involves the union of heuristic learning with the prescriptive teaching method.

- Frequency: 2 times a week
- Time: 1 hour and 30 minutes
- Duration: 3 months

Training phases:

1. Warm up (heuristic learning): 15/20 minutes of low-effort exercises and coordination work in pairs to promote relationship and fun. In this phase, the teacher is present to observe everyone but does not intervene to correct. The goals of the warm-up are motivation, pleasure, preparation of the body, dynamics.
 - General warm-up: couples. A directs b who must move in the direction indicated by a with his arm: right, left, up (= jump), down (crouch), front (back), etc. (theme: reaction to a signal)
 - Joint warm-up: high wall passages, facing couples sitting, kneeling, standing, with overhead and or not dribbles, etc.
 - Specific warm-up: two teams of three with a ball each: send the ball into the opponent's field with a throw from the chest in order to make it fall into the opponent's field, the defender can block before returning it or return it directly. A waiting team counts the number of balls that have fallen to the ground. (Objective: trajectory reading and construction of a target).

2. Central phase (prescriptive teaching): the teacher comes into play who demonstrates the correct way to perform the service from above, prescribes the most useful types of exercises to improve service and coordination, has the task of stimulating the children and finding always new effective alternatives based on the preparation and ability of each one. In this phase, from the duration of 45 min. approximately, the boys will also have the opportunity to improve the technical gesture as they had already had previous experiences. The exercises are based on the repetition of the beat from above without jumping (float beat). The important aspect of the float serve is to pay attention only to the hit and execute it after a very short throw. Some examples of exercises could include:
 - The coach placed on the side of the hitter who holds the ball at the right shot height,
 - A fixed support that holds the ball at the correct height through a rubber band (such as a ball held with a thread to exercise head strikes in football)

- Preparation and throwing of the ball by trying the coordination of the various movements several times
 - Simulate an empty stroke to be performed several times.
 - Hits from above with the ball while staying close to the net (the starting distance must initially be minimal, as the technical gesture is consolidated and if the athlete's strength allows it, the distance can be increased)
 - Other types of exercises may involve performing the self-throw after a short run but grabbing the ball instead of hitting it. Once the correct coordination between run-up and self-launch has been learned, all the didactic progressions typical of the service in general can be used. Exercises in which you are asked to hit the ball from gradually increasing distances are essential.
3. Cool down: everything that has been previously learned will be re-proposed in the form of a game. It is a fundamental phase that stimulates learning, relationships, the development of fair play. Here, too, the teacher has the role of observing the pupils and correcting them. Ex: circle game. In the field there are as many circles as there are team members who must be inside. The other team stands on a line at some distance. At the start with dribbles (bagher or dunk) you have to hit the children in the circles, who can dodge the shot but can only do so by staying inside the circle. Whoever eliminates more members of the opposing team in a certain time wins. Needed: balls and hoops.

C.G.1 training protocol using ecological-dynamic approach

- Frequency: 2 times a week
- Time: 1 hour and 30 minutes
- Duration: 3 months

Training phases:

1. Warm-up: light jog to increase body temperature and prevent the risk of injury.
2. Specific warm-up: exercises to prepare for running, jumping, striking and passing (dribbling, throwing exercises with a volleyball or a light weighted ball).
3. Central phase: free game run by students.
4. Cool down: bring the body from exercise to a state of rest in an efficient and advantageous way. Stretch.

C.G.2 training protocol using a cognitive approach

- Frequency: 2 times a week
- Time: 1 hour and 30 minutes
- Duration: 3 months

Training phases:

1. Warm up: light jog to increase body temperature and prevent the risk of injury. Specific warm up: exercises to prepare for running, jumping, striking and passing (dribbling, throwing exercises with a volleyball or a light weighted ball).
2. Central phase: the coach prescribes partial technique exercises to gradually improve the coordination aspect and at the same time the service. It's important:
 - Present the goal (helping the players to understand how the techniques of the game must be done)
 - Develop the motor program (planning the training so that the techniques of the game are actually trained)

- Improve responses
- Give retroactive information (feedback) to players on what they have done in order to make it clear if they need to improve something or not

Training examples may include:

- Repeat the run up 10 times with a free jump without throwing the ball (to improve the run up)
 - Perform a joke from above without running up and from a close distance to the net
 - Take a seat on the baseline holding a tennis ball in your hand and with the same movement as for the top serve, throw the ball into the opponent's court.
 - Simulate a blank stroke: try several times
 - Simulating the preparation and throwing of the ball: try the coordination of the various movements several times
 - Launch and perform a front serve placed in front of a wall 6-7 meters away.
 - Beat while staying close to the net.
 - Beat in pairs: strike alternately at the height of the chest of the teammate, who will take the ball with both hands and then perform the serve in turn.
3. Cool down: bring the body from exercise to a state of rest in an efficient and advantageous way. Stretch.

Statistical analyses

After verifying normality with the Shapiro Wilk test ($p > .05$), a one-way anova was performed to verify the differences between pre and post training protocol groups. A Bonferroni post hoc was performed to verify which group had the greatest improvement. Statistical significance was set at $p \leq .05$. Data analyses were performed using Statistical Package for Social Science software (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY).

