Journal of Physical Education and Sport ® (JPES), Vol. 21 (issue 6), Art 481, pp. 3556 - 3568, December 2021
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Effects of the didactic model of game action competences on tactical performance, motivation, and perception of skill in young football players

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Published online: December 30, 2021
(Accepted for publication December 15, 2021)
DOI:10.7752/jpes.2021.06481

Abstract:
Purpose: This study compares the learning effects of the Didactic Model Game Action Competences (DMGAC) with the Didactical Model of Direct Instruction (DMDI) in tactical performance, motivation, and perception of skill in young football players. DMGAC is a new didactic model that is based on constructivism educational theory. It promotes the learning of tactical behaviors, decision making, autonomy, and cognitive development. This new model is intended to be used in extracurricular settings such as sport clubs with competitive purposes. **Method:** A randomized control trial was performed in parallel. The participants were 36 children (U11 yrs.), who practiced football regularly in an extracurricular sport program. Both didactic models were implemented to teach the fundamental principles of football during 12 sessions of 80 min and evaluated in three stages (i.e., pretest, post-test, and retention test). The experimental group implemented DMGAC with five didactic strategies (i.e., small side games, psychokinetic games, 1 on 1 situations, self-directed learning of technical skills, and global game or representation). The control group used DMDI with three didactic strategies (i.e., technical skills, simulated game situations, and global game). Tactical performance index, motivation, and perception of skill were measured with the System of Tactical Evaluation in Football, Sport Motivation Scale, and Tactical Skills Inventory Sports, respectively. **Results:** The obtained outcomes suggest that the fundamental football principles were learned more effectively through a constructivism-based model (DMGAC) (p = 0.020). The tasks proposed in this model promote the integral development of game competences and autonomy; in addition, there was a significant tendency towards intrinsic motivation and a tendency towards a greater perception of tactical ability. **Conclusion:** Based on these findings, the children who participated in a teaching program through DMGAC attained a higher tactical performance index than those who participated in a teaching program through DMDI.
Keywords: Pedagogical models, soccer, game-centered approaches, direct instruction model, tactical behavior, didactic models

Introduction

The learning of technical skills is a central component in the traditional teaching process of football (FIFA, n.d.; García-Angulo et al., 2019; Watson, 2013). This conventional concept stems from the logic that controlling the ball in the game guarantees the performance; thus, the performance in the game should be as high as the capacity of its practitioners to execute technical skills such as dribbling, passes, kicks, and controls. Therefore, football is taught through DMDI. Advocates of this model claim that the effort and the greatest amount of time should be directed towards the learning of technical skills with an objective of improving the control of the ball. This means that according to the conventional teaching process of football, the didactic of football is a didactic of technical skills (Blázquez, 1998; Bunker & Thorpe, 1982; Costa et al., 2011; Greco & Benda, 1998).

Tactical behavior is an essential part of the technical skills in sport games (Filgueira & Greco 2008; Greco, 2006). However, the teaching of tactical principles is barely included in the didactic programs of football because it is assumed that children have not yet developed abstract thinking (Costa et al., 2011; Uribe & Fuentes-García, 2020). When this content is included, the coaches try to determine the tactical behavior of young players by delivering information in the form of indications, corrections, and feedback (Mitchell et al., 2020; Valencia, 2015). Nevertheless, tactical behavior requires the player to make decisions and to solve problems that arise in the game (Sánchez, 2021); it involves opposition and dispute with an adversary where each player tries to overcome other player's actions with the purpose of achieving partial objectives such as gaining space or making a pass to a well-positioned teammate (Harvey & Pill, 2016; Jones et al., 2010; Olosová & Zapletalová, 2015; Riera, 1995). The idea of starting to teach tactical principles only after the child develops abstract thinking is based on a wrong concept of tactics (Arias, 2012; Wein, 2012). Tactical behavior is present in every game; when a child plays, he/she confronts multiple situations that require cognitive involvement to make better decisions during the game (Figueira et al., 2018).

