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Effects of the Comprehensive and Technical Models of Sports Teaching in Secondary School Students

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Abstract: The aim of this study was to determine the effects of different teaching methodologies (comprehensive vs. technical), developed during a unit of ultimate frisbee, on the physical demands, technical–tactical variables, game performance and physical fitness of secondary school children. Forty-seven students were divided into two groups: Comprehensive Teaching Group (CTG; n = 25, Age: 14.5 ± 0.5 years) and Technical Teaching Group (TTG; n = 22, Age: 14.9 ± 0.8 years). The teaching models (CTG vs. TTG) were composed of 8 sessions of 55 min. Physical fitness was developed with the Alpha-Fitness method, while physical variables were analysed using GPS; the technical and tactical variables performed during the matches were recorded using Full-HD video cameras. The results showed that the CTG students had greater mean speed ($p < 0.001$), mean heart rate ($p = 0.006$) and covered more total distance/time ($p < 0.001$) than the TTG students during sessions. After the intervention, the CTG students showed greater values in good passes ($p = 0.001$), good catches ($p = 0.001$), good decisions ($p = 0.002$) and game performance ($p < 0.001$), while the TTG students only showed higher values in game performance ($p = 0.039$). In conclusion, the comprehensive teaching model is shown to be an effective pedagogical option to learn ultimate frisbee because the students achieved a higher overall development in the physical demands expressed in the sessions and in the management of the technical–tactical actions in the offensive and defensive phases of the ultimate frisbee game.

Keywords: ultimate frisbee; team sports; physical education; methodologies; high school

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1. Introduction

Teaching sports at school has been approached from traditional methodologies (focused on technical execution) and alternative methodologies, which are based on understanding the game (comprehensive–tactical focus). The traditional methodologies for teaching sports are based on the premise that the mastery of technical skills is required prior to their application in the game [1,2]. The role of the student is usually to execute the task by mimicry, while skill improvement occurs by repetition of the task through analytical exercises [3]. The most common criticism of the traditional approach to teaching sports has been that by focusing learning on the execution of the technical skills, teachers restrict the options for students to think about what actions to take, as well as how and why to take them; these are issues that stimulate student motivation and enthusiasm for learning [4]. Models focused on tactics emerged in the early 1980s as an alternative to traditional sports teaching methodologies [5]. Following this approach, game forms are used so that school children can experience different tactical problems and, in an integrated form, use the technical skills to successfully solve the different situations that are generated during the development of the game [4]. In this way, the student constructs his knowledge through the

interaction between her/his cognitive activity and the technical–tactical actions involved to resolve the different game situations [6]. Under these conditions, the teacher stimulates the students' reflection to better understand the internal logic of the game and the roles that students must be able to play [7]. However, the outcomes of the studies that have been conducted under the game-based approach have not been consistent with respect to game performance [8]. For this reason, there is a need to establish stronger links between the pedagogical model and game performance.

In game-based approaches (comprehensive methodology), small-sided games are adjusted according to levels of tactical complexity so that students improve their understanding of the sport through experience of playing with their peers [4,9]. Starting from the learner's previous experience, the design of small sided games (SSG) creates a favourable environment where the student can build a learning process in an adequate motivational, cooperative and autonomous climate. Although a strong body of research has been developed in recent decades around game-based approaches, traditional models are still the most widely used in physical education curricula [10,11]. The implementation of new pedagogical models is not easy as it forces the teachers to step outside of their comfort zone and have a growth mentality in order to face the educational challenges of a society that is constantly evolving [12]. Although traditional models have proved to be effective in certain issues linked to learning sports, from a critical point of view there is a need to experiment with new ways of teaching that promote more and better learning in students [10,11,13,14].

In the scientific literature, we find studies that analyse a wide range of sports. According to the classification of sports proposed by Almond [15], invasion and net/wall games are the most commonly analysed [8]. Ultimate frisbee is a team sport with millions of players around the world and is one of the team sports taught in physical education sessions. Reviews conducted in recent years indicate that the results of studies comparing the effectiveness of skills-based and game-based approaches are uncertain [16]. In terms of the affective domain, most research has confirmed that approaches that focus on understanding the game produce higher levels of motivation, enjoyment and autonomy [17,18].

Moreover, though the physical demands of physical education sessions have been analysed in recent years [19], more research is needed to understand the factors that can stimulate greater physical demands in physical education sessions and contribute to the development of health and fitness in school children [16]. In general, the teaching of sports in schools focuses more on the learning of the sport than the physical demands that are displayed during the intervention units. Physical demands of the sports and physical fitness of the students are core to game performance since speed is crucial for transitions and stamina is vital for enduring prolonged effort or agility on and off the disc, both for defense and offense [8,20]. Therefore, the aim of this study was to determine the effects of different teaching methodologies (comprehensive-oriented vs. technical-oriented) during a unit of ultimate frisbee on the physical demands, technical–tactical variables, game performance and physical fitness of the school children in a natural learning environment at a secondary school.

