

# EFFECT OF AN INTERVENTION TEACHING PROGRAM, BASED ON TGFU MODEL, ON THE COGNITIVE AND EXECUTION VARIABLES, IN THE PHYSICAL EDUCATION CONTEXT

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## ABSTRACT

The main of this study was to analyse the effect of an intervention program, based on the TGFU model, on the tactical behavior of secondary students in a unit of basketball. The study sample comprised of 46 students, with ages between 14 and 15 years, was divided into two groups (TGFU model group, n = 22, and instruction direct model group, n = 24). A unit of 9 sessions was applied, and the procedural knowledge, the technical execution and the tactical behavior of the students were measured in a real situation of game. The results showed students in TGFU model group displayed significantly higher procedural knowledge. Regarding the technical execution in isolation, significant differences were found in both groups after the intervention program in the three actions. In contrast, there were no significant differences in decision-making and execution in a real game situation in both groups. The findings show the effectiveness of comprehensive teaching programs of short duration (9 lessons) in educational context to achieve the improvement of procedural knowledge. We also highlight the importance to increase the duration these teaching programs to improve the decision-making and execution variables.

**Keywords:** Teaching Games for Understanding (TGFU), cognitive variables, execution

## EFECTO DE LA APLICACIÓN DE UN MODELO DE ENSEÑANZA TGFU SOBRE LAS VARIABLES COGNITIVAS Y DE EJECUCIÓN, EN LA EDUCACIÓN FÍSICA ESCOLAR

### RESUMEN

El propósito del presente estudio fue analizar el efecto de la aplicación de un modelo de enseñanza TGFU sobre el comportamiento táctico de los alumnos de educación física en la educación secundaria. La muestra estaba constituida por 46 alumnos, con edades comprendidas entre los 14 y 15 años, distribuidos dentro de dos grupos (TGFU model group, n=22 y direct instruction model group, n=24). Se aplicó una Unidad Didáctica de baloncesto de 9 sesiones y se midió el conocimiento procedimental, la ejecución técnica y la conducta táctica de los alumnos en una situación real de juego. Los resultados mostraron que los alumnos bajo el modelo TGFU alcanzaron un conocimiento procedimental significativamente mayor. En relación con la ejecución técnica en situación cerrada, se encontraron mejoras significativas en ambos grupos, tras el programa de intervención en cada una de las tres acciones analizadas. Por el contrario no hubo mejoras significativas en la toma de decisiones y en la ejecución en situación real de juego, en ambos grupos. Los resultados muestran la efectividad de los programas de enseñanza comprensiva de corta duración (9 sesiones) en el contexto educativo para conseguir mejoras en el conocimiento procedimental. También debemos resaltar la importancia de aumentar la duración de este tipo de programas para mejorar la toma de decisiones y la ejecución.

**Palabras clave:** Teaching Games for Understanding (TGFU), variables cognitivas, ejecución.

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## INTRODUCTION

The direct instruction model has prevailed for many years in Physical Education (PE) classes. In this model, the practice conditions are decontextualized, carrying out a technique approach in isolation. This makes it impossible to generalize practice to real game conditions (Light, Harvey, & Mouchet, 2014). Due to the lack of satisfaction that this technique-focused model has created in the education world, some alternative models have emerged, based on teaching games through comprehension (e.g., TGfU, developed by Bunker and Thorpe, 1982). These models integrate the technique approach into the tactic approach, always starting practice in a contextual situation and introducing technical aspects when necessary (Smith, Harvey, Savory, Fairclough, Kozub, & Kerr, 2014). Whereas in the traditional model, practice is divided into two phases: a first phase that focuses on learning and improving the technique, and a second phase that involves practice in a real game situation (Blomqvist et al., 2001), placing more emphasis on dominating the technique (Oslin & Mitchell, 2006: 627). In this regard, Bunker & Thorpe (1982) criticize the technical model, arguing that the majority of students obtain little knowledge about the intrinsic dynamics of the game during PE classes, resulting in a limited decision-making skill (for review, see Stolz & Pill, 2014) and a lack of creativity and reflection on sport (Hopper, 2002).

