Dual convergent model for volleyball initiation: 20 practical applications

Modelo dual convergente para la iniciación al voleibol: 20 aplicaciones prácticas

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Abstract

Since the introduction of mini-volleyball in the 1960s there has been no shortage of proposed formulas and methodological processes for adapting it for children under the age of 12. The present article analytically and critically synthesizes the historical origins and theoretical foundations of this phenomenon. Various scientific perspectives argue for a model of development across two domains: one based on the speed-precision ratio and aiming to maximize the performance of specific motor skills; the other based on the development of precision-control, where a focus on precision of execution requires decision-making to progressively more complex problems. In this proposal, the game is still at the heart of the model. However, there is a need for a specific out-of-game learning approach and for the inclusion of generic content implicated in long-term initiation models and physical literacy. To this end, we synthesize the practical experience and traditions of volleyball initiation worldwide; theories, scientific frameworks, and general research on sport initiation; as well as learning principles and prior pedagogical proposals. This culminates in 20 practical applications for a model that is original in that it is specific and committed to the trends in generic long-term sports development.

Keywords: Mini-volleyball; Sport initiation; Small-sided games; Motor skills; Movement pattern; Speed; Precision; Decision making; Complexity.

Resumen

Desde que el minivoleibol fue introducido en la década de los años 1960, no han dejado de aparecer fórmulas competitivas y procesos metodológicos con la finalidad de adecuar este deporte a las características de niños y niñas menores de 12 años. Este trabajo reúne de forma analítica y crítica tanto el legado histórico como los fundamentos teóricos que vienen inspirando este fenómeno. Desde distintos ángulos científicos se encuentran argumentos para configurar un modelo que evoluciona recorriendo dos ejes. Uno, basado en la relación velocidad – precisión, el cual pretende maximizar la posibilidad de acción de las habilidades motoras específicas. Otro basado en la evolución precisión-control, donde desde un compromiso con la precisión de la ejecución, expone la toma decisiones a problemas progresivamente más complejos. En esta propuesta, el juego se mantiene en el centro neurálgico del modelo; sin embargo, se justifica el abordaje de aprendizaje específico fuera del juego en sí y la inclusión necesaria de contenidos genéricos comprometidos con los modelos de iniciación a largo plazo y la alfabetización física. Por tanto, se ha sintetizado la experiencia práctica y la tradición de la iniciación al voleibol a nivel mundial, las teorías, las perspectivas científicas e investigaciones de carácter general, referentes de la iniciación deportiva, principios de aprendizaje y propuestas pedagógicas previas. Su resultado son 20 aplicaciones prácticas para un modelo que resulta original en lo específico y comprometido con las corrientes del desarrollo deportivo a largo plazo en lo genérico.

Palabras clave: Minivoleibol; Iniciación deportiva; Juegos reducidos; Habilidades motoras; Patrón motor; Velocidad; Precisión; Toma de decisiones; Complejidad.

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Sport initiation background

Different significant proposals have emerged through time and in several countries, trying to adapt the game of volleyball to the characteristics of players younger than 12 years old. These proposals ultimately converge in what we know as mini-volleyball.

Mini-volleyball or '*minivolley*' was first introduced in the 1960s by Horst Baacke (Fédération Internationale de Volleyball [FIVB] coach and Professor of Physical Education). The first regulations for mini-volleyball, both for 3v3 and 4v4, were published by the FIVB in 1975. Afterward, Baacke published the manual entitled "Mini Volleyball" in 1975, translated to several languages, which conceived mini-volleyball as a didactic simplification of adults' volleyball and a first phase towards 6v6 volleyball (Baacke, 1978, p.4).

Götsch, Papageorgiou, and Tiegel (1980) published the manual called "Minivolleyball", where they gathered the official regulations of Mini-Volleyball approved by the FIVB and valid at that moment. These official rules of mini-volleyball set out a series of principles. These incorporate the idea of attracting children to volleyball through the practice of mini-volleyball, (which is considered an attractive activity for them and a faithful and natural imitation of volleyball); that mini-volleyball (in this case 3v3) is a didactic adaptation for children played on a small court and with adapted rules; that it can be played by children aged 9 to 12 years; and that it will promote a good general development of movements that will be beneficial for later practice of volleyball (Götsch et al., 1980, p.81).

Düerrwächter (1974) put forward a proposal for volleyball initiation, focused mainly on children aged 11 to 14 years, with the following starting premise: "There needs to be a simple and straightforward approach that is easy to learn, has a large variety of movements, is capable of retaining the attention of children, and that does not require an excessively long period of learning and practice before starting the proper game" (Düerrwächter, 1974, p.10). Accordingly, his proposal for initiation involved alternating between a combination of games for tactical development (2v2, 3v3, or 4v4) and exercises for technical improvement. Games for tactical learning must have tactical demands like those in volleyball, but which should be simpler at the technical level (e.g., "balón volante" and its variants, which involve modifying the possibility to catch the ball, the height of the net, the dimensions of the court, or allowing self passes in the game; the serve – reception game; or volleyball with official rules in a small court), and exercises for the technical learning of the basic elements (passing, serving, digging, spiking and blocking). Another prominent aspect of this proposal was its novel and creative approach to taking advantage of the available facilities by proposing ways to create multiple courts or play spaces with different materials and marking systems.

A Spanish reference in volleyball initiation was the teacher and coach José Antonio Santos ("Toño" Santos), who published a model for the teaching of volleyball in 1995 and 1996 (Santos, 1995; Santos, Viciana Ramírez, & Delgado Noguera, 1996) after years of implementation and experimentation. This sports model is structured in four phases, although we focus on the development of the first phase - "Introduction to the game" - which aims to motivate and engage players through the use of games and varied competitions that have 1, 2, or 3 players per team; are either cooperative to maintain continuity or competitive with the aim to win; and allow the possibility for teams to share a player (Santos, 1995).

This approach to volleyball initiation is the same for all age groups and is (a) integrative, jointly developing the various elements of volleyball (i.e., technique, tactics, general and specific physical preparation, psychology preparation); (b) research-informed; and (c) global (non-analytical) (Santos et al., 1996). Highlights of Santos et al.'s (1996) proposal are presented below, as well as the authors' justifications. As a central resource, this model uses simplified games that have a structure similar to that of volleyball, but which are adapted to the player's abilities and training interests. Progression of learning then occurs through the modification of these games. This includes starting with a reduced number of players which is then increased; with a high net that is then lowered; with elongated courts, followed by wide courts and then square courts; starting with small courts with an overhead pass and larger courts with forearm passes; combinations of cooperative and competitive games; and finally starting with help to perform technical moves

which is then progressively stopped. When there is more than one player per team elements such as the number and type of contacts, the height of the net, and the size and shape of the court can be combined. For simplified games that are 1v1, 1 with 1, that share a player, or that do not share a player, overhead passes are used first because they have a smaller radius of action than the forearm pass, thus contributing to greater motor development. This is followed by forearm passes and then a combination of both. In games with two players per team, the serve is also included and the block and spike are simply initiated by means of a jump set (to include motivating elements at the end of the sessions). In games with three players per team, players experience the potential of the floating tennis serve, performing the motion of the spike (jump overhead; pushing the ball with an overhead touch from one hand, controlled hit of the ball; back row spike notions), and the blocking of two players. In this way, the purpose of this approach is largely to attain, from the first moment of experience, motivation and enjoyment in volleyball practice through the promotion of continuity in the game and a high participation of players in different simplified games.

The main contribution of the model by Santos et al. (1996) to the Dual Convergent Model for volleyball initiation (Dual-Con) presented in this document is that the modification of several variables in small-sided games (i.e. net height, court size, rules) allows the development of the skill of accurately passing the ball in open and challenging environments. The management of time allows its proposals to generate courses of action in order to link the control of the ball with the tactical fundaments and several physical requirements.

From the Dual-Con perspective, the main limitation of the model by Santos et al. (1996) is the lack of opportunities for developing explosive and speed actions.

APPLICATION 1. The logical order of progression proposed by Santos et al. (1996), advancing from a high net in small courts, will be a benchmark of the precision-control aspect of the Dual-Con model, and through this specific motor patterns for precision will be transitioned to controlled situations of increasing complexity.

The *PequeVoley* program - authored by José Ignacio Soto and launched in Spain in 2006 in association with the Spanish Volleyball Federation (RFEVB) - is largely grounded on the approach to volleyball initiation of Santos (Santos, 1995; Santos et al., 1996). Developed specifically for students in the third cycle of primary education (i.e., 5th and 6th grades), PequeVoley appeared as a proposal for volleyball initiation in the educational context and thus includes didactic support material for supporting physical education teachers carry out volleyball didactic units in their schools.