2. Materials and Methods

2.1. Participants and Inclusion Criteria

A total of 52 students in the third year of Compulsory Secondary Education, aged between 14 and 15 years old, voluntarily participated in this study. The study was carried out in a public secondary school in the region of Castilla–La Mancha (Spain). Students received 55-min physical education sessions twice a week during one month. None of the students had previous experience with the practice of the game "ultimate frisbee". The school children who participated in the study were heterogeneous in terms of gender (53.2% girls and 46.8% boys) and motor skills. However, each group had similar experiences in learning sports in previous years of secondary education in the same school. Students were excluded from the study if they failed to complete 80% of the sessions proposed in the intervention units.

The final sample of the study consisted of 47 students. The students were divided into 2 groups: the Comprehensive Teaching Group (CTG) (N: 25 students, Age: 14.5 ± 0.5 years, Height: 164.1 ± 5.8 cm, Body Mass: 58.8 ± 8.2 kg, ALPHA Fitness score: 4.01 ± 0.91 points) and Technical Teaching Group (TTG) (N: 22 students Age: 14.9 ± 0.8 years, Height: 167.8 ± 10.3 cm, Body Mass: 63.0 ± 10.0 kg, ALPHA Fitness score: 3.73 ± 1.39 points) (Figure 1). The sample size was previously calculated based on González-Espinosa et al. [21], who applied the tactical–game approach to improve the sport performance in high school students. The minimal number of subjects required to attain a power of 0.9 and a bilateral alpha level of 0.05 was calculated to be 10.

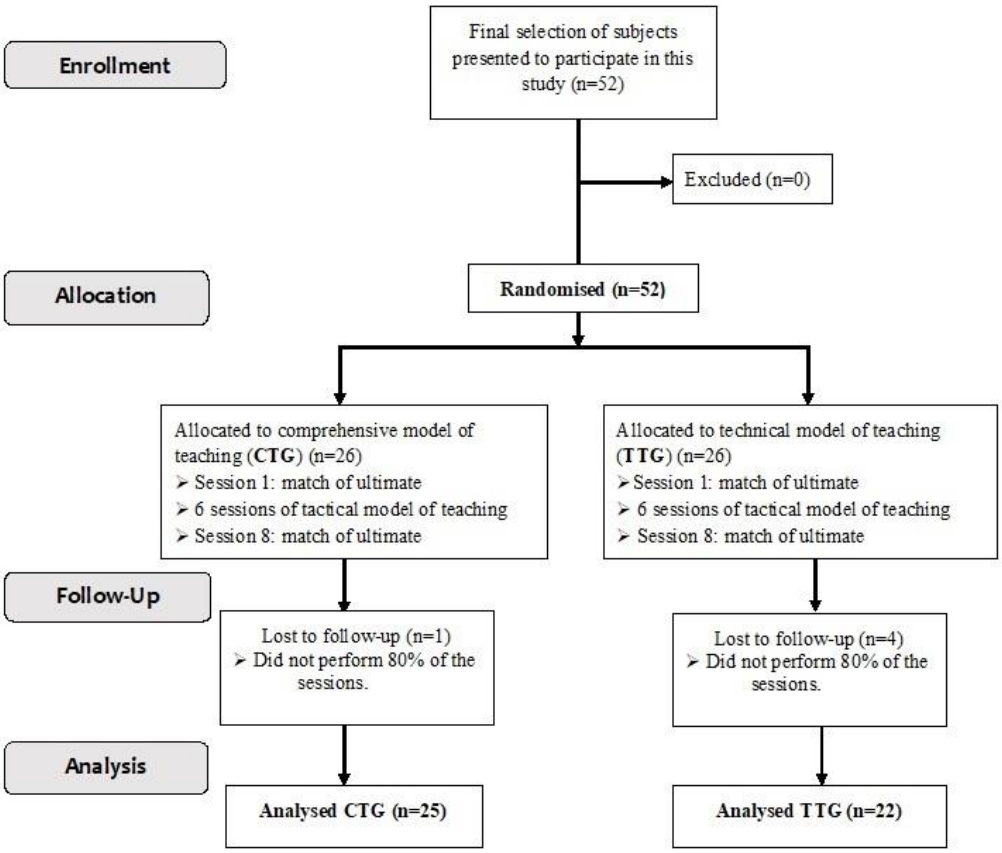

Figure 1. Flowchart of study. CTG = Comprehensive Teaching Group; TTG = Technical Teaching Group.

The parents of the students were informed of the purposes of the study and devices that would be used during the practical sessions and signed the informed consent form. The study was approved by the Ethics Committee of Clinical Research at the Hospital Complex in Toledo (Spain) (number 739, dated 1 July 2021) according to the principles of the latest version of the Declaration of Helsinki.

2.2. Experimental Design

The study was carried out following a clustered trial with random assignment pre-test–post-test design. Two groups were randomly assigned, as mentioned above, before baseline assessment (CTG vs. TTG). The teaching content that was carried out between the pre-test and post-test was a unit of the game called ultimate frisbee. The CTG developed a comprehensive sports teaching model (based on game tactics) where modified games were the central axis of the teaching process in which students, from the understanding of the internal logic of the game, made use of the technical gestures necessary to solve the diversity of game situations that arise during the practice of ultimate frisbee. The TTG

developed an intervention model based on traditional teaching that focused on mastery of the basic technical skills necessary for the development of the game.

The teaching models (CTG vs. TTG) were composed of 8 sessions of 55 min (twice a week), including pre-test and post-test sessions. An 8-session intervention was chosen because it was desired to identify the evolution of the students' learning in a natural environment (curricular) in which the usual conditions of teaching physical education in the school were faithfully respected. All sessions (except 1 and 8) of both models were structured around four tasks lasting 10 min each.