In a collaboration-opposition sport, such as basketball, where there is constant uncertainty in the game environment, developing decision-making is considered to be vitally important (García-González, Moreno, Moreno, Iglesias, & Del Villar, 2009), as it is determined by knowledge stored in the memory (McPherson & Kernodle, 2007). Thus, the greater and more varied this knowledge, the better the anticipation and decision-making of the athletes will be, thus reaching higher game performance (Gréhaigne, Godbout, & Bouthier, 2001). To this effect, to develop tactical-decision-based and cognitive skills in sport, the greatest number of tactical experiences possible must be fostered and constructed (García-González, Moreno, Moreno, Gil, & Del Villar, 2013). Consequently, situations with a high decision-making component prevail over situations with a high behavioral component.

Griffin, Brooker & Patton (2005) point to the TGfU model as one of the most favorable methodologies to achieve this decision-making ability in athletes. The aim of this model, based on the pedagogical principles of modified game and questioning (Thorpe, Bunker, & Almond, 1986), is to understand the game through tactical knowledge (Gray & Sproule, 2011). Modified games permit adapting the original version of the sport, in terms of the dimensions of the playing area, the number of participants and the rules, etc. (Harvey, Cushion, & Massa-Gonzalez, 2010), providing the sport teaching process with variability and enabling students to increase the solutions to certain game problems

(Clemente, 2012). In addition, the fact that contents are always learnt in a real game tactical situation (Serra-Olivares, González-Villora, García-López, & Araújo, 2015), means that students perceive their learning experiences as significant and authentic, thus increasing their motivation (Kirk & McPhail, 2002). Méndez, Valero & Casey (2010) also observed that students who were subject to more analytical methodologies became frustrated because they did not reach the expected expertise.

On the other hand, another essential element of the TGfU model is questioning. Gréhaigne, Richard & Griffin (2005) indicate that it is a methodological resource that favors cognitive development, creating a critical and thoughtful attitude in athletes. This process requires teachers to throw questions at the students, instead of telling them the movements that they have to execute, so, as they understand the objective of the drill, they themselves can search for a solution to the motor problem raised (Vickers, 2007). In this sense, there are studies that, after a comprehensive teaching program involving the application of questioning, have obtained improvements in cognitive aspects (Broek, Boen, Claessens, Feys, & Ceux, 2011) and in execution aspects (García-González, Moreno, Gil, Moreno, & Del Villar, 2014).

In scientific literature, numerous studies have focused on the TGfU comprehensive teaching model (in badminton, French, Werner, Rink, Taylor, & Hussey, 1996; in tennis, McPherson & French, 1991), and on comparing them with more technical approaches (in field hockey, Turner & Martinek, 1992, 1995; in football, Mitchell, Griffin & Oslin, 1995; in basketball and hockey, Allison & Thorpe, 1997; in tennis, Robinson & Foran, 2011). After applying teaching with a technical emphasis and teaching with a tactical emphasis, these studies still present reasonable doubt about which could be the best proposal in this regards (French, Werner, Rink et al., 1996; French, Werner, Taylor, Hussey, & Jones, 1996; Mitchell, Griffin, & Oslin, 1995). Likewise, Kirk, Brooker & Braiuka (2003) and Velázquez (2011) compared the “effectiveness” of technical and comprehensive models in education, concluding that there are no significant learning differences between one model and the other, although the comprehensive model was superior in some aspects, such as motivation and comprehension of the game. Finally, and with reference to the technical execution in isolation of the game, the majority of the studies have found significant differences after the intervention program in both teaching models, technique and tactic approach (Psotta & Martín, 2011; Turner & Martinek, 1999). This shows, on the other hand, that these differences did not exist between the two models in the post-intervention measurement (Griffin, Oslin, & Mitchell, 1995; Mitchell et al, 1995; Turner & Martinek, 1992, 1999).

Therefore, this research study goes further into the study of the improvement of cognitive and execution aspects in sport teaching in the educational context, in order to establish more conclusive results.

### *Study purpose*

The purpose of this study was to analyze procedural knowledge, technical execution in isolation from the competitive performance environment, and decision-making and execution in a real game situation, in a basketball teaching unit (9 lessons) through two pedagogical models: direct instruction (Blomqvist et al., 2001) and the TGfU model (Bunker & Thorpe, 1982). The first hypothesis suggests that students who learn under the comprehensive teaching model (TGfU) will show a higher level of procedural knowledge than students who learn under the technical model. The second hypothesis supports that both groups will improve the technical execution of passing, dribbling and shooting. The third hypothesis suggests that students who learn under the comprehensive teaching model (TGfU) will take a larger number of right decisions in real game situations than students who learn under the technical model. And the fourth and final hypothesis maintains that comprehensive teaching model (TGfU) students will obtain a higher performance level in real game situations than technical model students.