The Dutch Volleyball Federation (NeVoBo) website outlines a mini-volleyball program called *Cool Moves Volleyball* (CMV), created by Adrie Noij together with the Dutch Volleyball Association between 2000 and 2003. CMV - which requires players to rotate every time they pass the ball over the net - is an approach to development and competition for children aged 6 to 12 years. It is organized into 6 stages/levels, each advancing in progression and difficulty, and mainly prioritizes the overhead and forearm passes and the underhand serve. At all levels, Cool Moves Volleyball is played with 4 players per team. At levels 1 (6-7 years; throw, catch, and move), 2 (7-8 years, underhand serve) and 3 (8-9 years, forearm pass) the aim is to remove opposing players from the court, with this being made more difficult by the later entry of those players into the game. At these levels the games are 4v4 and played on a 6 m wide x 4.5 m long court, with the net at 2m and with a 62 cm mini volleyball. At level 4 (9-10 years, second contact gentle catch and throwing movement) the dimensions of the court and the height of the net are maintained, and a game with three contacts is encouraged with the second contact being catching and throwing the ball. The size of the court is increased to 6 x 6 m at level 5 (10-11 years, continuous play from the serve using passes) and level 6 (11-12 years, continuous play from overhand serve, using passes or spike at the net), with the net still at a height of 2 m. This proposal managed to attract and maintain players for the practice of sports but had a greater impact on girls than boys (Triep, 2013).

To improve participation and development of athletes in volleyball initiation, Mesquita, Graça, Gomes, and Cruz (2005) proposed the *Step Game Approach* (SGA). As Mesquita et al. (2005) state, the SGA is grounded in the

complexity of the game, intentional action, and the players' range of skills, and is based on the TGfU (Bunker & Thorpe, 1982) and the *Skill Development Approach* (Rink, 1993). The SGA proposes four forms of play (from 1v1 to 4v4) in which the number of players, the playing area, the size of the ball, the height of the net, and certain rules of the game are modified. It also differentiates three categories of tasks (Mesquita et al., 2005): (1) basic forms of play (cooperative and competitive); (2) thematic games that target specific tactical concepts or game actions; and (3) game-like tasks that preserve the sequence of offensive and/or defensive actions, even when restrictions are applied, and that are used when players do not control the actions necessary for the other two types of tasks.

The SGA is a reflection of the maturation process in the academic field. Despite its similarities to Santos et al.'s proposal (1996), it provides the added value of research, seeking theoretical references that lead the decisions and implementing a quasi experimental intervention in a didactic environment. It is worth mentioning that the study by Mesquita et al. (2005) used a sample of over 12-year-old children, and their results show positive impact in the female group, but not amongst males, as highlighted by Triep (2013) in the CMV. The interpretation of the contributions and limitations displayed for the proposal by Santos et al. (1996) is transferred to both these models, that harden the basis for our application 1.

With the ultimate intention of attracting boys to volleyball, Kramer's proposal (2004) offers the smash as the starting point in volleyball or mini-volleyball. It is a difficult skill, thus being necessary to start learning it in early stages. Furthermore, it is motivating, due to its resemblance to the shot at goal in football. Afterwards, Ruben Nijhuis and Matt van Wezel started applying this idea and teamed up in the development of a new proposal, as Triep (2013) reflects.

Hence, the Smashball appeared, created by Peter van der Ven from the Netherlands, with the aim of addressing the existing lack of young boys playing volleyball. In order to do so, a more appealing game was presented, centered around the most exciting volleyball action, the smash. The Smashball aims to teach in-game decision making, fundamental movement skills and physical alphabetization (Ontario Volleyball Association). As collected by Triep (2013), the Smashball presents itself as challenging, technically possible, dynamic, competitive, and the rallies always end with a smash. Factors such as the net height, type of ball, court size or teams composition (usually 3 players per team, but 2 is also possible). As an example, the court size can be 6x6 m, the serve can be performed from 2 or 3 m away from the net and the net height can vary from 1.5 and 2.1 m.

The Smashball establishes 5 levels that can be summed up as follows (Ontario Volleyball Association, 2017).

1) Serve – Catch – Self throw – Smash (over the net).
2) Serve – Catch and throw towards the net – Catch and throw along the net – Smash (over the net).
3) Serve – Catch and throw towards the net – Set overhead – Smash (over the net).
4) Serve – Pass - Catch and throw along the net – Smash (over the net).
5) Serve – Pass – Set – Smash (over the net).

The main contribution of the Smashball to the Dual-Con is the opportunity of action for the speed skills (jumping and hitting) through a playful approach and focusing, for the first time, on the spike.

From the point of view of the Dual-Con, the main limitation of the Smash ball is the lack of blending with the actions that require precision. The star action of the game (i.e. the smash) somehow limits the possibility of developing the tactic intentionality.

APPLICATION 2. The use of the spike in game forms, as proposed in the Smashball approach to volleyball initiation, will be central to an aspect of the Dual-Con model that is directed at specific motor patterns for speed through the speed-precision relationship.

Recently, in 2017, the *Monster Block Teen's* was introduced as an approach to learning volleyball in Argentina (Gómez & Fotia, 2018). The underlying intention of this approach was the same as Smashball; that is, to attract young boys, or indeed males of any age, to volleyball. As such, this approach suggests starting the

learning process with engaging actions like the spike, block, and defense (De Benedictis, 2018). Monster Block Teen's is played 2v2, with the aim to ground the ball into the court by attacking (spike, touch, or throw) and at the same time to prevent this from happening by defending (catching the ball) and progressively blocking. This is done considering three forms of organization according to the possibilities of the players (Gómez & Fotia, 2018).

The main contribution of the Monster Block Teen's to the Dual-Con is the presentation of jumping actions, as well as the experimentation with opposition in proximity and height.

From the perspective of the Dual-Con model, a major limitation of Monster Block Teen's is that including the block increases the action difficulty when performing the spike, if the speed hit pattern has not been properly previously acquired.

Conclusions about the evolution of the volleyball initiation game

For many years, introductions to volleyball using adapted, simplified, or modified games have been governed by the underlying priorities of promoting ball control and allowing for continuous play. As such, decisions regarding task conditions were linked to the learning of precision movement patterns. However, through its aim to attract boys (who are not well stimulated by the formulas for ball control presented to girls), Smashball has given a radical change of direction to the historical priority of control by emphasizing the spike in the game.

From the perspective of the volleyball, the speed of movement is a key factor in performance. Along this line, the Dual-Con fully considers that in the ages in which the model is of appliance is utterly essential to stimulate the speed of movement in children (Balyi & Hamilton, 2004; Lloyd & Oliver, 2012; Pichardo, Oliver, Harrison, Maulder, & Lloyd, 2018).

From 2013, in the University of Granada the resulting movement patterns have been studied and applied with different options to overcome these limitations. In addition to the study and discussion of this topic in technical meetings and university classrooms, young children have been practicing it in the sport schools of the University of Granada since 2015.

The convergence of both perspectives seems to be the natural integration of control and power. However, in our motivation to implement the Dual-Con model it was considered more important to obtain the best opportunity to transfer the enormous motor richness in volleyball to this age group. Moreover, the authors have seen an opportunity in classic games, which allow for greater continuity, to help with the internalization of game principles and development of emerging adaptation skills.

APPLICATION 3. We propose the development of a dual model, which is focused (a) on the relation between speed and precision by emphasizing the enrichment of motor skills, thus facilitating efficient patterns with clearly defined motor objectives, and (b) the execution of passes in favorable temporal conditions for precision, but which then transition by increasing complexity and demand for decision making. The characteristics of the games used will be adapted such as by lowering the net for strike speed, by elevating the net for continuity work and accuracy in passing, and by increasing the number of players for complexity, etc. This dual approach will help foster motivation through its variability in demands, by alternating control games with speed games, and by permanently renewing challenges in the demand for motor skills or increasingly complex decisions.

The domain speed – precision

Among all team sports, volleyball highly demands to master a relationship with the ball. Volleyball players must perform high-precision actions, such as setting with an overhand pass, but also high-speed actions, such as the spike. A skilled setter is able to achieve significant speed in precision actions (i.e. quick tempo sets from considerable distances). Also, the spike or the jump spin serve must seek, at some point, a high precision while maintaining notable speed.

However, that relationship between speed and precision is, in its origin, delicate. That is the reason why only in expert and skilled players both qualities can be contemplated.

Fitts (1954) established an inverse relationship between the speed of movement and the difficulty of the task, depending on the distance and the width of the target. This can be considered

as "the most universal expression for human movement" (Murakami and Yamada, 2021, p.1). That is why the study of Fitts's law, through the experimentation with different application and variables, seems to reach no end.

This inverse relationship between precision and speed has been the pivotal point of this proposal of volleyball initiation. The difficulty of Fitts's task represents a margin of error. In volleyball, this margin is expressed through an inverse relationship with the relative net height (depending on the player's reach) and a direct relationship with the size of the target (Figure 1).

So, if a development of the precision is required, the margin of error will decrease through increasing the relative net height and reducing the size of the target. On the other hand, if it is speed we are aiming for, the margin of error must be increased, lowering the relative net height and expanding the target.