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The modern development of sport games questions the secondary place of the tactic because in many cases, the cognitive ability of a player (expressed as tactical behavior) is superior to the technical skills and allows to overcome the opponent in game situations. In current sports, both technical and tactical training are considered to be equally important (Clemente & Mendes, 2011; Costa et al., 2011; Filgueira & Greco, 2008; Greco, 2006; Kannekens, 2010).

To balance the idea that sport games depend only on the technical skills, the didactic of school sports in the last three decades has proposed diverse didactical models for sport games such as *Teaching Games for Understanding (TGfU)* (Bunker & Thorpe, 1982), *Tactical Games* (Mitchell et al., 2006), *Play Practice* (Launder, 2001), *Tactical Decision Learning Model* (Gréhaigne et al., 2005), *Constraints-led Approach* (Renshaw & Chow, 2018), and *Game-centered Learning* (Slade et al., 2019); all abovementioned models are grouped into Game-centered Approaches (GCA) based on theories such as constructivism, cognitive learning, situated learning (Abad & Robles, 2013), ecological approach, dynamical systems theory, and nonlinear pedagogy (Chow et al., 2016; Machado et al., 2019; Renshaw & Chow, 2018). The differences between these didactic models and DMDI are tangible in the didactic strategies used, learning content, relationship of the player/student with the coach/teacher, and teammate interaction to solve tactical and strategic problems. These alternative didactic models focus on the competencies that the player should learn to properly perform during the game than on the actions that the coach must execute. The attention is not oriented towards the teacher as a bearer of knowledge, who provides information to solve tactical problems that arise in the game and who demands performance from the players; rather, the interest is focused on the development of players as the only ones who, through their actions, can intervene in the game. Therefore, the attention is directed towards the development of cognitive and behavioral abilities to solve tactical problems without having to learn pre-structured recipes to solve innumerable and varied actions of the game.

However, in extracurricular settings, mostly in sport clubs, the teaching of sport games (such as football) is strongly rooted in the execution and repetition of technical skills (Aisenstein et al., 2001; Alarcón et al., 2009; Josgrilberg, 2008). Coaching practice has been criticized for over-emphasizing conventional teaching, with an over-reliance on technique-focused direct instruction (tasks decomposed in drill-based practices) (Chow et al., 2016; Práxedes et al., 2019). For example, in Colombia, despite theoretical development and the creation of new models in the last two decades, innovations have had little resonance (Hoyos, 2012; Molina et al., 2016). DMDI is the most used model for teaching football in scope with a competitive orientation (Costa et al., 2011; Hoyos et al., 2012; Patiño, 2014). DMDI is used for teaching motor skills (Guzmán & Payá, 2020; Metzler, 2011); however, using DMDI, players hardly learn tactical behavior guidelines such as game principles (Clemente & Mendes, 2011; García-Ceberino et al., 2019; Harvey et al., 2020; Rocamora et al., 2019).

The question of how sport games should be taught is still controversial, and the debate between GCA and DMDI continues (Méndez et al., 2010; Mesquita, 2013; Singleton, 2010; Slade et al., 2019). Despite some evidence in favor of GCA, its superiority is not confirmed (Farias et al., 2019; Giménez, 1999; Mesquita, 2013). In addition, GCA were designed for physical education classes (Bunker & Thorpe, 1986; Bunker & Thorpe, 1982; Dyson et al., 2004; Hastie & Curtner-Smith, 2006; Launder, 2001; Metzler, 2011; Mitchell, et al., 2006; Siedentop, 1994), and most studies have been conducted in physical education settings (Harvey & Jarrett, 2014; Machado et al., 2019; Méndez et al., 2010). Alternative models to DMDI have not been consistently validated in extracurricular sport; therefore, DMDI is the more used model in the field of football, even for teaching tactical behavior to children.