## METHOD

### *Participants*

The sample consisted of 46 students, with ages varying between 14 and 15, who attended a secondary school in the province of Badajoz. The TGfU model group (3<sup>rd</sup> Secondary Education [ESO] C) consisted of 22 students (boys, n = 10; girls, n = 12), and the direct instruction model group (3<sup>rd</sup> Secondary Education [ESO] B) consisted of 24 students (boys, n = 12; girls, n = 12). All students were characterized by not having any experience at all in federal basketball or formal type basketball. All the research procedures received approval from the University of Extremadura Research Committee, head teachers and physical education teachers from the school involved. Informed consent was obtained from parents/guardians as well as from the children involved in the study, using approved University and school system protocols.

### *Variables*

The comprehensive teaching program was identified as the independent variable. The weekly TGfU and direct instruction lessons ran in parallel in each group. Both teaching programs were implemented for 9 lessons (2 per week), each of which lasted for 45 minutes of real practice.

For the direct instruction model, the teacher followed a traditional lesson structure outlined by Blomqvist et al. (2001), where an introductory activity was followed by a skills phase focusing on developing and improving the skill technique, and this then progressed into a game in the latter part of the lesson.

For the TGfU model, the teacher followed this structure: 1) introduction of the modified game; 2) modification of some structural elements of basketball (e.g., restricting the action of the defender to the interception of passes) and application of questioning related to tactical problems or elements of the game that need to be improved (e.g., in a 2 v 1, When do we have to pass the ball to our teammate and when do we have to dribble?); 3) real game situation without restrictions.

The characteristics of both programs are described below (see Table 1).

TABLE 1  
Characteristics of the drill design in both models – comprehensive and technical.

Drill characteristics	Direct instruction model	TGfU model
Groupings	- 1x0 / 1+1. - Passes directly to the real game situation of 5x5.	- Evolves in complexity, increasing the number of participants in the drill: from 2x1, 1x1, 3x2, 2x2, etc. - Evolves from situations of superiority in attack to situations of equality.
Drill design	Technique separated from tactic.	Technique integrated with tactic.
Model or solution	Ideal model previously presented or sought.	Not previously defined. Variable and based on context and individual.
Constraints or modifications.	In groupings or spaces.	Dimensions, time, execution technique, number of players, action level (nature of the game), motive, goal and objective of the drill.
Progression	Progressive introduction of the game.	From individual to group game depending on the complexity of the action. The group is favored.
Duration	Until gesture or action is improved.	Until optimal solutions are found or the game evolves depending on the need.
Information prior to the drill	Complete. The final objective is known.	Proposal of the drill, defining the practice parameters but not the aim of the practice.
Information during the drill	Referring to parameters that result from the model.	Questions about execution, game action and decision-making.
Feedback	Corrections and information based on things observed during the drill.	Directed by means of questioning but specific for the student.

### *Fidelity of intervention*

The same teacher delivered both programs – comprehensive and technical –, developing the same contents for students from both groups. This teacher had 10 years' experience teaching at a Secondary School, and he had specifically been trained in comprehensive models. Moreover, he had received more than 1,000 hours of supplementary teacher training. Even so, in order to guarantee that the model was applied correctly, prior to the intervention, the teacher designed the classes and these were supervised by an expert with more than 8 years' experience supervising teaching models. Finally, at the end of each class, the teacher analyzed his action and compared the class given with the designed class, taking note of possible unexpected events in a practice diary

### *Measuring instrument*

*Procedural knowledge evaluation questionnaire in basketball.* Procedural knowledge (about the game action) is the knowledge of how to act in the game context (McPherson & French, 1991). The questionnaire validated by Del Villar et al. (2004) was used to validate this. This questionnaire was an adaptation of the work carried out by McGee & Farrow (1987) on basketball. Both the validity and reliability of the instrument had already been proven in previous studies (Del Villar et al., 2004; Iglesias, Moreno, Santos-Rosa, Cervelló, & Del Villar, 2005).