The intervention programme and the structure of the sessions of the CTG were designed to take into account the contributions of García and Gutiérrez [22] and Mitchell et al. [4], which were characterised by tactical orientation as the main axis of learning of ultimate frisbee. In this model, known as CTG, the sessions began with an initial task in which the students, through challenging questions, were reminded of the tactical principles of the game and the associated skills performed in the previous sessions and linked them with the new purposes of the session in which they were to participate. The students ten played a game that synthesised the contents worked on in the previous sessions. In the central part of the session, one modified game was used to set the learnings and enable tactical awareness in the students through reflection guided by the teacher; this tasks considered how to solve the problems raised in the games practised in a way related to the purposes of the sessions. If the teacher appreciated any limitations in the execution of the skills to solve the tactical problems during the game, the students then practiced the skill through a practical task in which the teacher asked questions to establish the link between the importance of the skills required to solve game problems in the optimal way. These tasks were performed in a less complex context and focused on the improvement of technical skills. Subsequently, the students returned to the game form. The central part of the sessions ended with a simulated competition under conditions of offensive–defensive balance in which, depending on the session, the teams were composed of 3, 4 or 5 members. The end of the session was used for students to reflect on the learnings acquired through questions such as: what have we learned in the session?; what task was most difficult for us to perform?; how can we improve it?; where can we apply it?; and what have we learned? Students were also reminded of the upcoming session's content.

The technical teaching programme (TTG) was characterised by spending most of the session experiencing the basic technical skills of initiation related to the game of ultimate frisbee, such as throwing and catching in static and dynamic situations. For example, if the session taught the backhand throw, the teacher focused on teaching proper grip, foot placement, body orientation and dynamics in the execution of the throw. These sessions were made up of tasks of an analytical nature. The teacher previously demonstrated how they should be executed and the students developed a repetitive practice of the skills taught in various static and dynamic situations. The feedback provided by the teacher was focused on improving technical performance. In each session, a simulated competition task was developed under the same conditions as those described in the comprehensive model; however, the students did not usually receive tactical or strategical instructions from the teacher. Figure 2 shows the study design with the basic characteristics of the sessions carried out with each teaching group.

The instructional programmes (designed by the research group) were sent to four expert teachers in the teaching of invasion team sports in secondary education and at university level for validation of the teaching models. The experts used a 5-point checklist (1 = Poor, 2 = Fair, 3 = Average, 4 = Good, and 5 = Excellent) developed in an ad hoc manner based on the contributions of Butler [23]. In addition, they had publications of impact linked to the teaching of sports. The average score reported by the respondents was 4.76 (the agreement rate was 86%). The teacher who developed and carried out the units had 17 years' of experience in teaching physical education. The teacher also had a great command of both instructional models (comprehensive teaching and technical teaching) and teaching experience in ultimate frisbee.