For obvious reasons, of all the research branches concerning this topic, the ones dealing with discrete and quick movements catch the focus of these authors. In this continuum, it is not the relationship between difficulty and total movement time that provides most information of quality, but the changes it infers in the movement pattern. The relevance that the resulting movement patterns must have in the learning process of the fundamental and specific skills in volleyball will be justified further on in the text.

A fast movement directed towards a specific target region implies a primary sub-movement and an optional secondary sub-movement that has the function of making corrections to the primary movement. To minimize the average total movement time as the speed increases, the sub-movements become more variable yet keep a high frequency of hits on the objective (Meyer, Abrams, Kornblum, Wright, & Keith Smith, 1988). However, if participants don't want to fail, or if the task reduces error to 0%, they try reducing variation in the trajectory and an increase in movement time (Murakami & Yamada, 2021).

Therefore, the movements with longer distances and shorter durations would result in a lower probability of hitting the target. On the contrary, shorter distances and longer durations would lead to higher precision and hitting the target, but with a slower movement time (Stewart, 2018).

Sleimen-Malkoun, Temprado, and Berton (2013) differentiated between acceleration time (AT) and deceleration time (DT) to identify pattern changes in a specific Fitts task. Adults aged between 23 and 28 were found to use different motor patterns to accommodate increasing levels of difficulty. After surpassing a transition threshold in the difficulty index (DI) - the discontinuity between DI and AT - there was a change in the organization of the movement adopted that was closely related to the abrupt change in the variability of the AT/DT ratio.

Perhaps, the most popular instruction in motor control, "perform with the maximum possible precision at the maximum possible speed", is a contradiction itself. That is why, in movements with more than one objective (speed and precision), a priority must be established, and the secondary objective must be partially given up in order to allow the main one (Izquierdo, Echeverría, & Morante, 2008).

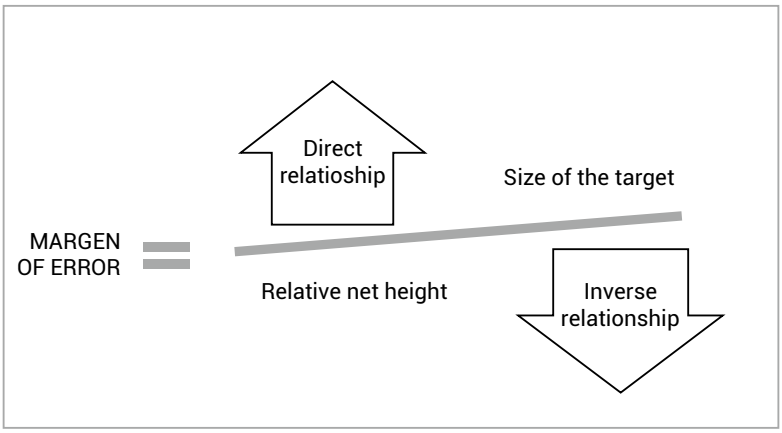

Figure 1. Variables influencing the margin of error for the relationship speed – precision in volleyball.

APPLICATION 4. The specific tasks, including adapted, small-sided and conditioned games, must identify the primary motor objective of the original specific skills and create the conditions of difficulty (margin of error) so that the players' responses develop from that objective (speed or precision).

Classification of the volleyball actions according to the motor objective

In sports and games characterized by the exchange of shots and receptions there is a clear differentiation between the actions of impulse and absorption of the ball. In volleyball, rules dictate that the ball is hit and, therefore, this differentiation is less clear in terms of handling the ball.

The principle of production/absorption of the impulse (Izquierdo et al., 2008) distinguishes between activities where large amounts of strength or speed are applied in a short time, versus those where it is necessary to absorb the intensity of the movement. Actions that require the highest jump, such as the spike, block, and jump spike serve all need impulsion to take-off and absorption for a safe landing.

When contacting the ball, some actions require the production of speed, such as the spike or the passes, and some others require absorbing the speed of the ball, such as the defense, the reception of a powerful serve or the block. A major dispute in the analysis of movement for volleyball is whether the contact surface, fingers or forearms, differentiates or matches the exchange actions between members of the same team. The first contact after the opponent action is dependent on the speed of the ball, not only due to the movement pattern, but also to the perceptive processes involved.

The distinction between impulsion and absorption is evident in the trajectory that needs to be given to the ball or the body, entirely or partially. These categories are equally affected by the speed-precision dimension (Figure 2), resulting in patterns of different effectiveness

The relationship precision – speed is considered a dimension (not a category), given that the transition threshold is variable and must be the domain responsible for the progression towards a higher skill.

APPLICATION 5. The specific tasks, including adapted, small-sided and conditioned games, must allow for the work of all four categories. Practitioners must learn to differentiate them. The progression towards a higher level of skill will take place considering the dichotomy impulsion – absorption and evolving through the continuum precision – speed.

Specific movement patterns to impulse the ball in volleyball

Kinetics account for how the two movement patterns differentiated by the task aim are effectively related to the impulsion of the ball. To apply the theoretical description of throwing and hitting patterns (Blazevich, 2011) to the characteristic actions of volleyball, we propose the scheme presented in Figure 3.

Examples of push patterns include those that are force-oriented (e.g., a rugby scrum) and those that are precision-oriented (e.g., a dart throw). In turn, examples of a throw pattern include the javelin throw. Often, learners' limitations in volleyball situations lead them to solve the task with less efficient patterns, which then become ingrained and a restriction on potential.

It is common to find young volleyball players applying a force-oriented push pattern when serving, spiking, or setting, and therefore compromising their prospects for developing speed or accuracy. This may occur because of the individual's particular motor deficiencies in the face of the game challenges, but can be exacerbated by the design of training tasks or by a coach's instructions (Goodway, Ozmun, & Gallahue, 2012).

In the case of setting, the overhead pass is preferred because of the human nature of performing high-precision skills using the wrists, hands, and fingers. Research has shown that the more challenging the mass of the ball, the greater the contribution of the large segments, especially those closest to the hip and spine, while in precision shots (if distance is not a major issue) larger muscles will make the outcome more difficult (Campos & Izquierdo, 2008).

Using an overhead pass to pass the ball far and high, so that it would be possible to spike, implies applying force; that is, more segments accelerating simultaneously towards the ball, more participation of the large muscles, and a

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greater travel acceleration of the whole body. Sensory perception anticipates a collision, and the mechanoreceptors generate a protection reflex where certain muscles contract and others are inhibited to protect the ligaments that are in danger. This response occurs at the spinal level and precedes the voluntary response (Lluch et al., 2015). Consequently, an involuntary pattern of force would be imposed, and any practice of a precision pattern would then be obstructed.

In a study that compared the biomechanics of the arms and wrists between two groups that differed in their skill at setting (Harrison, Keane, & Coglan, 2004), greater skill was found to be related to a shorter range of flexion and extension of the elbow and a deceleration in the final stretch of arm extension. This allowed an activation of the stretch-shortening cycle of the wrists. The relationship between this finding and the differentiation of the pattern from the acceleration and deceleration time depending on the difficulty of the task is interesting (Sleimen-Malkoun et al., 2013).

The use of official balls of an inappropriate weight, relative to the strength of the learning athletes, or trying to improve setting by practicing with heavier balls will only lead to the reinforcement of strength and ultimately lower expectations for accuracy.

A recent systematic review on the biomechanics of the spike confirmed the theory that "increased velocities are obtained through a specific proximal-distal order of the segments that begin with pelvic rotation and trunk flexion and end with elbow extension, shoulder internal rotation, and shoulder flexion when maximum angular velocities occur" (dos Santos Oliveira, Moura, Rodacki, Tilp y Okazaki, 2020, p.252).

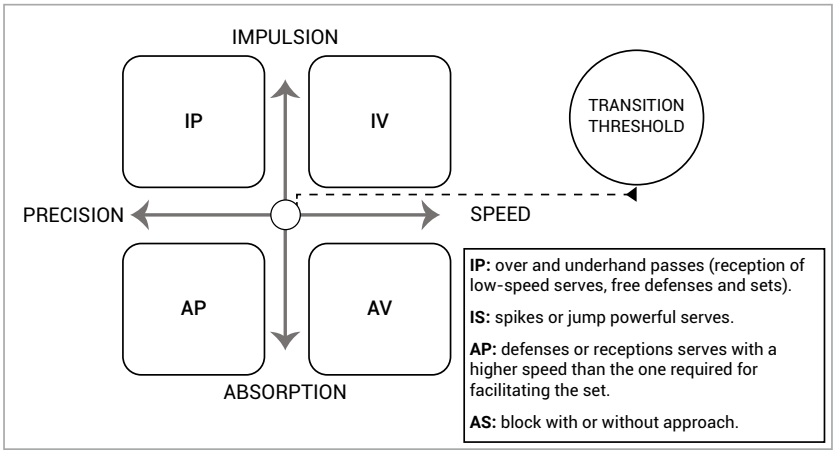

Figure 2. Matrix for the classification of the primary motor objectives in volleyball.
IP: Impulsion-Precision; IS: Impulsion-Speed; AP: Absorption-Precision; AS: Absorption-Speed.