*Technical execution test*, understood as the execution of a specific basketball skill, in a closed environment and isolated from the real game context. This variable was measured through execution tests of three specific skills that are highly representative of basketball: passing, bouncing and shooting:

*Pass speed against the wall*, defined by Blázquez (1992, p. 255) as “*Fast pass*”, whose aim is to measure the player's speed when passing and receiving a ball in a continuous manner. The time is recorded from the start signal until the individual finishes the 10 passes and receptions. This test has been carried out in several studies (Méndez, 2005), showing a reliability of .89.

*Ball dribbling speed*, defined as “*Dribbling*” (Blázquez, 1992, p. 260), whose objective is to measure the speed and skill of the individual when dribbling the ball and avoiding obstacles. The time is recorded from the start signal until the individual dribbles around 6 cones in zigzag, in both directions. This test has been carried out in several studies (Méndez, 2005), showing a reliability of .91.

*Effectiveness in shooting from a short distance*, defined by Méndez (2005, p. 94) as “*Throws under the hoop*”, measures the individual's skill to throw at the hoop and then catch the ball to throw it again under the hoop. The best of the two attempts is recorded and one point is scored for each goal during the 30

seconds the test lasts. This test has been carried out in several studies (Méndez, 2005), showing a reliability of .80.

*Systematic observation of decision-making and execution in real game situations.* Decision-making is defined as the response selection process, and execution as the final result of the motor execution. The instrument proposed by Méndez Giménez (2005), adapted from French & Thomas (1987) was used to observe both variables. All the passing and shooting actions of each one of the students was recorded. The decision-making component of the aforementioned instrument was used to evaluate decision-making, assigning a value of 1 to right decisions (e.g., for the shooting action: aiming at basket from inside or near the 6.25 meter area when open), and 0 to incorrect decisions (e.g., for the pass action: passing to a place on the court where there is no teammate). For the execution category, 1 was assigned to each successful execution (e.g., for the pass action: ball reaching an open teammate with adequate speed), and a 0 to each unsuccessful action (e.g., for the shooting action: screened shot). Finally, to measure both variables, the percentage of right decisions and the percentage of successful executions were taken and applied to the passing and shooting actions.

#### *Observer reliability*

An observer, with basketball knowledge and experience in observational methodology, was trained to analyze decision-making and execution of the passing and shooting actions. A sample of more than 10% of the total sample was used to train the observer. Cohen's kappa coefficient was used for the intra-observer reliability analysis, obtaining values of above .90 in the 4 training sessions. A value of .81 was exceeded, which is the minimum required to consider adequate concordance (Fleiss, Levi and Cho Paik, 2003), thus obtaining the necessary reliability for the subsequent dependent variable encoding. For the time reliability analysis of the measurement, the same encoding was carried out at two different moments, with a time difference of 10 days, obtaining Cohen's kappa values of over .85.

#### *Procedure*

A quasi-experimental design was used for both groups, establishing a total of 3 phases to develop the research.

- *Pre-treatment measure.* This phase lasted for 3 classes, when the procedural knowledge questionnaire was passed out, the technical execution tests were conducted and the matches were recorded in real game situation (3x3) for subsequent analysis of the decision-making and execution. In the 3x3 game situation, the teams were established in agreement with the score obtained in the execution tests so that the teams were balanced. The matches

lasted for 7 minutes. These measures permitted establishing an initial level prior to the intervention in all variables.

- *Application of the intervention program.* The program lasted for a total of 9 classes. The teaching program was applied between the pre- and post-measures. The program was comprehensive for one group and technical for the other. There were 2 weekly classes, each one lasting for 55 minutes.

- *Post-treatment measure.* The same procedure as in the pre-treatment measure was carried out in order to know the effect of applying the intervention programs. This also took place over a 3-day period. So, the same teams played against each other in the 3x3 game situation.

Below we give a table describing the sequencing of the classes that comprised the intervention program (see Table 2), whose common goal was to “initiate students in the basic regulatory and tactical-technical aspects of basketball”.

TABLE 2  
Characteristics of the drill design in both models – comprehensive and technical.