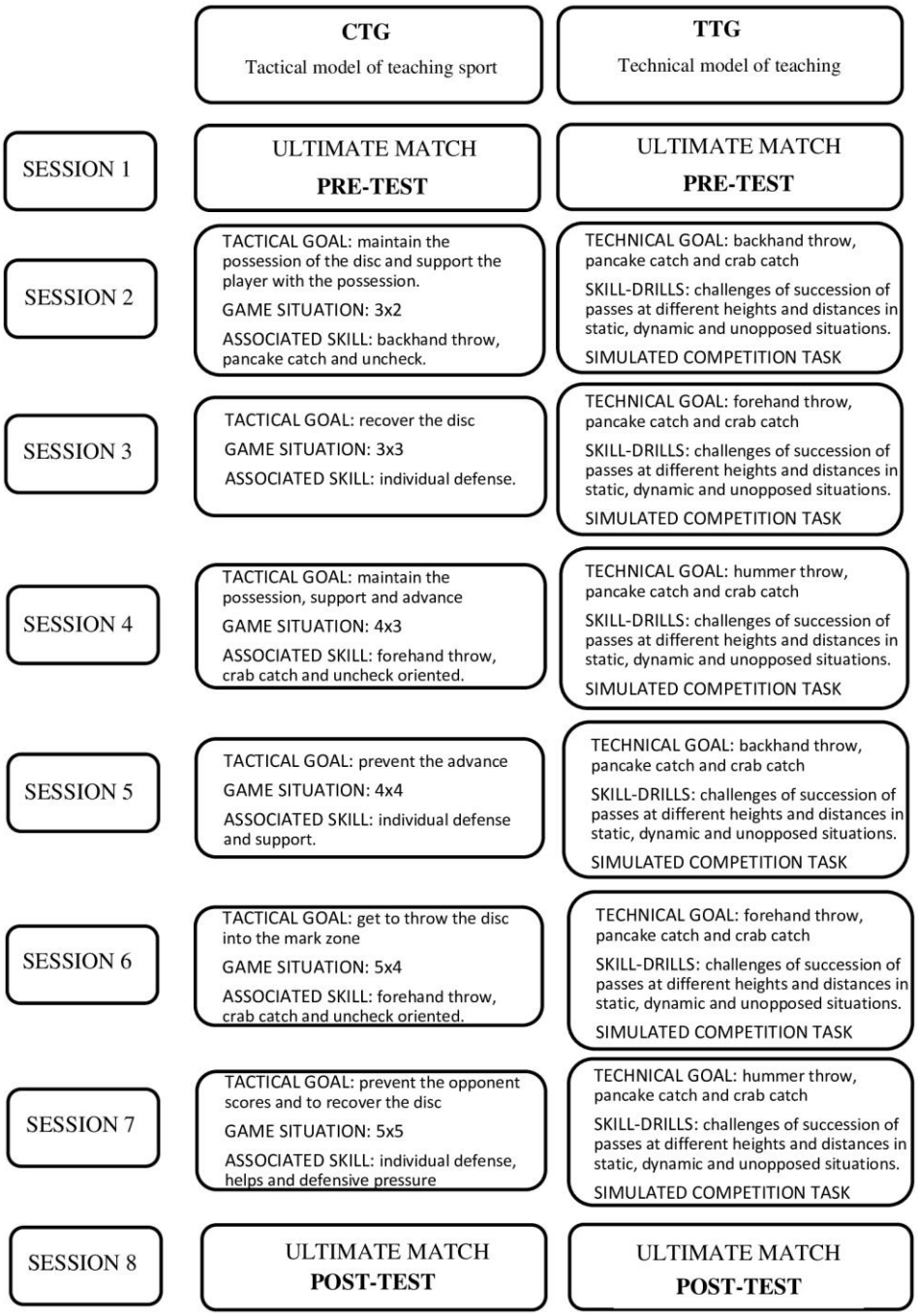

Figure 2. Design of the study. CTG = Comprehensive Teaching Group; TTG = Technical Teaching Group.

2.3. Experimental Protocol

The Alpha-Fitness battery was developed to provide a set of valid, reliable and safe field tests to assess health-related physical fitness in children and adolescents [24]. The protocol established by this test battery was followed and included the test sequence, measures, number of trials and scoring. Cardiorespiratory fitness was assessed by the 20-m SRT (shuttle run test); motor fitness was evaluated by the 4 × 10 m SRT test; and musculoskeletal fitness was measured by the standing broad jump and the handgrip strength tests. The following instruments were used: (1) for the 20 m SRT, a USB with the test protocol; (2) a digital stopwatch (Casio, Tokyo, Japan) for the 4 × 10 m SRT test; (3) the standing broad jump was measured in metres with a polyvinyl chloride (PVC) measuring

tape; and (4) the handgrip strength test was measured with a manual dynamometer (Takei Scientific Instruments Co., Tokyo, Japan). The flexibility test and the body composition was not included in our study despite being part of the version of the battery.

Physical variables were analysed in two levels: (1) during sessions 2 to 7 (within the unit); and (2) during the ultimate frisbee matches (pre- and post-intervention). Physical variables during sessions 2 to 7 and during the ultimate frisbee matches were analysed using a 15 Hz GPS (Spi HPU, GPSport®, Canberra, Australia). This system required students to wear a small backpack which contained the device; students wore this equipment throughout the match. The matches were played with the format 4 × 4 and on a pitch of 16 × 32 m (area per student: 64 m^2). Accelerations and decelerations were measured through the accelerometer of the GPS device with a sampling frequency of 100 Hz. The distances covered were estimated using Team AMS software version 7 (GPSport®, Canberra, Australia) and presented in kilometres per hour ($km \cdot h^{-1}$). The reliability and validity of GPS devices for measuring physical demands in team sports have been provided in previous studies [25]. In the school setting, GPS devices have also been used to assess physical demands in physical education sessions [2].

The physical variables recorded with the GPS were: total distance/time of participation (m/min), peak speed (km/h), mean speed (km/h), number sprint/time of participation, maximum heart rate (ppm), mean heart rate (ppm), total accelerations, total decelerations and total distance covered (m).

Technical and tactical variables performed during the ultimate frisbee matches were recorded using two GZ-R315BEU Full HD video cameras (JVC®, Tokyo, Japan) fixed on a tripod in the middle of the field at a height of 5 m, ensuring an overhead view of the game [26]. The technical–tactical actions studied were observed by two different researchers (coaches of the Spanish Team of ultimate frisbee). In case of disagreement between observers in the evaluation of the action, the observers re-visualised the specific action and discussed it until a final decision was reached. The different actions carried out by the students during the game were treated through the LongoMatch game analysis software. Inter- and intra-reliability were assessed by the analysis of one designated small-sided game by the investigators. These observations were completed at least 7 days before the beginning of data collection to prevent any learning effects influencing the data. The level of agreement for the work rate analysis was determined using the percentage of agreement between two repeated observations to provide an indication of the consistency of the data [27]. The percentages of exact agreements for both inter- and intra-reliability were 93%. This score is above the value suggested by Van-der-Mars [27] as suitable for a complex system. Technical–tactical actions were measured using the Game Performance Assessment Instrument (GPAI) adapted to invasion team sports, which is the category to which ultimate frisbee belongs [3,4]. The GPAI has been found to be a valid and reliable instrument for assessing game performance. The reliability of the coding instrument ranged from 0.84 to 0.99 for invasion team sports [28].