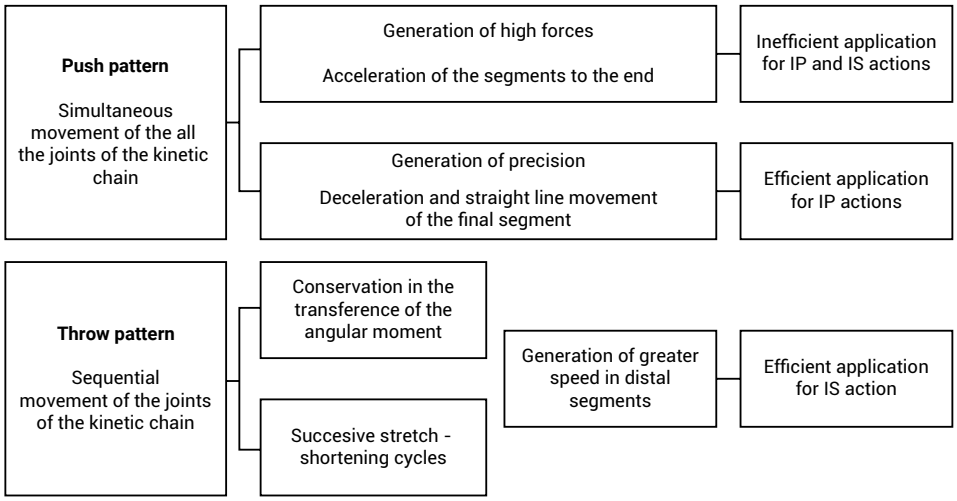

Figure 3. Efficient motor patterns for the impulsion of the ball in volleyball..
IP: Impulsion-Precision; IS: Impulsion-Speed (see Figure 2).

APPLICATION 6. Specific tasks that involve setting - including adapted, simplified, or conditioned games - should only allow the performer to choose the overhead pass when he/she can comfortably make an impulsion action using the wrists and fingers, which slows down the extension of all body segments towards the end of the push and allows for moderate arm travel. This can be done by bringing the target of the set sufficiently close and encouraging players not to go further than this target or practicing with heavier balls. Learning to set with the forearm pass is a necessity, even at the highest level, and can be done while allowing the overhead pass more time to progress.

According to Fitts's Law, individuals training the spike will have their motor control directed to a pattern of precision if the margin of error is not sufficiently widened. With practice, the learned pattern leads to a greater application of force, which consequently wastes resources and is a potential limitation.

A sequential or throwing pattern is advantageous, gaining kinetic efficiency with the development of force, the longer the length of the performer's body segments. In the generic part of the Dual-Con model, emphasis will be placed on this last factor (Goodway et al., 2012).

APPLICATION 7. Specific tasks that involve spiking - which include adapted, simplified, or conditioned games - should stimulate faster ball speeds, decrease the difficulty of the task by allowing for a greater margin of error (reducing the height of the net and expanding the target area), and not introduce instructions or elements that direct the practice towards precision. This approach should be maintained as long as required until it is confirmed that the boys and girls are successful at performing a throwing pattern.

Specific movement patterns to jump in volleyball

In volleyball, the varying conditions of the block create optimal jumping patterns quite different to one another. In all of them, the elastic component of muscles and tendons is of high relevance. Taking advantage of the elastic energy contributes to the power output of the jump through the stretch-shortening cycle (SSC).

Depending on the game situation, different block jump techniques allow different ways of using the elastic energy:

- Without movement: long SSC or countermovement.
- Small movement: short SSC or reactive.
- Large movement: long SSC added to the speed of the movement.

The spike requires long SSC combined with speed of the approach too. It is the basic skill for the Dual-Con. As we know, it is the most complex specific skill in volleyball. Thus, it is necessary to justify the steps the model will adopt in its regard.

The scientific research about high jumping with an approach shows from Dapena and Chung (1988) the positive contribution of the approach speed.

Horizontal speed when jumping is positively correlated with the jump height, but vertical speed associates negatively (Gutiérrez-Dávila, Giles, Gutiérrez-Cruz, Garrido, & Rojas, 2014). Approaches with a small vertical step, previous to the proper jump, present worse results than those with a long and more horizontal step (Harrison et al., 2004). The length of the impulse step (antepenultimate to penultimate step) and horizontal speed have both shown to be predictors of spike jump height (Harrison et al., 2004), and are related to other explanatory variables such as the reared position of the center of mass in relation to the step (Dapena & Chung, 1988).

The length of the antepenultimate to penultimate step is a very complex variable because it should be combined with the best use of the stretch-shortening cycle (SSC). The braking of momentum occurs in this penultimate stride, with the relationship between this braking step and the final step being decisive. In this sense, another inefficient pattern occurs when the penultimate step transfers the horizontal speed to the final step (Fuchs et al., 2019), thus applying a lower pushing activity of the braking leg. A stereotyped learning of the spike run-up can lead to inefficient patterns, such as approaching the driving step from a prior vertical flight.

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APLICACIÓN 8. The specific tasks about spiking, including adapted, small-sided and conditioned games, will avoid stereotyped spike approaches or the spatial references for the different steps of the approach.

The best use of the SSC can be achieved by reducing the time of the eccentric phase (flexion of ankles, knees, and hips), for neurostimulation of the Golgi apparatus, and increasing the strength of the concentric phase (extension of the joint chain) (Slovák et al., 2022).

However, a fast approach with a long and horizontal penultimate step, delaying the center of mass, supposes a high eccentric tension that increases the step time in its eccentric phase. There is a time limit to bear load during the eccentric phase and if this is exceeded a protective reflex is activated and the energy of the eccentric phase cannot be used for concentric pushing as it is absorbed. The amount of load that a person can tolerate within the SSC during the eccentric phase depends on individual motor performance (Goranovic, Petkovic, Hadzic, & Joksimovic, 2022).

Demanding running speed and/or a long penultimate step, exceeding the individual capacity of tolerance of eccentric force, will inevitably transfer the horizontal speed to the forward leg, generating another inefficient habitual pattern.

The development of general strength, its application to countermovement jumps, and plyometric training are essential adjuncts to the margin of improvement in jump height. The speed and distance of the run-up should be progressively stimulated as this attribute progresses.

APPLICATION 9. There will be no direct impact on the speed of the spike approach, but as the eccentric tolerance capacity improves, it will be challenged with tasks that require higher spikes and greater starting distances. Until that moment, serious and adequate training of strength and general jumps will be promoted, progressing towards the best use of the SSC.

The final arrangement of the feet in the impulsion is related to the hand that strikes the ball. As described, the sequence of rotations from the pelvis improves the final speed of the spiking hand. This pattern is facilitated by an arrangement of the hip line that is oblique to the place of hit at take-off, with the side of the body of the striking hand behind. However, this body arrangement does not contribute to the height achieved.

Therefore, learning the spike jump separately from the hit can contribute to a pattern that is effective for the jump but limiting for the hit itself. Further, variability in the trajectory of the set demands continuous adjustments to the execution of the approach that will affect the whole of the action. These variations can alter the amplitude and the time of the steps and, therefore, condition the action of the arms, since these influence in an integrated way the approach for the jump and the optimal preparation of the trunk for the hit.

In another paradigmatic study on motor learning, Naylor and Briggs (1963) established a relationship between the number of parts that make up a task and the interrelationships among those parts (i.e., their organization). The spike corresponds to a skill made up of few parts but with high organization, as described above. Prior studies have shown that analytical learning for these types of skills, progressing from the parts of the movement, was less effective than global learning. As far as the authors are aware, the research to date on transfer and practice strategy has failed to refute this relationship.

APPLICATION 10. The spike will be practiced in tasks that comprehend the whole execution, always with moving balls. Only when the skill is well automated is recommended the analytic learning.

While the sequence of steps for the spike does not influence the jump, it can affect the block. As described, specialization of the spike sequence depends on the dominant hand and usually appears in the game long before the use of blocking techniques with cross displacement. The approach pattern for this blocking technique uses the antepenultimate step to accelerate the body and the penultimate step to apply force with the long, fast step that has been described

for the spike. The specialization of one leg to accelerate the body and the other to drive in the spike can affect the bilateral knowledge required by the game for this moving technique applied to the block (Mercado-Palomino, Aragón-Royón, Richards, Benítez, & Ureña Espa, 2021).

On the other hand, in certain attack situations, a more horizontal flight has some advantages over the opponent block and is facilitated by a pattern of momentum on one leg. Although this movement is applied deliberately in the spike strategy, forced situations for spikers and blockers are effectively resolved when a one-foot impulse pattern emerges spontaneously.