Class	Objectives	Contents
1	Raise awareness of the importance of control dribbling and passing.	Managing the ball and pivot technique. Bouncing: speed dribbling and control dribbling.
2	Raise awareness of the tactical importance of the pass.	Bouncing and controlling the ball. Pass: chest pass, bounce pass, lob pass and baseball pass
3	Raise awareness of the tactical importance of shooting and entering the basket.	Bouncing and controlling the ball. Shoot with and without opposition, Entry into basket.
4	Practice and know the basic defense guidelines, marking and opening.	Passing and bouncing. Defense: defensive position, defense of man with ball. Marking and opening.
5	Practice and know about opening and dribbling	Passing and bouncing. Shooting at basket and entry. Pivot. Dribbling, fake, reverse (attackers' options to create spaces).
6	Practice and know about opening and dribbling	Passing and bouncing. Shooting at basket and entry. Dribbling.
7	Practice and know about opening and dribbling.	Passing and bouncing. Shooting at basket and entry. Individual defense and in zone. Counterattack.
8	Practice and know about opening, faking and dribbling	Passing and bouncing. Shooting at basket and entry. Opening, Pass faking and receiving.
9	Know and practice offensive support actions.	Passing and bouncing. Shooting at basket and entry. Faking and dribbling. Picking/screening.

#### Data analyses

The SPSS 20.0 statistic program was used to analyze and process the data. Firstly, data normality was examined. The asymmetry measurements, Kurtosis



and Kolmogorov-Smirnov (for samples of over 30) with Lilliefors correction, verified that the sample distribution followed a normal distribution in the procedural knowledge variable and did not follow normal distribution in the other variables. Then, for the decision-making and execution variables, the descriptive statistics were calculated, obtaining the mean (M) and the standard deviation (SD). Afterwards, and to verify the existing differences between the pre-and post-measure in both groups, an inferential analysis was conducted for the procedural knowledge, by means of the t-test for related measures, and the Wilcoxon test for measures related to the Bonferroni correction for the other variables (significance level of .05).

## RESULTS

### *Procedural knowledge*

With respect to procedural knowledge, Table 3 shows the pairwise comparison between the two measures established in both groups. As observed, in experimental group 1 or comprehensive group, there are significant differences in procedural knowledge after the intervention program. However, these differences are not observed in experimental group 2, or technical group.

TABLE 3  
Descriptive statistics and analysis of differences of procedure knowledge for both groups between the two research phases.

Group	Pre-test	Post-test	t	Typical Error	Sig	Differences 95% CI	
	M ± SD	M ± SD				LL	UL
TGFU	.491 ± .171	.701 ± .129	-.209	.039	<.001	-.292	-.126
Direct instruction	.622 ± .169	.622 ± .170	-.00	.000	.364	-.000	.000

Notes. CI = confidence interval; LL = lower limit; UL = upper limit

### *Technical execution in isolation*

With reference to the technical execution measured in isolation, Table 4 shows the pairwise comparisons between the two measures in both groups. As observed, in the comprehensive model group (experimental group 1), significant differences are found in the 3 technical-tactical actions evaluated. Insofar as the technical model group is concerned (experimental group 2), these differences are found in the passing and dribbling actions. The same does not occur in the shooting actions.

TABLE 4  
Descriptive statistics and analysis of differences of technical execution in isolation for both groups between the two research phases.

Execution skills	Group	Pre-test	Post-test	Wilcoxon Z	Sig
		M ± SD	M ± DT		
Passing	TGfU	24.013 ± 18.915	14.090 ± 7.224	-3.165	<.001
	Direct instruction	16.944 ± 6.420	14.078 ± 3.802	-3.143	<.001
Dribbling	TGfU	12.798 ± 2.177	10.886 ± 1.437	-4.107	<.001
	Direct instruction	12.187 ± 2.147	11.395 ± 1.741	-3.943	<.001
Shooting	TGfU	2.956 ± 2.305	4.260 ± 2.666	-2.195	.028
	Direct instruction	3.708 ± 3.665	4.750 ± 3.082	-1.618	.106

#### *Decision-making in real game situation*

With regards to decision-making, Table 5 shows the pairwise comparison between the two measures in both groups. As observed, no significant differences are found in either of the groups or in any of the actions.

TABLE 5  
Descriptive statistics and analysis of differences of decision-making in real game situation for both groups between the two research phases.