GCA mostly focus on teaching to play through games by disregarding complementary components and processes of sport games such as technical skills, individual and collective coordination, 1 on 1 strategies, and player fitness. Moreover, the competitive context at sport clubs incorporates presser for winning on players, coaches, and parents, which complicates the implementation of didactic innovations. The abrupt change in DMDI for GCA is problematic; these alternative models require a deep knowledge of the sport and specific skills from the coaches (e.g., game comprehension, reflection, problem-based didactic, and questioning of skills); above all, the development of cognitive abilities through GCA requires more time than learning of technical skills through DMDI. In competitive settings, it is desirable to have a step by step adaptation to new ways of teaching when changing the focus from the coach to the game and players.

DMGAC is a good alternative for learning cognitive, procedural, and attitudinal competences for football practice (Arias, 2012; Arias et al., 2013; Valencia-Sánchez & Arias-Arias, 2017); this new didactic model is based on constructivism and promotes an implicit learning of game skills and the construction of knowledge through the manipulation of game situations and five didactic strategies (i.e., small side games with different focal points, psychokinetic games, 1 on 1 situations or duels, self-directed learning of technical skills, and finally the global game or representation) (Figure I).

DMGAC resembles some characteristics of previous GCA such as the game and the player as the center of the didactical process and the strategies to foster comprehension (e.g., questioning, reflection, and stimulus) for the cognitive development. It differs from other GCA (e.g., TGfU) in its competitive aim and complex content. While previous didactic models are intended for physical education classes and consider only the elemental knowledge of sport games, DMGAC considers specific content for improving the players´ performance (e.g., technical skills, fitness, 1 on 1 strategies, and complex tactical content) as the game principles that are specific for every sport game. DMGAC proposes the use of different didactic methods and techniques not considered by other models such as cooperative learning, coeducation, and autonomous learning (Metzler, 2011). Finally, from an ecological dynamical systems perspective, DMGAC proposes to improve game performance by considering three different but interrelated social systems, i.e., microsystem (1 on 1), mesosystem (group vs. group), and macrosystem (team vs. team). DMGAC can be introduced step by step to the coaching practice and considers innovative strategies for the learning of complementary elements of the games with an objective of learning the technical skills (Coyle, 2009; Ericsson, 2006; Valencia & Arias, 2016).

This study compared the learning effects of DMGAC with the learning effects of DMDI in young football players participating in a program to learn the fundamental tactical principles of football in a competitive context.

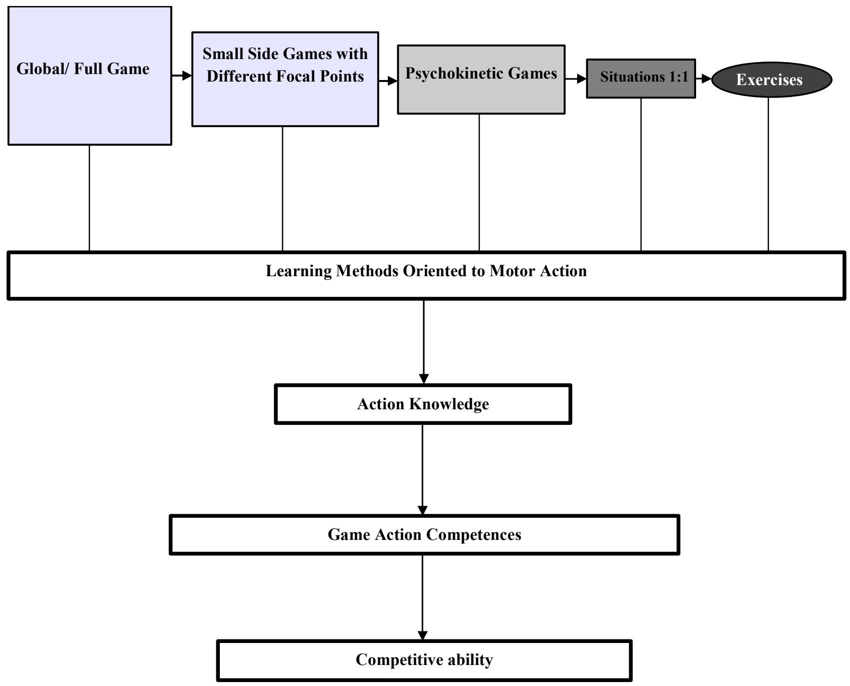


Figure I. Didactic Model of Game Action Competences (Arias, 2012)

