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Experimental analysis of a protocol for teaching simple temporary numerical inequality in U14 water polo players

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ABSTRACT

This study tries to validate a teaching protocol of playing micro-situations in simple temporary numerical inequality in water polo. 20 theoretical and practical sessions were designed and applied on the appropriate actions to be taken. Observational methodology was used through a descriptive and correlational longitudinal design. The differences between an experimental group and a control group were analyzed in 160 playing micro-situations in relation to goal achievement, failure, interception and duration. There were significant differences between groups ($\chi^2(2)$=16.99, p<.001; TE=.23), finding more goals and fewer interceptions in the experimental group. Likewise, there is no statistical significance when analyzing the influence exerted by the start field position in the experimental group, which if observed in control group, who receives more goals from the left wing and more interceptions from the left flat. Finally, there are more failures in control group considering the 3:3 game system. It is concluded that the protocol used with the experimental group is valid, reliable and it is recommended its application in teaching process to facilitate understanding the game dynamics. **Key words:** LEARNING, TACTIC, SUPERIORITY, INFERIORITY.

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INTRODUCTION

The quest for improved sports performance involves deep knowledge of the game developed by elite teams. Therefore, the observation and subsequent analysis of the players performance and their formations is essential (Canossa, Garganta, Argudo & Fernandes, 2009) in professionalism context and sports specialization that is currently lived. For this reason, in recent years, the training of physical capacities in an integrated way through the game (Hassan, 2014) has been imposed as a better alternative to traditional analytical training, being the method most used to try to replicate to the maximum exponent the demands of real competition during training (Tursi, Napolitano, Polidoro & Raiola, 2013).

From scientific point of view, the limited research in water polo comes from applied sports sciences such as biomechanics (Sanders, 1999; Webster, Morris & Galna, 2009), physiology (Smith, 1998; Platanou, 2009), medicine (Annet, Fricker & McDonald, 2000; Pavlik, Kemeny, Kneffel, Petrekanits, Horvarth & Sido, 2005; Webster, Morris & Galna, 2009), education (Carpenter, 2007) and psychology (Royal, Farrow, Mújica, Halson, Pyne & Abernethy, 2006; Farrow, 2007). These studies provide relevant results on certain influential aspects of sports performance such as heart rate during play, throwing speed (Borges, Ruiz & Argudo, 2017) decision-making mechanisms, more frequent injuries, etc., but not takes into account the motor actions that occur in the field of play or the communication used by teammate players or their use of space for the achievement of the motor objective, in short, they cannot reveal the dynamics of the game action (García, 2009).

For this reason, in the last few years research has appeared that developing a detailed notational analysis that allows coaches to identify performance indicators (technical and tactical) characterize the type of actions that take place in the field of play, describe the movement and action profile of each position, analyze how the regulation modifies match development, control its performance (verbalizations and time outs) and calculate the game actions effectiveness.

But sometimes, this is a very dense knowledge that can hardly be transferred to professional practice. Therefore, with the intention of taking advantage of this information and that coaches and players can improve training and increase their performance, this methodology arises which aims to generate new game systems, modify ball and throwing patterns, etc., and which can be used to analyze the own team and the opponent, which allows designing and improving the process of teaching the game systems. In this sense, if one considers a multifactorial sports preparation that considers the development of physical, psychological, technical, tactical capacities, the training contents should be properly selected. Therefore, it is necessary to discriminate the relevance of each situational framework to adjust the training time at an early age to improve the learning of future elite players (García & Argudo, 2015). Therefore, it is proposed to consider 50-60% of training time on equality, 20-30% on inequality and 10-20% on counterattack and penalty, in proportion to their contribution to sports performance (Argudo, García, Alonso & Ruiz, 2007).

For other side, scientific study of water polo is characterized by a great complexity of behaviors and actions that hinder their observation and analysis (Carling, Williams & Reilly, 2005). It is for this reason that in order to facilitate it, it is divided into smaller units that maintain the structure and dynamics of the sport in order to analyze and transfer the results to the training and competition planning, called playing micro-situations (Argudo, 2005). These units are not all the same, developed in different contexts called situational frameworks, which according to Argudo (2005) are defined as the set of motor behaviors present in the game dynamics in team sports, determined by the factors of: symmetry, organization of the game systems and ball

possession. It can be distinguished in the case of water polo: numerical equality, numerical inequality, transition and penalty.