Decision-making skills	Group	Pre-test	Post-test	Wilcoxon Z	Sig
		M ± SD	M ± SD		
Passing	TGfU	.781 ± .176	.665 ± .220	-1.530	.126
	Direct instruction	.675 ± .304	.737 ± .293	-.524	.601
Shooting	TGfU	.646 ± .288	.629 ± .384	-1.502	.586
	Direct instruction	.675 ± .304	.586 ± .340	-1.513	.130

#### *Execution in real game situation*

With regards to execution, Table 6 shows the pairwise comparison between the two measures in both groups. As observed, no significant differences are found in either of the groups or in any of the actions.

TABLE 6  
Descriptive statistics and analysis of differences of execution in real game situation for both groups between the two research phases.

Execution skills	Group	Pre-test	Post-test	Wilcoxon Z	Sig
		M ± SD	M ± SD		
Passing	TGfU	.716 ± .188	.608 ± .228	-1.502	.133
	Direct instruction	.525 ± .318	.730 ± .322	-1.774	.076
Shooting	TGfU	.416 ± .265	.421 ± .384	-.724	.469
	Direct instruction	.525 ± .534	.318 ± .367	.000	1.000

## DISCUSSION

The purpose of this study was to analyze procedural knowledge, technical execution in isolation from the competitive performance environment, and decision-making and execution in a real game situation, in a basketball teaching unit (9 lessons) using two pedagogical models: direct instruction (Blomqvist et al., 2001) and the TGfU model (Bunker & Thorpe, 1982). The results obtained with respect to the different hypotheses considered in the research will be discussed below.

### *Procedural knowledge*

The first study hypothesis established that students who learnt under the comprehensive teaching model (TGfU) would achieve a higher level of procedural knowledge than students learning under the technical model. The results obtained show significant differences in procedural knowledge after the intervention program in the group of students submitted to the comprehensive model. The same did not occur in the group of students who were taught under the technical model. Therefore, we can state that the first hypothesis was satisfied.

Our results show that the comprehensive teaching program applied has given rise to a significant improvement in the students' procedural knowledge. With these findings we can guarantee that these students have improved their cognitive expertise level, as they show they have a better understanding of the game and of its structure (Kirk, Brooker, & Braiuka, 2003; Velázquez, 2011). In this sense, the use of comprehensive methodologies seems to be adequate to improve students' tactical knowledge and acquire the basic principles of each sport.

Many research studies can be found in scientific literature, both in the education context and in a sport context, that are in line with the results obtained in our study (Griffin et al., 1995; Turner & Martinek, 1995, 1999), as significant differences in procedural knowledge can also be observed in these studies after applying a comprehensive teaching program. Likewise, and referring to questioning, there are studies such as the one by Broek et al. (2011) that obtained differences in the group of players that were trained with a comprehensive approach with the involvement of questions. In this study on volleyball, a greater improvement in tactical awareness was observed in these students when compared with students whose program did not include the application of questions. Thus, when a comprehensive teaching methodology is applied, the teacher must allow students to experience moments of cognitive dissonance by practicing games, and then reflect on that practice so that they can have a better knowledge of the essence of the game and of its basic tactical principles. This is the case because one of the basic pillars of the

comprehensive approach focuses on tactical comprehension and it is this capacity that represents one of the most relevant difficulties in the sport initiation process (Devís, 1996).

In this sense, the findings seem to indicate that the application of comprehensive methodologies based on the TGfU model, which involves designing drills based on manipulating the structural elements of basketball and applying questioning, is effective to improve procedure knowledge, and in short, the cognitive expertise of students.

#### *Technical execution in isolation*

The second study hypothesis suggested that both groups would improve the technical execution of passing, dribbling and shooting. The results obtained show that students taught under the comprehensive model experienced a significant improvement in “speed passes against the wall”, “dribbling” and “short distance shooting at basket” tests. On the other hand, students taught under the technical model also significantly improved, but only in two of the technical tests (passing and dribbling). Conversely, no improvement was observed in these students in the shooting at basket test after the intervention program. The results show that both teaching methodologies were effective in improving technical execution in closed situations, given that the students from both groups obtained significantly higher values after the intervention program. From this understanding, we can affirm that the second hypothesis is also satisfied.