Materials and methods

Design

A randomized control trial was performed in parallel (Friedman et al., 2015; Hernández et al., 2014). The participants were taught with DMGAC or with DMDI during 12 sessions and assessed during three stages: pre-test, one week before the start of the didactic process; post-test, one week after finishing the process; retention test, nine weeks after the end of the intervention. This final test was performed to check the duration of learning of each didactic model (Figure II).

RG_1	0	X_1	0	-	0
RG_2	0	X_2	0	-	0

R: Random assignment; G: Subject group; 0: Measurement; X: Intervention; -: Absence of the stimulus.

Figure II. Experimental design diagram

Participants

The study participants were 36 children between 8 and 11 years old (M = 10.04 ± 0.57), who practiced football regularly in the extracurricular sport program at a private school. These participants were selected on the basis of selection criteria. The study included fourth grade elementary school students enrolled in the football program affiliated with the health system; their parents supported their participation by signing an informed consent; the players signed an informed assent. The children were assigned to the experimental or the control group by a random procedure using the Program for Epidemiological Analysis of Tabulated Data (EPIDAT 4.2, Servizio Galego de Saúde, 2016). A total of 18 participants per group was a sufficiently large sample to evaluate the tactical performance index of football players because the statistical power of the study was 97%; therefore, the effect size was significant for the practice (Dorey, 2011). To calculate the statistical power of the sample of 18 players per group, the necessary data were obtained from the study of tactical performance in young football players that was performed in Portugal using the System of Tactical Assessment in Football (Sistema de avaliação táctica no Futebol, FUT-SAT) by da Silva et al., (2013), which found a difference of averages of 2.98 points between winning and losing teams. The probability of committing type II error was obtained with the difference of averages of 38.9 and 41.88; the standard deviation was 6.54, and the group size was 18 participants per group with $Z\beta = -1.93$, $p = 0.0268$.

Measures

The assessment instruments used were:

- Tactical performance index: The system of Tactical Assessment in Football (*Sistema de avaliação táctica no Futebol,* FUT-SAT) developed by Costa, et al., (2011) at the university of Porto (Portugal) was used to assess the fundamental tactical principles. In this test, there is a 4-min small-sided game of 3 on 3 players with goalkeepers (Costa et al., 2011). The description of the test procedures can be found elsewhere (Costa et al., 2009; Costa et al., 2011; Moniz et al., 2020). The test was validated for football players of several age groups, including U11 players (Costa et al., 2011) (i.e., 9 and 10-year-old children), and it is frequently used to assess U11 players (Américo et al., 2016; Cardoso et al., 2015; Castelão et al., 2014; da Costa et al., 2010; Gonçalves et al., 2020; Machado & Teoldo, 2016; Machado, J. C. et al., 2019; Ueda et al., 2020). The mean age of the study participants was 10.04 (±0.57); only one child was 8 years old but he was born in December; thus, he was only several months younger than the 9-year-old children.
- Motivation: A questionnaire was used to measure the level of self-determination in motivation to practice football. The Sport Motivation Scale (SMS), which contains 24 items, was adapted to football (Calvo, 2006) at the University of Extremadura. For this instrument, the authors performed a cross-cultural adaptation (Epstein et al., 2015; Wild et al., 2005).
- Perception of game skill: The Tactical Skills Inventory Sports (TACSIS) questionnaire, which was developed in Netherland, was used. It contained 22 items (Elferink-Gemser et al., 2004). For this instrument, the authors performed a translation into Spanish and a cross-cultural adaptation following the guidelines proposed by Epstein et al., (2015) and by ISPOR's Translation and Cultural Adaptation Good Practice Principles (Wild et al., 2005).