Specifically what happens in this study, *Simple Temporary Numerical Inequality* (STNI) is defined as a playing micro-situation determined by the regulation in which the number of players (+1) is altered in favor of the team that owns the ball during a maximum of 20 seconds or until lost ball possession (Argudo, 2005). It has recently gained importance because of its relevance and impact on the final result, since it determines between 23 and 46% of the goals of a match and has a frequency of appearance of 4 to 12 times per match (Platanou, 2004; Takagi, Nishijima, Enomoto & Stewart, 2005; García, Argudo & Alonso, 2012, 2015). Therefore, it is essential in the field of sports performance to know and identify the motor actions that achieve the highest levels of effectiveness and justify their training in the scheduled sessions (Simović, Matković, Mijanović, Kocić & Vojvodić, 2012; Hassan, 2014). In short, its analysis will provide the necessary scientific knowledge that every sport needs to evolve and progress (Borrie, Jonsson & Magnusson, 2002).

In this way, studies on notational analysis of absolute national high-level matches have been recently published (Platanou, 2008; Lupo, Tessitore, Minganti, King, Cortis & Capranica 2011; Lupo, Minganti, Cortis, Perroni, Capranica & Tessitore, 2012; García, Argudo & Alonso, 2013) and professional teams (Napolitano, Tursi, Di Tore & Raiola, 2013) which have been developed through specific softwares such as Polo Análisis Directo v1.0 (Argudo, Alonso, Fuentes & Ruiz, 2005). Being nonexistent studies that have analyzed the game dynamics at sport initiation.

On the other hand, another few examples of previous studies in this respect is Petrov (1986), who points out the principles on which the success of the attack in STNI is based and analyzes the different variants that can be adopted by the teams in attack. Platanou (2004) investigates the shot effectiveness in this micro-situation and looks for differences between field positions and winning or losing teams. Similarly, Soares (2004) directs his study on efficacy in SNTI and performs an analysis of 2001-2002 Portuguese Men's League, comparing it with studies of Argudo (2000).

The studies by García, Argudo & Alonso (2012), analyzing the 96 matches played in the X Water Polo World Championships held in Barcelona 2003, and the 1230 micro-situations in STNI were observed. Where the analysis revealed that the most used game systems were 4:2 (56.5%), followed by 4:2/3:3 (19.1%) and 3:3 systems (16.3%) discarding the (8%) of micro-situations that end without system, being penalized with the last regulatory modification approved by the Fédération Internationale de Natation (FINA). In this sense, this type of micro-situation has a great relevance in the final result of the encounter given its high occurrence frequency (12.81 micro-situations per match), great influence on the result (4.78 goals per match) and its high efficiency percentage (31.74% of the STNI finish in goal) as explained by García (2009).

Therefore, the objective of this study is to validate a protocol for the teaching of playing micro-situations in STNI for the U14 category in water polo.

METHOD

Participants
The sample was 13 players of U14 category with more than five years of experience each. The population under study is a homogeneous group at the physical, technical and tactical level, reasons for which they were selected and in which they participated voluntarily.

Tools and measures

The conditions of the 160 playing micro-situations were delimited, a space of game in which the considered actions were developed (10m long x 15m wide) and a goalpost of this category (3m wide x .90m high). The ball used was the regulation for this category size 4 or Women of the brand Turbo. Secondly, the playing micro-situations were grouped according to the reason for finishing (a) goal, (b) failure and (c) interception; the ending motive based on the starting position of the playing micro-situation, (a) right wing, (b) right flat, (c) left wing and (d) left flat. Depending on the game system used, (4:2 and/or 3:3), and duration of playing micro-situation (average ± standard deviation, expressed in seconds). Thirdly, placed in the delimited space, each playing micro-situation was started from the 4 outer positions described until the end of the playing micro-situation (goal, failure, interception), 15 dimensions (tactical indicators) with their respective categories were analyzed to describe the reasons for ending the 160 playing micro-situations of SNTI analyzed.

Procedures

The observational methodology (Anguera, 2003) was used through a descriptive and correlational longitudinal design, to determine if there are differences between the effectiveness of SNTI actions in water polo. For this, the sample was segregated into two groups. The Experimental Group (EG) received 20 theoretical and practical explanations about different ways of solving SNTI micro-situations (+1 and -1). While the Control Group (CG) performed a specific technical training.