RESULTS

A detailed description of the results of the eye-hand coordination test performed before and after to administering the protocols, is shown in Table 1.

Table 1. Descriptive statistics of pre-post eye-hand coordination tests in S.G, C.G.1 and C.G.2.

	Mean \pm SD
<i>S.G. Pre</i>	8.2 \pm 2.6
<i>S.G Post</i>	15.6 \pm 3.6
<i>C.G.1 Pre</i>	7.6 \pm 2.7
<i>C.G.1 Post</i>	9.9 \pm 2.4
<i>C.G.2 Pre</i>	6.9 \pm 1.9
<i>C.G.2 Post</i>	12.6 \pm 2.1

A statistically significant difference was observed, after administration of the protocols, between groups ($p < .05$). Before the administration of the protocol the result was not statistically significant, which implies that students had the same level of coordination ($p > .05$). A detailed description is given in Table 4. A detailed description is shown in Table 2.

Table 2. One way anova pre and post training protocol between three groups.

		Sum of squares	df	Quadratic mean	F	Sig.
Pre	Between groups	12.133	2	6.067	.977	.385
	Within the groups	260.667	42	6.206		
	Total	272.800	44			
Post	Between groups	241.111	2	120.556	15.063	.000
	Within the groups	336.133	42	8.003		
	Total	577.244	44			

A statistically significant result was found among all three groups, however, the mixed method (S.G.) had the greatest improvement, followed by the cognitive approach (C.G.2) and finally the ecological-dynamic approach (C.G.1). A detailed description is shown in Table 3.

Table 3. Multiple comparisons with post hoc Bonferroni.

	(I)	(J)	Difference in mean (I-J)	Std error.	Sig.	95% confidence interval	
						Lower limit	Upper limit
Bonferroni	S.G.	C.G.2	3.000*	1.033	.018	.42	5.58
		C.G.1	5.667*	1.033	.000	3.09	8.24
	C.G.2	S.G.	-3.000*	1.033	.018	-5.58	-.42
		C.G.1	2.667*	1.033	.040	.09	5.24
	C.G.1	S.G.	-5.667*	1.033	.000	-8.24	-3.09
		C.G.2	-2.667*	1.033	.040	-5.24	-.09

DISCUSSION

The results showed that there were significant improvements in coordination in the group of students who trained with the mixed method, greater than in C.G.1 and C.G.2. Despite this, we can see how C.G.2 (prescriptive training) has had greater improvements compared to C.G.1 (heuristic training) but less than S.G. Most likely, this is because during training with the prescriptive method, the students worked individually, concentrated on technique and high repetitions, cancelling any form of experimentation and cooperation with their peers. This resulted in students becoming bored, decreasing intrinsic motivation and, consequently, the drive to learn. For every learning process, in fact, the high repetition of a gesture is fundamental for its learning, improvement and stabilization (Raiola et al., 2014). This is a characteristic of the cognitive approach. It is also true that play, relationships, cooperation with one's partner and experimentation are equally important, especially if we are talking about a school context, in which ample space should be given to the ecological-dynamic approach. Thanks to training with the mixed approach, the students have improved the coordination aspect and the technique of serving in volleyball, without ever abandoning the dynamic ecological approach. This has made it possible to increase team dynamics, fun, cooperation and the relationship with each other, fundamental aspects in the learning process (Altavilla et al., 2015). The motivational climate refers to the teacher's ability to promote an adequate situational structure of the environment (Sgrò et al., 2019). With an adequate climate, the students felt more stimulated and increased their intrinsic motivation, with positive consequences on learning. We must not forget that emotions play an important role in learning and memory processes (Altavilla et al., 2014). Cooperative Learning constitutes a specific teaching methodology through which students learn in small groups, helping each other and feeling co-responsible for the reciprocal path. Physical education (Raiola 2020ab) has a broad pedagogical value and must be exploited to the fullest (D'Elia, 2020; D'Elia et al., 2020; D'Isanto, 2016). The teacher assumes the role of facilitator and organizer of the activities, structuring "learning environments" in which students,

favoured by a positive relational climate, transform each learning activity into a process of "group problem solving", achieving objectives whose realization requires the personal contribution of all. These objectives can be achieved if, within the small learning groups, students develop certain social skills and competences, understood as a set of interpersonal and small group skills essential to develop and maintain a qualitatively high level of cooperation (D'Elia et al., 2021ab). Physical education teachers are encouraged to use a mixed approach, as it appears to be the most suitable in a school setting, combining performance and fun, thus allowing students to tackle student sports games or other school competitions.

CONCLUSION

The study made it possible to decree the importance of the mixed approach in the sports context, rather than using prescriptive teaching or heuristic learning. Unlike the latter two, the mixed approach allows you to effectively repeat a motor skill, thanks to the use of elevations and the teacher's correction, as well as to work on the emotional and collaborative aspect. Both are vital, especially when participating in student sports games or other school competitions. Exercise science teachers should take into account these methodological indications with the aim of planning specific training based on high repetitions and specific gestures, both on exploration, experimentation, cooperation between children and problem solving.

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