For both the block and the spike, the jump in volleyball has an extraordinary need for variability and its technical model should not be shut down to stereotyped forms or to specialize the athletes in unique patterns according to their playing position. The motor richness of the jump, which the players will have accumulated in their motor experiences since childhood, will be different to those who have learned to jump in a way that is specific to a technical model.

APPLICATION 11. In the generic section of the Dual-Con, the training of the jumps, besides seeking the acquisition of efficient muscle and tendon stretch-shortening mechanics, will try to widen the motor development of this fundamental skill in children. In order to do so, open and diverse challenges will be necessary, promoting a variable and adaptive response.

If Fitts played volleyball: a flying ball!

It is necessary to consider a variable of particular importance in practice: the ball is in motion when hit. The more inexperienced the practitioners are, the more unpredictable the movement. Coincidence-anticipation, or interceptive action, involves cognitive processes that allow players to predict an encounter with the ball at a point of interest. In these actions, the player calculates the time required for the movement (effector anticipation) and the time for the object to reach that point (receptor anticipation) (McMorris, 2014). The first exposures to the challenge of spiking are very demanding on this ability.

Furthermore, many boys and girls who start playing volleyball do so with little experience of games that involve the exchange of balls, or other mobiles, which can have a variety of challenges for motor development. This is linked to the current urban and digital culture, but it is not properly compensated for by sports due to a tendency for sports specialization from an early age. This issue is another important aspect of the Dual-Con model.

If this low performance is associated with unstable setting trajectories, we go back to the Fitts's Law statement on task difficulty. The influence of this variable is so great that in most studies about the biomechanics of the spike the ball is either not moving or thrown by an expert to give it a stable trajectory (Goranovic et al., 2022). However, in reality, trajectories will be variable and the demand of the coincidence-anticipation process noticeably affects the outcome of the spike and increases its difficulty.

If the difficulty of the Fitts's task is expressed inversely with the amplitude of the target, and directly with the distance, the coincidence-anticipation multiplies the value of the distance. As such, the margin of error would have to be even greater to maintain a speed pattern.

As we have seen, an ample and fast approach requires that strength is applied effectively to SSC, which takes time to develop. Additionally, increased distance makes it more difficult to spike. Therefore, increasing strength and efficiency in obtaining elastic energy, and intensively stimulating improvement in the anticipation of interceptive actions, are two variables that, in parallel, should allow the spike to progress along the speed-precision continuum (Figure 4).

APPLICATION 12. For both the generic and specific parts of the Dual-Con model, emphasis will be placed on enriching coordination experiences with balls and other mobiles. If the specific task does not favor a throw pattern neither the height of the net nor the distance of the spike approach will be increased, and the valid area where the spike can be directed will be expanded.

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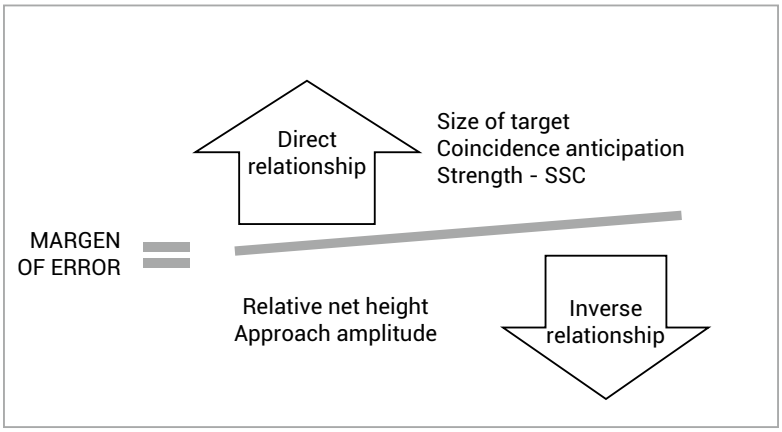

Figure 4. Variables of the margin of error that affect the spike speed..

The domain precision – control

By the logic that follows from the development of the itinerary on the speed – precision domain, time will be the key to change. The underlying goal is to give participants enough time to execute successfully and to extend the timing of action for motor patterns that promote precision. Following Fitts's logic, the games will be made less difficult by raising the net and reducing the court area permitted.

However, due to these constraints there is also an opportunity for tactical learning based on decision-making. In this way, the domain of growth in this itinerary will not result from changes in difficulty, but rather in complexity. Precision will evolve from growing demands for situational control.

The organic origin of the *General Systems Theory* (Von Bertalanffy, 1976) and its principles have enabled the dynamic systems perspective to apply Bernstein's concept of degrees of freedom (Bongaardt & Meijer, 2000), originally for the coordination of body segments and their synergies, to interindividual systems. Duarte, Araujo, Vanda, and Davids (2012) compare a team to a super organism as an analogy to represent the integration of systems into subsystems and supra-systems through their interactions.

Synergies, as indicators of self-regulation within a sports team, are a key principle of open systems (Ribeiro et al., 2020). Araújo and Davids (2016) proposed that synergy mechanisms can be understood through four key system properties: dimensional compression, reciprocal compensation, interpersonal coordination, and degeneracy. The general conditions of the games in this itinerary provide an opportunity, above all, for the enrichment of synergistic behaviors.

Level I of control

The itinerary of the domain precision – control in the Dual-Con starts with a competitive relationship of 1 vs 1. The match itself, with its conditioned rules and space, links primarily the sub system "player" with the supra system "team vs team". We will deal with the degrees of liberty of the system "team", assuming that all degrees of liberty of each component of the team for each response is integrated in it. Taking the risk of oversimplification, we could talk about one degree of liberty for each participant.

At the tactical level, the non-negotiable objective of scoring points will not favor appropriate precision motor patterns. The constraints of smaller courts and a higher net do not support speed patterns either (Figure 5). Nonetheless, it is relevant for the authors that the principle of opposition governs the progressive complexity of the whole process. The authors interpret that the mechanisms of synergy and reciprocal co-determination of General Systems Theory emerge if the final objective of the action remains hierarchically superior during the game action. However, the proposal ends up with a high level of determinism and a low level of complexity.

Level II of control

The second level of the itinerary for the domain precision – control deals with the relationship between teammates and against opponents through playing 2 vs 2. It would entail two degrees of liberty of the system "team", represented by two possible sequences (defense – attack or set) depending on who performs the first contact. This new situation allows stimulating the property for the synergy of interpersonal connections (Araújo & Davids, 2016).

In the property of reciprocal co-determination, Von Bertalanffy (1976) recognized a tendency to repeat working patterns. Volleyball, from this primary level of collective organization, tends to establish pre-assigned functions that facilitate problem-solving. However, the hierarchical principle of opposition and the lack of precision of the participants will often lead to a collapse of the pre-assigned sequence.

In this case, the game provides adaptive richness through the search for solutions to the disruption of the planned order and provides an opportunity for action for reciprocal compensation. In other words, if one member of the team does not fulfill their function then the other members must change their contributions so that the aims of the task are still achieved (Araújo & Davids, 2016). Exercises that are facilitated and controlled to reproduce ideal sequences do not favor this emerging quality.

In addition, exposure to task switching - that is, action monitoring, inhibiting planned actions, and switching to new actions - requires training of the attentional executive network (model by Posner and Petersen, 1990) for a meaningful increase in the neural plasticity of children (Juárez Ramos & Fuentes Canosa, 2018).

At this level, the game relaxes its deterministic condition (although the level of complexity is still far from the final goal of the Dual-Con model).

At this level, teammates are allowed to pass between themselves to commit to the push pattern, including deceleration for precision (IP), presenting an ideal moment at level II for the speed itinerary to coincide temporarily (Figure 5). The action of passing the ball to the other court does not yet present an opportunity to link to any efficient pattern of speed or accuracy.

APPLICATION 13. The cooperative variants in the precision-control itinerary will be relegated to a secondary position that is subordinated and incomparable in volume to those of the real (competitive) reference game. It must be clear to learners that the objective of maintaining the circulation of the ball and participants is procedural and focused on enhancing the subsequent competitive response. The coach will consider the proactivity of the opposition action in the game and then aim to achieve surprise with responses from outside the standard sequence.

Level III of control

At the third level of the precision-control itinerary the team is extended to three members and three degrees of freedom. Because two players then share the function of receiving the first contact, this implies adding more conflict to the principle of cooperation. At the previous level, the scenario of a ball being defended near the net creates the possibility of a change in task, and this is maintained at this third level. Additionally, a flawed execution of the first contact could suggest a change of role between the person close to the net (setter) and the other person in the defensive function.

This provides the opportunity for a more stochastic and more complex game development if functional assignment approaches are not rigid. The need to pursue a pattern of precision in the second contact (setting), contrary to what it might seem, allows for a relaxation of tactical organizational rigidity. If the person best placed to decelerate the second contact on the court assumes that action, then defenders and setters will be encouraged to change roles during the game.