Students were analysed during the whole match; the technical actions were coded as positive (good) or negative (bad) in each game category. The technical actions studied were passes (the direction and height of the pass was adjusted to the play position of the teammate (good) or did not meet the previous condition (bad)), catches (the player caught the flying disc (good) or did not meet the previous condition (bad)), unmarking (the players occupied a free space to be able to catch in time and distance (good) or did not meet the previous conditions (bad)), decisions (the player with possession of the flying disc passed to the unmarked player in the best position (good) or did not meet the previous condition (bad)), marking (defensive actions put pressure on the opponent (good) or did not meet the previous condition (bad), game involvement (number of total technical actions) and game performance (number of good technical actions/number of total technical actions).

2.4. Statistical Analysis

The statistical analysis was performed with IBM SPSS Statistics 23.0 (SPSS, Chicago, IL, USA). All data were expressed as mean ± standard deviation. The data were tested for normality with the Shapiro–Wilk test. Since the assumption of normality (all variables $p > 0.05$) was verified, a two-way mixed ANOVA (2 × 2) was used to determine the main effects of the two interventions (comprehensive and technical models of teaching) with repeated measures in the timeline variable. One factor was the intervention group (CGT and TTG) and the other was the timeline (pre- and post-intervention). Student's *t*-tests for independent samples were used to compare physical variables in sessions 2 to 7 during the intervention programmes. Effect size (ES) statistics were used to quantify the magnitude of the difference in pairwise comparisons according to the formula proposed by Cohen [29]. The magnitude of the effect size was interpreted using the scale of Cohen [29]: an effect size lower than 0.2 was considered as small, an effect size around 0.5 was considered as medium, and an effect size over 0.8 was considered as large. A probability level of $p < 0.05$ was defined as statistically significant.

3. Results

3.1. Physical Fitness Results

There were no significant within- or between-group differences for the variables recorded with the Alpha–Fitness test (Table 1) or in the physical variables recorded during the ultimate frisbee matches pre- and post-intervention (Table 2).

Table 1. Alpha–Fitness variables pre- and post-intervention programme.

			Group Effect		Time Effect		Time × Group Interaction	
	PRE	**POST**	**F**	***p*-Value**	**F**	***p*-Value**	**F**	***p*-Value**
			20-m SRT (stages)					
CTG	6.94 ± 2.82	7.44 ±2.64	2.41	0.127	4.03	0.051	3.36	0.074
TTG	6.05 ± 2.28	6.07 ± 2.30						
			Standing broad jump test (m)					
CTG	1.79 ± 0.38	1.73 ± 0.41	0.84	0.365	0.26	0.615	3.74	0.060
TTG	1.65 ± 0.28	1.68 ± 0.29						
			4 × 10-m SRT test (s)					
CTG	10.95 ± 1.27	10.96 ± 1.22	0.36	0.555	2.50	0.122	2.80	0.102
TTG	11.31 ± 1.33	11.05 ± 1.19						
			Right hand grip strength (kg)					
CTG	31.92 ± 7.22	31.45 ± 7.78	0.04	0.840	0.19	0.663	1.40	0.243
TTG	31.64 ± 8.45	32.68 ± 10.01						
			Left hand grip strength (kg)					
CTG	28.96 ± 8.60	29.16 ± 9.20	0.51	0.477	2.78	0.103	1.77	0.191
TTG	29.91 ± 7.44	31.68 ± 8.67						

CTG = Comprehensive Teaching Group; TTG = Technical Teaching Group; SRT = Shuttle Run Test.

Table 2. Physical variables for matches of ultimate frisbee pre- and post-intervention programme.

			Group Effect		Time Effect		Time × Group Interaction	
	PRE	**POST**	**F**	***p*-Value**	**F**	***p*-Value**	**F**	***p*-Value**
			Total accelerations					
CTG	66.89 ± 22.49	68.22 ± 24.43	1.64	0.211	1.43	0.241	0.56	0.461
TTG	53.61 ± 23.62	59.38 ± 30.35						
			Total decelerations					
CTG	103.61 ± 36.77	96.89 ± 36.95	3.04	0.092	0.14	0.708	3.45	0.073
TTG	72.31 ± 35.84 #	82.46 ± 43.62						

Table 2. *Cont.*

			Group Effect		Time Effect		Time × Group Interaction	
	PRE	**POST**	**F**	***p*-Value**	**F**	***p*-Value**	**F**	***p*-Value**
			Maximum Heart rate (ppm)					
CTG	194.75 ± 11.55	198.38 ± 12.68	1.81	0.197	0.003	0.954	6.07	0.025
TTG	192.00 ± 7.64	188.20 ± 10.63						
			Mean Heart rate (ppm)					
CTG	181.88 ± 13.76	181.88 ± 9.96	2.20	0.158	0.34	0.566	0.34	0.566
TTG	174.60 ± 11.93	172.10 ± 15.10						
			Total distance covered (m)					
CTG	1697.95 ± 190.28	1744.23 ± 225.29	5.33	0.027	3.76	0.061	0.42	0.521
TTG	1505.54 ± 282.13 #	1598.31 ± 266.49						

= $p < 0.05$ from CTG; CTG = Comprehensive Teaching Group; TTG = Technical Teaching Group.