A total of 160 SNTI micro-situations of each group were recorded and observed. The recording was made with a digital video camera (JVC, GZ-MG50E, JAPAN), placed in an elevated position and centered on the space enabled for the study. After this the images were analyzed by two observers not linked to the study with more than 500 hours of experience and previously trained by the Polo Análisis Directo v1.0 software (Argudo, Alonso, Fuentes & Ruiz, 2005). The reliability among the observers was verified using the kappa index (Leon & Montero, 2003), reaching a value higher than .85.

Analysis

Contingency tables were used to study the results of playing micro-situations, field start position and game system, using the Pearson Chi-square test (χ^2) as a statistic. The expected frequency of distribution for all cells was greater than 5, so no corrections were required in the data. Subsequent analysis of the relationships found was performed by multiple posterior comparisons based on corrected typified residuals. Effect sizes (ES) were calculated using the Cramer V test and their interpretation was based on the following criteria: .10 small effect, .30 average effect, .50 high effect (Cohen, 1988). For analysis of playing micro-situation duration data, we used a one-way ANOVA variance analysis. In this case, the ES were calculated with the Eta partial-square statistic and their interpretation was based on the following criteria: .01 small effect, .06 medium effect, .14 high effect (Cohen, 1988). The level of significance was set at $p<.05$. The statistical package SPSS version 21.0 (IBM Corp., Armonk, NY, USA) was used for the analysis.

RESULTS

Table 1 shows the results regarding the ending motive of playing micro-situation (goal, failure, interception) in SNTI for EG and CG. The results showed statistically significant differences between both ($\chi^2(2)=50.49$; $p<.001$; ES=.40). The subsequent analysis revealed significant differences, with a significantly higher number of goals scored for EG versus CG ($p<.001$) and a smaller number of intercepts. No significant differences were found in the number of playing micro-situations ending in failure ($p> .05$).

Table 1. Contingency table with descriptive values as a function of the group, playing micro-situation with ball possession and/or without ball possession, start position and game system (4:2 and 3:3) in U12 water polo players.

| | Group | | | | Situation | | | | Position | | | | | | | | System | | | |
| | EG | | CG | | P | | WP | | RW | | RF | | LW | | LW | | 4:2 | | 3:3 | |
	Frec	%	Frec	%	Frec	%	Frec	%	Frec	%	Frec	%	Frec	%	Frec	%	Frec	%	Frec	%
Goal	90	56,25	40	25	130	40,63	130	40,63	34	42,5	28	35	30	37,5	38	47,5	70	43,75	60	37,5
Failure	34	21,25	22	13,75	56	17,5	56	17,5	16	20	16	20	8	10	16	20	24	15	32	20
Intercept.	36	22,5	98	61,25	134	41,87	134	41,87	30	37,5	36	45	42	52,5	26	32,5	66	41,25	68	42,5
Total	160		160		320		320		80		80		80		80		160		160	

Intercept (Interception); EG (Experimental group), CG (Control group); P (With ball possession), WP (Without ball possession); RW (Right wing), RF (Right flat), LF (Left flat), LW (Left wing).

In this sense, Table 1 also shows the results regarding the reason of ending the playing micro-situation (goal, failure, interception) in SNTI depending on the different field starting positions for EG and CG. For EG, the results did not show statistically significant differences as a function of the starting position ($\chi^2(6)=9.03$; $p>.05$; ES=.17). While for CG, statistically significant differences were observed ($\chi^2(6)=16.77$, $p<.01$; ES=.23). The subsequent analysis revealed a significantly higher number of goals when the playing micro-situation started at LW compared to the other positions analyzed ($p<.01$). Also, a significantly higher number of interceptions were found when the playing micro-situation started on LF versus a start on LW ($p<.01$). No significant differences were found in reason of ending for rest of the starting play positions analyzed ($p> .05$).