Tactical rigidity, the practice of isolated sequences, or starting the game with balls provided by the coach perpetuates the natural tendency of the system to repeat patterns. In terms of human attentional systems, this will have the effect of directing the orienting network to a predetermined functional sequence. Alternating attention is a solution for immediate recognition of a deficient or unusual situation, although if

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this is not sufficiently activated when the teammate makes contact the surprise of the change in situation could activate the alerting system and impose a high cost in response time.

Moreno, Claver, and Jiménez (2014) propose to improve the attentional capacity of the players as a strategy of intervention for their emotional and cognitive development. The approach of the Dual-Con, in this level, promotes the adaptation of the conducts to contexts of emergency, which, as has already been justified, boosts the attention and the attentional executive net.

APPLICATION 14. Training will lead to the second contact being made by the player with the best situational conditions to execute accurately. Changing the players who start in a position to set to an attacking role will be considered. Likewise, players who start as attackers can, when the game allows it, change to a setting role.

In the itinerary for the precision-control domain, the time dedicated to games with smaller court sizes and a higher net has allowed for adaptability in action when faced with increasingly complex situations, enhancing the stimulation of cognitive resources, and without changing the underlying focus on the most basic principles of the game: opposition and cooperation.

The role of cooperative games

As anticipated, the games and activities taken by the Dual-Con model for this domain are a close reference to the work of (Santos et al., 1996). Within the proposed activities the authors include competitive games and their cooperative counterparts. These have the same desired sequence as the competitive form, but the opponents cooperate to keep the ball in repeated circulation. While we acknowledge that such games have their usefulness within the domain, from the perspective of the Dual-Con model it is necessary to highlight a series of limitations.

1. They do not promote the principle of cooperation. As explained, the competencies of cooperation are intrinsic to the direct requirements generated by situations of opposition.
2. Repeatedly facilitating the optimal course of the ball and the players intervening is not game-specific; it even interferes with intrinsic cognitive mechanisms, as justified in level II and III of control.
3. They are hugely valuable as standard self-assessment tasks for the players to evaluate their skill of passing with precision under physical, cognitive or volitional fatigue.
4. They are extremely adjustable regarding the flow and addition of team components, thus being appealing and challenging.
5. They should be clearly regarded as a means, not an end in itself, playing its role in each level, after having experienced the competitive variant sufficiently.

Recap of the model for the specific learning

In order to enlarge the motor knowledge, efficient movement patterns have been presented, but the abilities of the young players in this initiative stage represent a challenge when it comes to teaching volleyball. That is why a double progression of games is proposed, which starts from the highest chance of action for speed, in one itinerary, and for precision, in the other. How fast or slow we progress will depend on how consolidated the efficient movement patterns are, represented through different games that should allow their convergence at the end of the process in the official mini-volleyball game.

The condition for an efficient precision motor pattern remains with a one-dimensional relationship in the precision-control domain and is only directed at passes between teammates. However, the conditions of the task throughout the itinerary allow for progression towards a growing demand in decision-making for problem-solving. If difficulty has motivated the evolution in the speed – precision itinerary, then complexity has governed the possibilities of action in the precision-control itinerary.

The itineraries of both domains are used simultaneously in the Dual-Con model, either by alternating between classes/training sessions that are dedicated to each, or by alternating games from each domain within the same session. Acknowledging the benefits of free play (Côté & Erickson, 2015; Renshaw & Moy, 2018), described below, there will also be sessions

where participants can choose between the speed-precision or precision-control domains and decide the rules of the game themselves without intervention from the coach.

The reference games will adjust their rules, number of players, court size and net height so they can consider the motor objectives to work on according to the progress of the participants.

A summary of the fundamental rules of the game for each group of preferential motor patterns is presented in table 1.

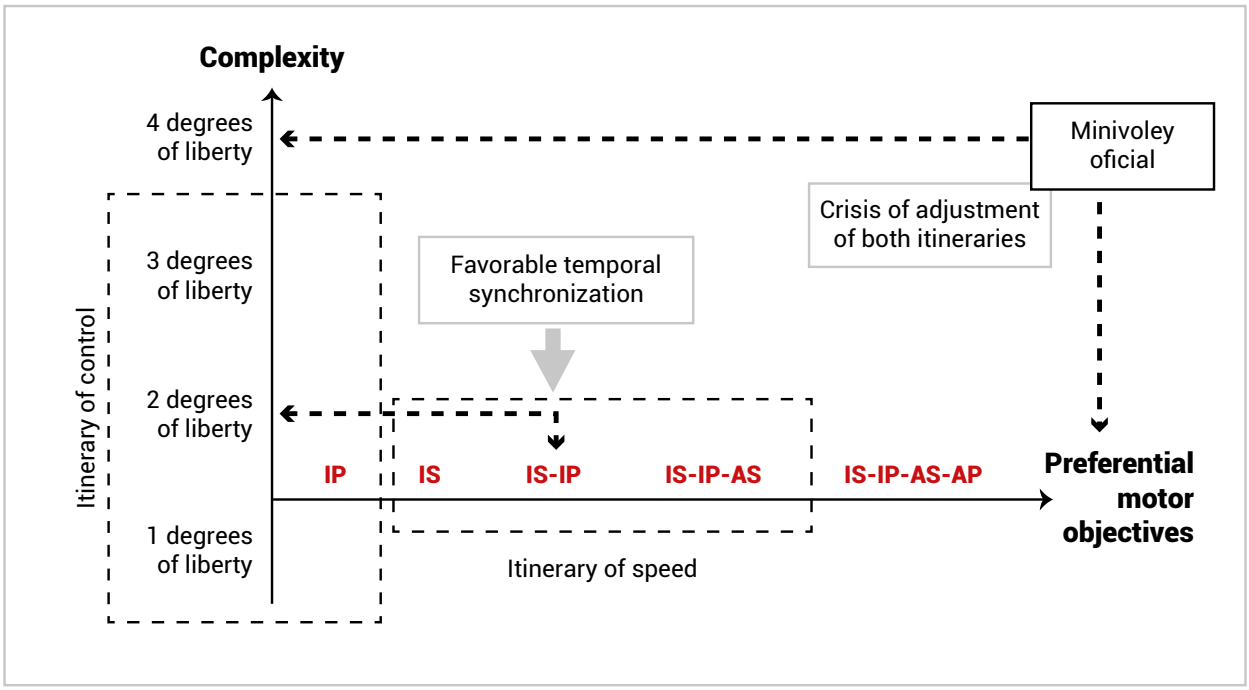

Figure 5. Esquema de la secuencia de juegos adaptados del modelo dual convergente para la iniciación en voleibol.

Table 1. Características de los juegos de referencia del Dual-Con.

Control I	1 vs 1 with enough execution time to facilitate the continuity of actions with a high net. We should promote the correct selection of type of pass for every situation. The tasks of cooperating opposition are relevant in this level in order to compensate the low chance of action of this pattern during the real game.
Control II	2 vs 2. The change of roles (from setter to attacker) is encouraged when necessary. It must coincide with games of Speed II, seeking a motor pattern of precision when passing the ball to the teammates. The tasks of cooperating opposition are relevant in this level in order to challenge and promote the precision under physical effort conditions.
Control III	3 vs 3. The conflict between defenders and receivers is added. The help from the player in best conditions for the set to be performed with a precision pattern must be encouraged. Points scored with innovative solutions must be overvalued. We ought to consider lowering the net height to hinder the precision, and in doing so allow for actions that require absorption to appear. Make sure the efficient precision pattern is carried out.
Velocidad I	Spike after throw of a teammate. One bounce is allowed before catching the ball and going to the net to throw the ball off towards the spiker. The net is lowered and the court size increased so that everyone can smash the ball. The allowed target areas can be adjusted for advanced spikers.
Velocidad II	Self-thrown overhand pass substitutes the throw. A precision pattern is promoted for the overhand pass. This level should coincide in time with the level of control II.
Velocidad III	The bounce of the ball is not allowed, but after the defense it can be caught and thrown to the setter (with variants that facilitate a pattern of precision in the setter). The net height should be constantly revised representing a permanent challenge for the spike, in terms of hitting the ball in the highest point posible without hindering the speed of the hit.

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Learn playing

Usefulness of the free play and non-structured activities in sport initiation

Playing is of high relevance for the development of the child (Piaget, 1972), and is an excellent resource in the teaching and learning process in the initiation to sport.

But not only the deliberate or structured game is useful in this process, but also the free and unstructured play (i.e. playground games) can have an important value. In this regard, Kessel (2012), among some methodological aspects to keep in mind in sport initiation, highlights the relevance of using the game in the teaching – learning process, as well as promoting what he calls "street" volleyball. The free play is the first step, regarding the organization of the practice, and is considered a fun and non-controlled or instructed activity, where the participants focus only on the process, getting pleasure from practicing it (Côté & Hay, 2002), and guaranteeing their intrinsic motivation (Renshaw & Moy, 2018), otherwise being free to stop doing it.