3.2. Physical Demands Results

The total distance covered by the students during sessions 2 to 7 was higher with a large ES in the CTG than in the TTG (42.56 ± 12.46 vs. 25.47 ± 8.59 m/min; $p < 0.001$, Interval confidence (IC) 95% = from 10.67 to 23.50, ES = 1.62). The CTG also showed greater mean speed with large ES (2.81 ± 0.48 vs. 2.17 ± 0.35 km/h; $p < 0.001$, IC 95% = from 0.39 to 0.89, ES = 1.55), number of sprints with large ES (0.22 ± 0.13 vs. 0.10 ± 0.05 n°/min; $p < 0.001$, IC 95% = from 0.06 to 0.18, ES = 1.33) and mean heart rate with large ES (149.75 ± 11.17 vs. 136.67 ± 15.26 ppm; $p = 0.006$, IC 95% = from 4.02 to 22.14, ES = 0.99) than the TTG. No differences between groups were observed in peak speed (13.73 ± 2.06 vs. 14.85 ± 2.72 km/h; $p = 0.116$, IC 95% = from −2.53 to 0.29, ES = 0.47) or in maximum heart rate (187.90 ± 11.49 vs. 182.83 ± 12.16 ppm; $p = 0.208$, IC 95% = from −2.95 to 13.08, ES = 0.43) (Figure 3).

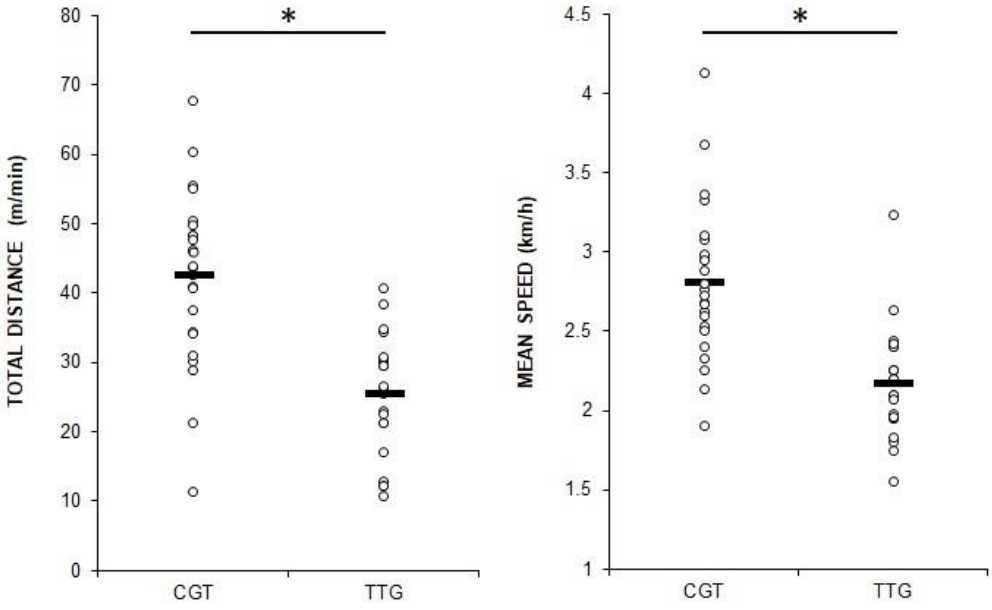

Figure 3. *Cont.*

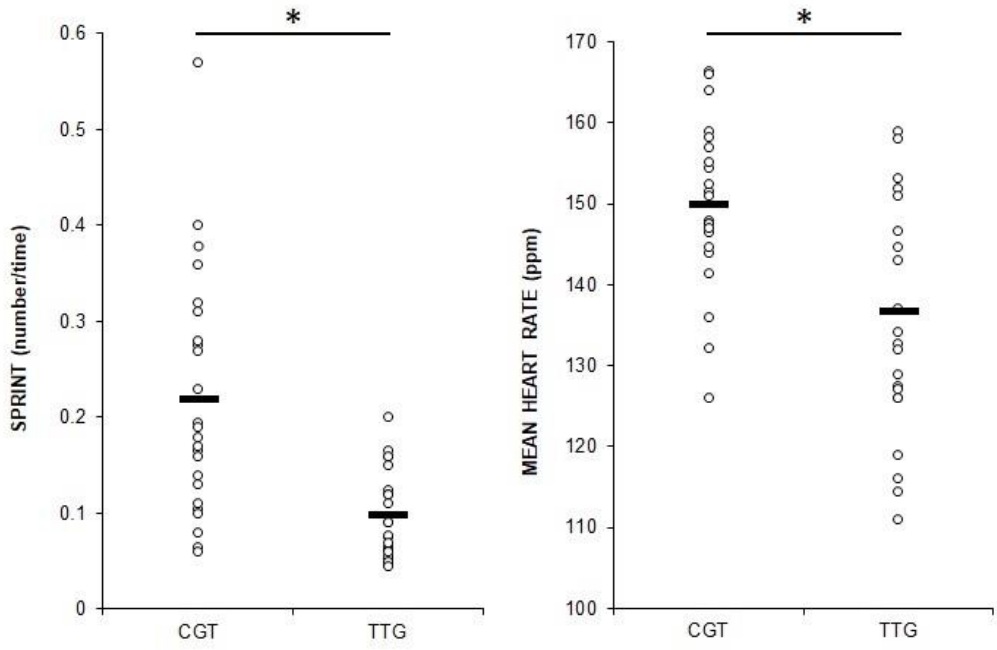

Figure 3. Physical variables of sessions 2 to 7 during intervention programme in Comprehensive Teaching Group (CTG) and Technical Teaching Group (TTG). * = $p < 0.05$.