Table 1 shows the results referring to the reason for ending playing micro-situation (goal, failure, interception) in SNTI depending on the game system for EG and CG. The results did not show statistically significant differences as a function of the system used ($\chi^2(2)=.61$; $p>.05$; ES=.06) when analyzing EG. While in CG, the results revealed statistically significant differences as a function of the game system ($\chi^2(2)=6.19$, $p<.05$; ES=.20). The subsequent analysis revealed a number of playing micro-situation that ended in significantly greater failure when using 3:3 game system versus 4:2 game system ($p<.05$). No significant differences were found depending on the game system when the playing micro-situation ended in goal or interception ($p>.05$).

Finally, Table 2 shows the average duration of the playing micro-situation for different reasons of ending. The results found did not show significant differences between EG and CG for any types of playing micro-situation: finalized in goal ($F_{1,128}=.36$; $p>.05$; ES=.01), finalized in failure ($F_{1.54}=1.65$; $p>.05$; ES=.03), nor in intercepts ($F_{1,132}=3.23$, $p>.05$; ES=.02). The subsequent analysis also did not show significant differences in the average duration of the playing micro-situation when comparing the different start and play positions for CG and EG ($p>.05$), so the data will be obviated and will not be presented.

Table 2. Duration of playing micro-situation (average ± standard deviation, expressed in seconds).

	Goal		Failure		Interception	
	Media	*DT*	*Media*	*DT*	*Media*	*DT*
Experimental Group	7.4	3.8	12.0	2.2	10.0	1.9
Control Group	7.7	2.9	10.7	5.0	8.5	5.0

DISCUSSION

The study and analysis of the influence exerted by theoretical and practical knowledge of tactical solutions in SNTI reveals that the teaching protocol proposed improves and significantly increases number of goals scored and decreases number of interceptions in EG. This would suggest that teaching protocol performed would favor team's performance in SNTI.

When examining the benefits reported by the field start position of the playing micro-situation in SNTI, it reports that there are no differences in the performance of EG. This would suggest that this group assimilates tactical solutions to be performed in SNTI in the same way for different starting positions, showing the same performance. However, it is noteworthy that EG obtained their best results when they started the playing micro-situation from LW (higher number of goals and fewer interceptions). This, together with the above, would suggest that the fact of not proposing a specific teaching program for SNTI micro-situations can cause important differences in team performance depending on the different positions, making it significantly affected by the starting position of the playing micro-situation. This could influence the team performance during the match.

Trying to find out if the use of any game system in SNTI reports differences in relation to goal achievement, failure or interception. It is found that EG obtained similar performances with the two game systems. This would suggest that the teaching protocol proposed makes the players achieve the same performance in the two game systems indifferently, granting them multiple possibilities during matches. On the other hand, CG had worse performances with the 3:3 game system, with a significantly higher number of playing micro-situations ending in failure versus 4:2 game system. This limits the possibilities of the team (to stick to a single game system) and would recommend a specific protocol that regulates the differences in the team performance when they play with one or another game system.

Finally, no differences were found between EG and CG in terms of the average duration of the playing micro-situations. If this fact is joined by the fact that if there are differences in the overall performance in favor of EG, it would suggest that players who have done the teaching protocol in SNTI are able to obtain higher performances than those obtained by CG players without the need to spend more time in playing micro-situations. That is to say, it would show an improvement in the time of elaboration of successful playing micro-situations in EG.

CONCLUSIONS

For all these reasons, it is concluded that the protocol used with EG is valid, reliable and useful for the training and improvement of the tactical resolution in playing micro-situations of SNTI. In this sense, the protocol

would prove successful and it would be advisable to apply it in order to improve the learning process of this aquatic sport modality, as well as to facilitate the understanding player's game dynamics.

FUTURE LINES

The research that is detailed here opens new lines in the study of the tactical understanding of this sport. For this reason, it would be advisable that future studies extend the sample to different player's level, category and experience. The gender variable should also be considered, since Garcia, Argudo & Alonso (2012) appreciate differences between two groups, the coach's performance and communication during practice (Calpe, Guzmán & Grijalbo, 2013) the play of field dimensions (Casamichana, Castellano & Hernández-Mendo, 2014). On the other hand, it should be considered to analyze the existence of differences in the variables analyzed (goal, failure and interception) in the resolution of playing micro-situations of real competition in SNTI. Besides, it would be beneficial to improve the teaching of game systems to consider whether this type of training work has a later impact on competition, analyzing the effectiveness of solving this type of playing micro-situations during it.

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