This kind of games, especially when played with older participants and a competitive nature, might be very formative (Cooper, 2010; Renshaw & Chappell, 2010). Some of its pros are: maximum practice time, freedom of the player in terms of what and how to do it, possibility of different actions and making mistakes (Renshaw & Moy, 2018), promotes the innovation, creativity, adaptability and flexibility (Côté & Erickson, 2015). Particularly in volleyball, the study by Coutinho, Mesquita, Davids, Fonseca, and Côté (2016) revealed the contribution to the physical, technical, tactical, cognitive and motivational improvement of this type of play. The cited authors emphasize how different kinds of practice, structured and non-structured, can affect positively the sports career.

Along these lines, Moreno et al. (2014) propose it as one of the intervention strategies for the emotional and cognitive development of sports players.

Small-sided, adapted, modified games or deliberate practice in sport initiation

Results from prior experiences and research, with a genera focus on sport initiation, allow us to observe the existence of different learning models or approaches, or models of development in sport, with a relevant contribution, that use primarily small-sided games or deliberate practice.

The Constraint-Led Approach (CLA) (Davids & Araújo, 2005), based on the ecological perspective and the theory of the dynamic systems, revolve around the manipulation of constraints as a way of facilitating the coupling between perception and action. Newell (1986) defines the constraints as limitations of the features or aspects that condition the movement, meaning demands set upon the action and generate the emergence of motor behaviors. Such constraints can adopt three forms: organic, environmental or of the task. The proposal of this model is in line with the assumptions of the non-linear pedagogy that, as pointed out by Chow, Davids, Button, and Renshaw (2015), is considered useful for improving the learning of the tactical behavior in team sports.

APPLICATION 15. The Dual-Con proposes to leave freedom to the participants some days to play speed or precision games, being themselves who decide upon the rules and competition system. Those days, the coaches will play a role of controlling the group, refereeing or even participate in the games, but will not give instructions or condition the games.

For its part, the *Teaching Games for Understanding* model was developed in the educational context with the specific intention of being applied in Physical Education (Bunker & Thorpe, 1982). This model posits that an understanding and appreciation of the game, as well as tactical knowledge, should be acquired before the technical mastery. It is, therefore, an approach that aims to promote tactical understanding using simplified games as a fundamental resource. According to Thorpe, Bunker, and Almond (1986), these types of simplified games have tactical similarities with real-game scenarios that occur in the sport, meaning that players can gain an understanding of existing principles by participating in them.

McCarthy, Bergholz, and Bartlett (2016) have defined the re-design of sport for young people and, although the adaptation of game elements is not something new, the sources of inspiration for their proposal and the recommendations for its implementation are interesting. These

authors draw on: systemic thinking, the influence of choice on behavior from economic theory, adapted sports, the relevance of making universal designs, the historical dynamics of innovations for sports at the competitive level, the ad hoc adaptations that children continuously make on the playing field, inventiveness through discovery, and video game designs.

It is common for the proposals of adapted games to state aims and justify their choice of adaptation variables, although it is less common for the impact of these adaptations to be evaluated. To do so, McCarthy et al. (2016) recommended being close to the action, observing and taking note of the results, taking time to reflect on these results, and listening to coaches and participants through observation, recounting, and questioning.

A systematic review about small-sided games (considering several perspectives and learning and pedagogic models) as a methodological resource to teach team sports in under 18-year-old teenagers (Fernández-Espínola, Abad Robles, & Giménez Fuentes-Guerra, 2020) proved such small-sided games as optimal to teach team sports at that age. Along the same lines, a meta-analysis on the assessment of the effect of small-sided games programs in technical performance and tactical behaviors in an under 18-year-old sample (Clemente et al., 2021) showed a positive effect of this kind of games on technical enhancement.

Prior to this, the *Developmental Model of Sport Participation* (Côté, 1999; Côté & Hay, 2002) had highlighted the value of this type of game. In this model, for development trajectories in recreational sports participation or elite performance, fundamental importance is attached to the use of deliberate play, particularly in the period of diversification (from age 6 to 12 years). Likewise, research has shown that participation in this type of game contributes to tactical creativity in team sports (Memmert, Baker, & Bertsch, 2010).

Motivation in sport initiation

A primordial objective in sport initiation should be to achieve the motivation and adherence of the children. Santos et al. (1996) make a specific reference in this regard.

In this sense, the Self-Determination Theory can explain the factors that promote desirable or undesirable levels of motivation (Deci & Ryan, 1985). Among other issues, intrinsic motivation, which implies a person's voluntary participation in an activity for the motivation and well-being that it entails, is considered the highest level of self-determination. As such, building a solid foundation of intrinsic motivation for pleasurable and fun participation in sport is critical to being highly motivated, self-determined, and committed to participation in sports in the future (Ryan & Deci, 2000). According to the Self-Determination Theory (Deci & Ryan, 1985), intrinsic motivation, which we consider to be desirable for initiation to volleyball, contributes to the satisfaction of the three innate psychological needs: competence, autonomy, and social relationships.

APPLICATION 16. In the Dual-Con model, during the initiation process (and mainly in the initial or diversification stages) priority will be given to the appropriate use of simplified adapted games or deliberate play to develop speed or precision and control. The passage from one game form to the next, and the conditions that these games have, will be decided through a shared evaluation of performance with the participants themselves. In this way, the hope is to take full advantage of the potential for learning, motivation, fun and creativity provided by such games.

The *Competitive Engineering Model* (Burton, Gillham, & Hammermeister, 2011) is also oriented towards self-determined intrinsic motivation and tries to find scientific evidence of the type of adaptations to children's sports games that encourage sport adherence. It establishes objectives for this purpose, such as increasing the number of actions and opportunities to score, establishing rotation systems that allow for extensive participation of all, keeping close scores and favoring positive relationships. In general, not only the Dual-Con model, but also the set of alternative proposals that make up the evolution of the games before six-player volleyball could be identified in a largely explicit way with these four objectives.

Other contributions from the theoretical field have been prescribed for the promotion of intrinsic motivation at young ages. Among them:

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a high use of unplanned games between the ages of 6 and 12 (Côté, Lidor, & Hackfort, 2009), participation in unstructured games (Ryan & Deci, 2000; Vallerand, 2001), and the practice of varied games to encourage diverse experiences (Claver, Jiménez, Gil-Arias, Moreno, & Moreno, 2017; Memmert et al., 2010). As described above, intrinsic motivation can also be promoted by providing opportunities for participants to freely choose - or participate in choosing - what they want to do, and how and when they want to do it (Renshaw & Moy, 2018). Indeed, a study grounded in Self-Determination Theory (Deci & Ryan, 1985) by Claver et al. (2017) showed that young volleyball players who experienced an intervention program, in which they were allowed to choose their activity and then questioned on tactical issues, improved in terms of satisfaction of their basic psychological needs for autonomy and competence, autonomous motivation, procedural knowledge, commitment to sport, as well as perceived performed.

It should be noted that intrinsic motivation encourages learning, exploration, novelty, challenge, and development of one's abilities, but also that experiences that maintain an intrinsic interest in practitioners are attractive for their novelty, challenge, or aesthetic value (Ryan & Deci, 2000).

APPLICATION 17. The tasks used in the Dual-Con feature the predominant usage of the game (both structured or deliberate or free), including variants, facilitating the participation of players in the decisions about the session, in order to contribute to the intrinsic motivation.

The challenge in sport initiation

Establishing an appropriate level when approaching the games or tasks, and promoting their personalization, is important for the success of the teaching-learning process. According to the *Flow Theory* (Csikszentmihalyi, 1975), obtaining a flow experience requires striking a balance between the challenge posed in the tasks and the personal skills of the practitioner, while also considering the influence of the context. This balance will be maintained by modifying and adapting the stakes or challenges to the development of the subject's skills. "Flow is a subjective state that people experience when they are fully involved in something to the point of forgetting about time, fatigue and everything else except the activity itself" (Csikszentmihalyi, 2009, p.183). Allowing for experiences of flow in sports initiation would be desirable. Indeed, this may be possible considering that play, creativity, ritual and other forms of structured practice are situations in which one might have such an experience (Csikszentmihalyi, 1975).

Therefore, not only an adequate level of challenge is required in adapted, small-sided or conditioned games, but also in other tasks that emerge during the sports career of the players, fit within the deliberate practice. According to this, the proposal of challenges out of the comfort zone is one of the main features of the deliberate practice (Ericsson & Pool, 2017).

As for the previous volleyball initiation proposals presented at the beginning of this work (Düerrwächter, 1974; Santos et al., 1996), it is also highlighted the importance of setting optimal challenges in the tasks.

APPLICATION 18. The different games and tasks used in the Dual-Con must be challenging for each participant, but also achievable, guaranteeing the learning and individualization of the process, favoring the intrinsic motivation in doing so. Linked to it, the double itinerary, control and speed, should allow the self-perception of progress, offering alternative methods for the perceived self-efficacy.