3.3. Technical-Tactical Results

Data from the technical–tactical variables are presented in Table 3. A time × group interaction ($p < 0.05$) was found in bad passes, bad marking and game performance. No group interactions were found for any of the technical–tactical variables studied except in the good marking with higher values in the CTG. A time effect was found in almost all technical–tactical variables. The CTG showed greater values post- than pre-intervention in good passes ($p = 0.001$, IC 95% = from 2.42 to 7.58, ES = 0.27), good catches ($p = 0.001$, IC 95% = from 2.01 to 6.39, ES = 0.24), good decisions ($p = 0.002$, IC 95% = from 1.86 to 7.61, ES = 0.23) and game performance ($p < 0.001$, IC 95% = from 0.12 to 0.23, ES = 0.56). In the same way, the TTG showed higher values of game performance ($p = 0.039$, IC 95% = from 0.01 to 0.13, ES = 0.35) in post- than pre-intervention.

Table 3. Technical–tactical variables for matches of ultimate frisbee pre- and post-intervention programme.

			Group Effect		Time Effect		Time × Group	
	PRE	**POST**	**F**	***p*-Value**	**F**	***p*-Value**	**F**	***p*-Value**
			Good passes					
CTG	7.20 ± 4.71	12.20 ± 4.68 *	0.256	0.617	11.65	0.002	3.63	0.068
TTG	8.25 ± 4.31	9.67 ± 4.14						
			Bad passes					
CTG	5.67 ± 2.99	2.60 ± 1.76 *	0.09	0.769	7.32	0.012	6.57	0.017
TTG	3.92 ± 2.87	3.83 ± 3.10						
			Good catches					
CTG	6.47 ± 4.10	10.67 ± 4.62 *	0.065	0.801	12.36	0.002	3.04	0.094
TTG	7.50 ± 3.42	8.92 ± 4.32						
			Bad catches					
CTG	1.53 ± 0.74	1.33 ± 1.23	0.28	0.601	6.56	0.017	3.84	0.061
TTG	2.33 ± 1.61	0.83 ± 0.72 *						
			Good unmarking					
CTG	4.07± 1.67	4.67 ± 1.88	0.007	0.933	0.17	0.688	2.64	0.117
TTG	4.92 ± 2.07	3.92 ± 2.39						

Table 3. *Cont.*

			Group Effect		Time Effect		Time × Group	
	PRE	**POST**	**F**	***p*-Value**	**F**	***p*-Value**	**F**	***p*-Value**
			Bad unmarking					
CTG	1.60 ± 0.91	0.80 ± 0.86 *	0.42	0.525	1.28	0.268	2.99	0.096
TTG	1.33 ± 0.65	1.50 ± 1.83						
			Good decisions					
CTG	9.93 ± 4.85	14.67 ± 5.08 *	1.62	0.215	10.58	0.003	1.60	0.218
TTG	9.17 ± 5.39	11.25 ± 4.83						
			Bad decisions					
CTG	3.47 ± 1.92	1.27 ± 1.03 *	0.35	0.561	11.46	0.002	1.94	0.176
TTG	3.17 ± 2.29	2.25 ± 2.30						
			Good marking					
CTG	6.67 ± 2.64	6.33 ± 2.19	13.91	0.001	0.006	0.939	0.29	0.595
TTG	3.75 ± 2.22 #	4.00 ± 2.00 #						
			Bad marking					
CTG	5.13 ± 1.73	2.87 ± 1.96 *	1.96	0.174	1.36	0.255	13.22	0.001
TTG	2.58 ± 1.51 #	3.75 ± 2.56						
			Game involvement					
CTG	51.73 ± 15.88	57.40 ± 16.09	1.26	0.272	1.89	0.182	0.18	0.676
TTG	46.92 ± 15.61	49.92 ± 17.75						
			Game Performance					
CTG	0.66 ± 0.09	0.84 ± 0.07 *	0.39	0.541	35.79	$p < 0.001$	7.49	0.011
TTG	0.70 ± 0.12	0.76 ± 0.08 *#						

* = $p < 0.05$ from pre match; # = $p < 0.05$ from CTG; CTG = Comprehensive Teaching Group; TTG = Technical Teaching Group.

The CTG showed lower values after the intervention in bad passes ($p = 0.001$, IC 95% = from 1.47 to 4.66, ES = 1.03), bad unmarking ($p = 0.042$, IC 95% = from 0.03 to 1.57, ES = 0.88), bad decisions ($p = 0.001$, IC 95% = from 0.94 to 3.46, ES = 1.15) and bad marking ($p = 0.001$, IC 95% = from 0.97 to 3.56, ES = 1.31), while the TTG showed lower values in bad catches ($p = 0.006$, IC 95% = from 0.48 to 2.52, ES = 0.93).