On the other hand, there are authors such as Méndez (2005) who suggest that during the first sport initiation stages, practicing well-designed drills favors learning the technique, regardless of the teaching model used. This is because the most relevant aspect at basic teaching levels is the accumulation of technical execution practice hours, regardless of whether the student practices the execution model in isolation or whether they practice it through modified games, in real game situations.

Different studies in the educational context follow the line of the results found in this study. More specifically, in their study on football, Psotta & Martín (2011) obtained significant differences in the execution of passing and dribbling, in isolation, after a comprehensive teaching program. They also observed differences after applying the technical model, but only in the pass action. A possible explanation to these differences compared with our study, where differences were found in almost all the actions, could be the sport (basketball in our study and football in the study by Psotta & Martín). Today, football is probably the most popular sport in the world (Aguiar, Botelho, Lago, Maças, & Sampaio, 2012). This means that the level of students who start

playing a sport like football is much higher, meaning that the improvement range is smaller, above all when dealing with a small number of sessions.

On the other hand, there are studies that have verified that, after applying several teaching programs (technique approach and tactic or comprehensive approach), no significant differences were found between the two models (Griffin, Oslin, & Mitchell, 1995; Mitchell et al, 1995; Turner & Martinek, 1992, 1999). Therefore, it seems that when the aim is to improve skill execution in isolation, both teaching models appear to be effective. Although they take the motivating nature of each methodology into account, Chow, Renshaw, Button, Davids, & Tan, 2013 question the effectiveness of the traditional model to satisfy the basic psychological needs. In this line, Méndez et al. (2010) observed that students who were submitted to more analytical methodologies became frustrated because they did not reach the expected expertise. This may lead to them abandoning sport.

Therefore, and as both methodologies permit improving the execution of skills in isolation, we believe that using the comprehensive is preferable to using the technical model, as with this model, higher intrinsic motivation levels are reached (Jones, Marshall & Peter, 2010). This leads to greater motivation in PE classes and consequently, the wish to continue practicing sport is also greater (Deci & Ryan, 2000).

#### *Decision-making in real game situation*

The third hypothesis maintained that comprehensive teaching model (TGfU) students would take more right decisions in real game situations than technical model students. The results obtained did not show significant differences in decision-making in the passing or shooting actions, after the intervention program, in either of the two groups of students. Thus, the comprehensive teaching program has not been sufficiently effective to improve this variable. Therefore, this third hypothesis has not been satisfied.

The fact that higher significant results have not been obtained in decision-making after applying a comprehensive teaching model means that we should consider if the difficulty students encounter when they have to select the right answer in each of the game situations in which they participate, is due to the short time the teaching programs last in the education environment. In this regard, we can point out that some authors found no differences between groups, or even improvements throughout the treatments (Turner & Martinek, 1992; French, Werner, Rink et al., 1996), regardless of the number of sessions (studies between 6 and 12 sessions). Others did establish differences in favor of the comprehensive teaching model group, (Allison & Thorpe, 1997; French, Rink, Taylor et al., 1996; Griffin et al., 1995; Robinson & Foran, 2011, Turner & Martinek, 1995), but always after at least 12 teaching sessions. This may be

due, as MacMahon and McPherson (2009) point out, to the influence of knowledge in the different cognitive processes that determine decision-making, and the adaptations in memory that take place in the long term. Thus, these methodologies that focus on learning cognitive aspects may require a longer learning time.

Another aspect to be evaluated is that students lack the habit of reflecting on sport practice, which requires a learning period (Thomas, French, Thomas, & Gallagher, 1988). On this, we should probably adapt the questioning to the needs of each student and to each context, as this is a decisive factor to be able to favor optimal knowledge in students. Although we must recall that teaching via questions or questioning is an instruction method whereby the teacher asks the students questions for them to discover how to solve the motor problem raised by themselves (Vickers, 2007). In this regard, Webb & Pearson (2008) point out the need to apply effective questioning to favor cognitive development. This must have been planned in detail within the intervention program. In this sense, the comprehensive teaching program initially included an outline of the questions to be asked, but after analyzing the teacher's practice diary, it was observed that the same basic questions had to be repeated in many cases throughout practically the entire program. This leads us to believe that the decisions to be taken were very complicated for the sport initiation phase or the knowledge acquired was not effectively transferred to the decision to be taken in the real game context. In many cases, students answered the questions correctly but then their decisions and executions were not correct.