For the translation and cultural adaptation of TACSIS into Spanish, two independent translators conducted a forward translation from the original language (English) to the target language (Spanish). The translators were Spanish native speakers who were fluent in English. They were asked to maintain the conceptual equivalence of the original version, rather than literal equivalence. An expert panel (which included: translators, researchers, and an expert linguist in Spanish) met to discuss the discrepancies between the two versions in Spanish until a unified version was obtained.

Two English native speakers who were fluent in Spanish separately translated back into English the unified version of the questionnaire. The back into English translated versions were discussed again by the expert panel, and a unified version was obtained. The equivalence between the original version and back-translation was evaluated. The items were rated as: A) Conceptual and linguistical equivalence to the original item; B) Functional equivalence with grammatical differences; and C) Without equivalence.

The expert panel met to discuss the discrepancies in equivalence (categories B and C) and to find an equivalent version in Spanish. The report on equivalence between original and back-translated versions was sent to the author of the original questionnaire for evaluation. The final version of the instrument was tested with a group of children between 8 and 12 years old to evaluate any difficulties in the understanding of the final Spanish version.

Randomization

This procedure was performed using the Epidat 4.2 software with a random number generator with a ratio of 1:1 or groups of equal size. For the bias control, a randomization stratified by sports experience was made; the children were divided into three groups, i.e., high, medium, and low experience. The data on the formal sports experience in football measured in years were obtained with an *ad hoc* predesigned survey. The obtained information was corroborated by the parents/guardians.

To control the selection bias, a randomization stratified by sports experience was understood as the starting age of participation in a team. According to the deliberated practice theory, the greater is the number of hours the person practices, the greater is the sports performance (Ericsson, 2006; Ericsson et al., 1993). Therefore, stratifying this variable, the equilibrium of the groups was guaranteed by the random process. Only formal practice was considered, i.e., organized sport practice (excluding playground games or bouncing a ball with friends).

Blinding of the evaluators

The names of the children were written in alphabetical order in each group, with a number assigned to each name. Using the random number generator software, the children were assigned to the experimental (DMGAC) or control (DMDI) groups. Randomization was performed by a person with knowledge of the procedure, but he did not know the children. The researchers only had access to the information when the groups were formed and were in the official lists of the institution.

The questionnaires were applied by a researcher who did not previously know the children, and he did not know to which group the players were assigned. The analysis of the videos was performed by the research group from the Centre of Research and Studies in Soccer (*Núcleo de Pesquisa e Estudos em Futebol*, NUPEF), who analyzed 18 games. The FUT-SAT protocol was used, i.e., both the teams from each group and the match that each team played were randomly assigned; this procedure was performed every 6 games (each moment of evaluation).

Bias control

Three pilot tests were performed to anticipate difficulties and determine the conditions necessary to comply with each of the protocols suggested by the instruments used. Information biases were reduced by training the person who conducted the surveys and performing the field test to standardize the assessment. The assessment staff was guided by a university lecturer with expertise in the subject area. The measuring equipment was calibrated (scale, height meter, and adipometer). Co-interventions of training hours in formal settings or in deliberated practice of sports games were also monitored weekly using an individual sports activity diary. An analysis by intention of treatment was performed with the aim of respecting randomization; specifically, the individuals were evaluated in the group to which they were initially assigned; the missing data of the quantitative variables with normal distribution were obtained through mean imputation.

Procedures

The experimental group implemented DMGAC that has five didactic strategies (Arias, 2012), i.e., small sided games with different focal points with a volume of 60%, psychokinetic games with a volume of 10%, 1 on 1 situations or duels with a volume of 10%, self-directed learning of technical skills with a volume of 5%, and a global game or representation with a volume of 15% during each training (Figure III).