4. Discussion

When playing sports, school children must respond in an integrated way to the physical, physiological and technical–tactical demands of the game. The main purpose of this research was to determine the effects of different teaching methodologies (comprehensive-oriented vs. technical-oriented) during a unit of ultimate frisbee on the physical variables, technical–tactical variables, game performance and physical fitness of secondary school children. The results of the present study showed that students from the CTG had greater mean speed, mean heart rate and covered more total distance/time than the TTG during sessions 2 to 7. The CTG showed greater values in post- than pre-intervention in good passes, good catches, good decisions and game performance, while the TTG only showed higher values of game performance. In addition, the CTG showed a decrease after the intervention in bad passes, bad unmarking, bad decisions and bad marking, while the TTG only showed a decrease in bad catches. These results suggest that the comprehensive model had a greater impact than the technical model during the sessions on the physical variables, causing students to undertake more physical work in the physical education sessions, and on the technical–tactical variables, with an increase in the number of successful actions and a decrease in bad actions during the game.

Studies that have analysed the activity profile with other measurement instruments (accelerometers, pedometers, observational analysis) showed that the physical education lessons focused on games produced higher intensity efforts than the analytical skills contexts for teaching team sports [30,31]. The school children who participated in the CTG showed significantly better results on variables associated with physiological and running demands than those who participated in the TTG. The results are consistent with

other studies that have analysed physical variables under different teaching methodologies with GPS technology [2,21]. In addition, previous studies that have analysed the heart rate response of school children in different types of tasks and sport teaching models have found higher average heart rates with comprehensive methodologies that combine actions such as fast running, sprinting, throwing, unmarking and changes of direction during the games [21,32]. However, in the study of Garcia-Ceberino et al. [2], the average speed achieved was significantly higher in the technical teaching model. This discrepancy could be due to the school children's previous experience with the sport (in the technical programme, 42.9% of the students practised football out of school, while only 15% of the students who participated in the game-focused programme practised football out of school). Therefore, the game-based approach seems to be an adequate teaching model to improve the physical demands during the game in students without experience in the sport.

Under the conditions of teaching in the educational context where units last more than 6–10 sessions, it is necessary to choose the most effective teaching model to increase the acquired knowledge. In physical education, the efficacy of both teaching models, comprehensive and technical, have been analysed previously during team sports units with positive results after the intervention [21,33,34]. In our study, in which the participants were novices in ultimate frisbee, only CGT students improved in technical–tactical variables during the match (increase in successful skill execution and decrease in unsuccessful skill execution) and decision making after the intervention programme, in accordance with previous investigations focused exclusively on analysing the learning effects of comprehensive sport methodology [35,36]. In addition, although both groups improved their game performance results after the intervention, CGT students achieved significantly greater values than TTG; therefore, the game-based approach is the best option in context with small learning time.

Improving physical fitness is one of the most relevant objectives of physical education in order to promote the health status of the pupil [37]. However, one of the learning outcomes of the physical education curriculum in Spain is that students improve their physical fitness with respect to the initial levels achieved (Organic Law of Education in Spain (LOMLOE), in Royal Decree 217/2022, of 29 March, which establishes the organisation and minimum teaching of Compulsory Secondary Education). From this perspective, our study explored whether the physical demands of the pedagogical models used contributed to improving the physical fitness of the students. These results in our study in the Alpha–Fitness components assessed are not consistent with those shown by previous studies in which improvements in the components of physical fitness were observed in school children [38]. These differences can be explained by differences in the depth of the intervention units (six months vs. one month). Our study was adjusted to the natural conditions of curricular physical education teaching in schools in Spain, where the depth of the intervention units usually ranges between 4 and 6 weeks. A greater depth of intervention may be needed to have a positive impact on school children's physical fitness. Therefore, longer intervention units (>8 lessons) would be recommended for greater effectiveness of the comprehensive model in the students' physical fitness and sports learning [8].

This study had some limitations. Firstly, given that the students were novices in ultimate frisbee, generalisations on players with diverse level of playing skills should be made with caution. Secondly, the TTG model focuses on offensive techniques, though there was a focus on assessing defensive skills (marking)in this study; thus, this variable should be analysed with caution. In addition, the studied population was from the same region, making difficult to extrapolate the results in different contexts. Finally, the study's sample size can be considered small, thus, new studies with greater number of participants would be necessary to confirm our results.

Practical Applications

Taking into account the natural conditions of curricular physical education teaching, the comprehensive teaching model emerges as an effective method for learning invasion

team sports even in natural environments of teaching (curricular). Physical education teachers could focus their attention on the comprehensive model because it enables school children to improve their performance in learning sports in a holistic way.

Non-contact sports, such as ultimate frisbee, represent a recreational framework in physical education in which pupils can have fun and improve their motor skills. For this reason, we must offer school children physical activity proposals in which they can move more regularly and enjoyably, as is this case of ultimate frisbee. The use of recreational games in simulated competitive conditions is a framework that can help students to improve their motor skills and performance in sports.

5. Conclusions

According to the results of this study, students in the CTG supported higher physical demands during the development of the lessons (2 to 7) than students in the TTG, which may contribute to improving the school children's physical wellbeing and health. We suggest that the CTG is shown to be a better pedagogical option than the TTG to learn ultimate frisbee in high school. The students achieved a higher overall development in the physical variables expressed during the sessions, as well as in the management of the technical–tactical actions in the offensive and defensive phases of the game after the intervention.

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