In this sense, more studies on the application of questioning in the education context will be required, especially to adapt the level of difficulty of the questions to the students' assimilation capacity, and in parallel to the decision-based demand of the drills that we set out in the motor practice, given that students need to develop their tactical comprehension capacity and their capacity to adopt correct decisions at the same time.

Therefore, a possible conclusion would be that for a comprehensive teaching program to obtain results in decision-making, longer teaching periods (e.g., one term) would be required. In this sense, more longitudinal studies are needed to go even further into this field of knowledge. We also believe that developing sport activities during recess, for example, may help improve cognitive aspects in students.

#### *Execution in real game situation*

Finally, the fourth hypothesis established that students of the comprehensive teaching model (TGfU) would obtain a higher performance level in real game situations than students using the technique approach. The results

obtained did not show any significant differences in performance after the intervention program in either of the two groups of students. Therefore, we cannot state that the application of the comprehensive teaching program would entail an improvement in this variable.

There are many studies in line with the results found in this work. Tuner and Martinek (1992), in their study on hockey, attributed the negative results obtained in this variable to the time the intervention program lasted. In this regard, only those studies where the intervention program lasted for more than 15 days, obtained improvements in performance in real game situations (French, Werner, Taylor et al., 1996; Turner & Martinek, 1995, 1999). These improvements were greater the longer the program lasted (McPherson & French, 1991; French, Werner, Rink et al., 1996). So, the duration of the intervention program is a decisive factor in the improvement of this variable. In our study, this could have been the reason for the lack of significant differences in such a short time.

In this study, the low initial technical level shown in the shooting and passing actions may have acted as a limiting factor, thus resulting in the lack of significant improvement in the game performance variable (Costa, Ferreira, Junqueira, Afonso, & Mesquita, 2011; Gutiérrez, González-Víllora, García-López, & Mitchell, 2011). Furthermore, during the intervention program, we did not focus on other determining factors of sport performance, such as physiological and emotional aspects (Janelle & Hillman, 2003; Phillips, Davids, Renshaw, & Portus, 2010).

Finally, we must analyze the relationship between cognitive variables and performance variables. There are different research studies in scientific literature that have found a clear and significant relationship between cognitive variables (procedural knowledge and decision-making), and performance variables (Del Villar, García-González, Iglesias, Moreno, & Cervelló, 2007; Griffin et al., 1995; Gutiérrez et al., 2011). The results obtained show that, in the group of students subject to the comprehensive approach, there was a significant improvement in knowledge and in technical execution, but the short time the program lasted in the education context prevented an improvement in decision-making. This has made it almost impossible to improve performance in real game situations, as other previous studies had already established.

From this understanding, the relationship between cognitive and performance variables must continue to be studied in depth in order to discover if comprehensive teaching based intervention programs, which focus on improving cognitive variables (especially decision-making), give rise to an improvement in sport performance, too (Gil, 2013), above all, when the students or athletes are just starting the sport and have little technical control.

As indicated by French & Thomas (1987), both the quality of the decisions and the motor execution determine successful performance in sport..

#### CONCLUSIONS

The application of the comprehensive model has proved to be more effective than the technical model for understanding the game dynamics and the tactical principles of basketball (procedural knowledge). Thus, teachers must try to get students to experience cognitive dissonance moments by practicing modified games and then reflecting on this practice so they have a better understanding of the essence of the game as well as of its basic tactical principles.

The results show that both teaching methodologies have been effective in improving technical execution in closed situations, given that students from both groups reached a similar level of specific motor skills. But, given the greater motivation favored by the comprehensive model, we believe it would be preferable to use this model in the early sport initiation stages, as a greater level of enjoyment and intrinsic motivation are reached, and these are key factors in the desire to continue practising sport.

Our results show that significant differences have not been obtained in decision-making or in game performance in either of the groups after applying a 9-session comprehensive teaching program. The short time the teaching units of the school physical education program lasts advises guiding sport practice towards an out-of-school context, where the teaching sessions can be extended. Thus, the minimum threshold to improve the students' decision capacity would be reached and consequently, their real game performance would improve.

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