When playing is not enough

Dual-Con aligns with the value provided by the fundamentals of CLA (Davids & Araújo, 2005). This means allowing time to practice and evolving the level of challenge so that learners engage with the motor goal of the tasks. This involves monitoring the appropriateness of the constraints for a positive interaction. Even so, skills for which learners depend on the declarative components of performance will be provided.

Reference authors on CLA (Renshaw et al., 2016) do not rule out the possibility of using complementary approaches that can provide other models.

In this regard, Goodway et al. (2012) make a broad summary of research results on motor development with a focus on the conditioning

factors that operate in the acquisition of motor efficiency. This work acknowledges the value of the role and knowledge of the teacher of the motor skill, and the contribution of the principles of learning.

Verbal cues are short, precise phrases that direct the performer's attention to key parts of a motor skill. Raisbeck and Diekfuss (2015) suggested that attention should be directed toward the general aspects of motor movement to reduce perceptions of workload. Moreover, they confirmed that a verbal cue for attentional focus was beneficial for immediate retention and speculated that practitioners could split up the number of keys they use as a mechanism for attentional efficacy (Raisbeck & Diekfuss, 2017).

Research findings (Lam, Maxwell, & Masters, 2009) have indicated that individuals practicing with metaphors had decreased explicit conscious processing, were more able to direct their attention toward other tasks and retained this ability better in later situations of competitive anxiety than those who learned using performance rules. Here, analogies were used as metaphors that represent a known movement that can be translated to a skill to be learned. "Teaching aids, such as instruction by analogies, which help novices to rely less on the declarative components of performance, can stimulate attention-control structures similar to those of experts" (Koedijker at al., 2011, p.11), although in executions with high-speed demands differences were observed between experts and novices.

APPLICATION 19. The game resources and various tasks will be made available so that children can identify and engage with the primary motor objective. Time will be given for the emergence of the desired motor patterns in an implicit and procedural way, especially the spike because of its high demand for speed of execution. If, after some time, there are individuals that continue to struggle after the manipulation of the task conditions, we will proceed to train the specific skill using a teaching method that maintains global integrity, directs attention towards a small number of principles in the model, and uses metaphor or analogy.

Much more than volleyball

In the sections where the game design is justified in relation to the motor objectives and movement patterns of volleyball, explicit reference was made to a necessary generic treatment to complement the specific proposals. Beyond the basics for the proper movement in volleyball, the Dual-Con model also considers other criteria. The principles and models of reference authors that support this necessary generic extension of the initiation program are presented schematically.

Bompa (2000), an authority in the field of theory and practice of training in children, published the guidelines for a long-term training plan around the concept of multilateral development, pointing out the psychological, physical and performance expectation-related risks derived from early specialization.

The DMSP by (Côté, 1999) described several differences about the participation throughout the life stages of the young athletes and the roles of their families. In particular, one of these characteristics was a multi disciplinary sport initiation and a progressive journey when it comes to the ultimate choice of sport. This is in agreement with the proposal by (Bompa, 2000).

Shortly after, (Balyi & Hamilton, 2004) coined the term Long-Term Athlete Development Model (LTADM). They differentiated between sports that require and do not require an early specialization. Team sports do not require it.

Despite not focusing on the same study objectives, there are no discrepancies between the characteristics of the DMSP and the LTADM from 6 to 13 years old. However, for late specialization sports, the LTADM divided this period of age in two stage: the first, between 6 and 9 years old for boys and 6 and 8 years old for girls, and the second, between 9 and 12 years old for boys and 8 and 11 years old for girls.

Although the initiation proposal presented in this work is directed to this second stage practically, the relevance of the first stage of the LTADM not only resides in its current suitability, but it conditions the future potential of achievement.

The first stage must focus on the development of the fundamental motor skills, serving as basis of the future sport specific skills, the development

of the ABCs (agility, balance, coordination and speed) and the participation of a wide spectrum of sports. All of it within a fun and playful environment.

The second, involving the age groups from the proposed initiation model, should be aimed at increasing the development of fundamental motor skills and learning sports skills in general, maintaining a diverse practice of sports, the development of physical qualities with methods that are age-appropriate, especially speed, in combination with demands for speed, agility and changes of direction.

The relevance of the development of the fundamental skills before and during the period of introduction to the specific skills is argued and backed unequivocally by Wormhoudt, Savelsbergh, Teunissen, and Davids (2017), being based in considerations such as that the movement patterns seem to display universal principals and the influence of a perceptive transference upon which depend needs that are common to several contexts and applications of the motor abilities.

From this paradigm, scientific evidence has been updated and organized to propose the *Youth Physical Development Model* (YPD) (Lloyd & Oliver, 2012; Lloyd et al., 2015a, 2015b; Pichardo et al., 2018). The YPD, which emerged from the *Long-Term Athlete Development Model* (LTADM), offers a dimensional rather than a categorical approach within the critical "windows of opportunity" during developmental years, and further specifies the stimuli and their interactions. Both models are oriented toward the development of athleticism. This concept "refers to the ability to repeatedly perform a variety of movements that require competent levels of motor skills, strength, power, speed, agility, balance, coordination, and endurance" (Lloyd et al., 2016, p.1491).

The *Athletic Skills Model* (ASM), proposed by Wormhoudt et al. (2017), was specifically designed to address an apparent proliferation of early sports specialization and a decrease in the physical fitness of children. This model is also situated in the foundational approach of the LTADM and delves deeper into motor skills and their learning processes than the YPD. The Dual-Con model, like the ASM, is based on the search for optimal learning situations for the maximum expression of motor skills.

The three development models, LTADM, YPD and ASM, emphasize the use of the Peak Height Velocity (PHV) in reference to the biological maturation and maturational stage of the children (Mirwald, Baxter-Jones, Bailey, & Beunen, 2002).

The group of main contents of the program in distributed in a theoretical flow that contemplates a specific and a multilateral area throughout the process (Figure 6). Given its implementation is actually possible, the expected growth for the Dual-Con relies on a process of assessment of its contribution through the flow of "observing, telling and asking", proposed by McCarthy et al. (2016).

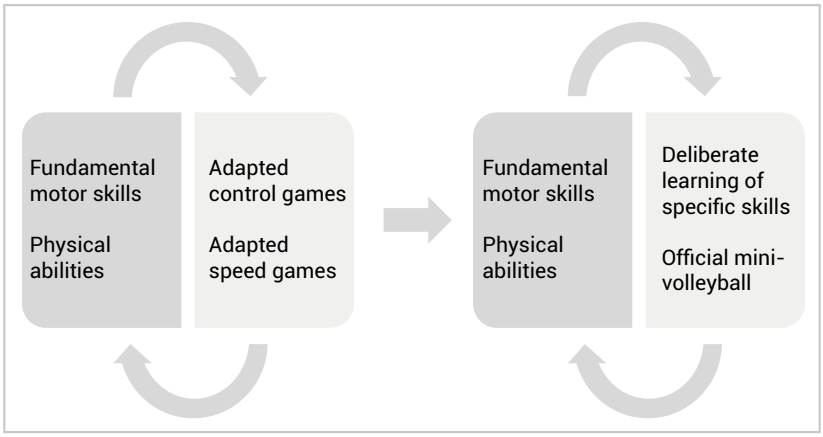

Figure 6. General diagram of the Dual Convergent Model for volleyball initiation.

APPLICATION 20. Between 50% and 60% of the total session duration will deal with multilaterality, through the training of physical abilities and the development of the fundamental motor skills, in a fun and playful environment. The commitment to avoid the risks of an early specialization and of the weakened exposure to physical activity in everyday life is shared with the long-term athlete development models. The choice of training factors will include the measurement of the PHV as a reference of the biological maturation of the children.

Conclusion

A proposal for the sport initiation in volleyball aimed for children under 12 years old is presented. At that age, 6 vs 6 volleyball is started. The Dual-Con is sensitive to the problems of early specialization and the tendency of a weakened motor competence in children, and aligns with the group of models that form part of the concept of "long-term development". A generic part with influence in the fundamental motor skills and the physical condition will have the same relevance and dedication that the part with volleyball-specific activities.

For volleyball initiation as such, a dual progression of adapted games is utilized. By themselves, these games are formally similar to several solutions previously proposed. Nevertheless, the whole of this strategy is based on a larger depth in the search for the development of the specific motor skills through the relationship speed – precision and a more systemic build-up of the game through the relationship precision – control.

During the process of several years of feedback between the theoretical construct and the practical experience for its design, the Dual-Con has benefited in its interdisciplinary spectrum, which intends to provide an added value to the numerous precedents of volleyball initiation. Thus, different theories from diverse scientific fields are integrated and applied in this proposal, such as the Deliberate Practice, the Constraint-Led Approach, Fitts's Law, the relationship complexity – task organization, the kinematics and kinetics of movement patterns, the motor development, the deliberate learning through keys and analogies, the Attentional Networks Model, the Self-Determination Theory, the intrinsic motivation, the Flow Theory, the Dynamical Systems Theory or the Long-Term Athlete Development Model.

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