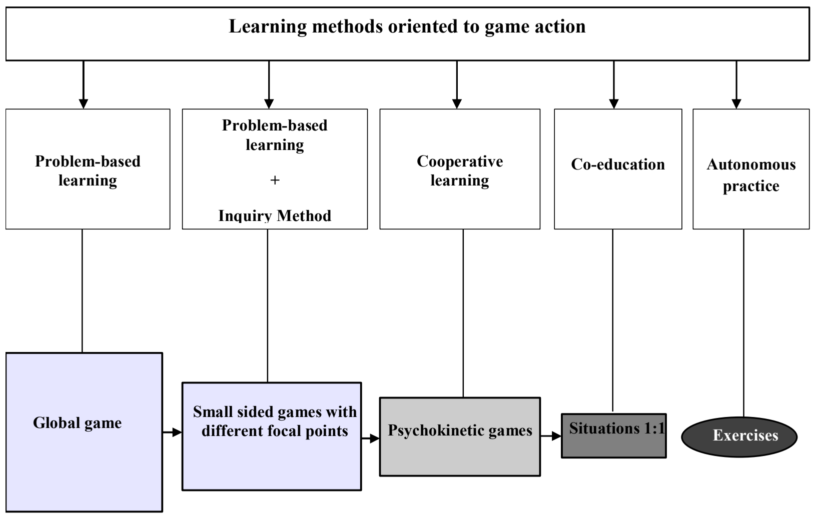


Figure III. Content oriented towards the development of autonomous players and high level of development of their cognitive abilities (Arias, 2012)

The control group used DMDI with three didactic strategies established according to the literature, as follows: technical skills with a volume of 40%, simulated game situations with a volume of 30%, and a global game with a volume of 30% in each training (Alarcón et al., 2010; Blázquez, 1998; Contreras et al., 2001; Giménez, 1999; Metzler, 2011; Sánchez, 1986). The two groups had the same learning contents called fundamental principles of football (Table I) (Costa et al., 2009).

Table I. *Distribution of learning content*

Class #	Topic
1	General Principles
2-3	Operational Principles: 2 Defensive – 2 Offensive
4	Defense–Attack/Attack–Defense Transitions
5-6	Fundamental Principles: Penetration – Containment
7-8	Fundamental Principles: Offensive Coverage – Defensive Coverage
9-10	Fundamental Principles: Mobility – Balance
11-12	Fundamental Principles: Space – Concentration

Ethical aspects

This study was approved by the ethics committee of the National School of Public Health of the University in session 110. The study was classified into the category of minimum risk and in compliance with the norms of the Helsinki declaration where the protection of privacy, intimacy, confidentiality, and anonymity of people and compliance of research with humans are guaranteed.

Data analysis

The normal distribution test ($n < 30$) was performed with the Shapiro-Wilk test to determine the distribution of the data. In the univariate analysis, quantitative variables were summarized through the measures of central tendency (mean and median) and variability measures (standard deviation and interquartile range). For data with non-normal distribution, the non-parametric Wilcoxon signed-rank test of intragroup analysis and the Mann–Whitney U test were used to identify differences between the experimental and control groups. For data with normal distribution, parametric statistics was applied to establish differences between two independent means using Student's t-test for independent means. The effect size was calculated using the adjusted Hedge's g to establish the magnitude of the difference. The percentages of change were calculated as: ([post-test value − pretest value]/pretest value) × 100. The analysis was performed with the objective of respecting randomization. For all analyzes, an alpha value < 0.05 ($p < 0.05$) and a reliability of 95.0% were set. The statistical package SPSS version 22.0 for Windows was used. The missing data of the quantitative variables were imputed according to the distribution of the data.

Reliability analysis in the observations

The reliability of the observations obtained with the FUT-SAT instrument for the first outcome was re-evaluated in 186 tactical actions (10%), which is a value that is recommended by Tabachnick & Fidell (2007). The evaluations were performed by three trained evaluators and members of the NUPEF group (research group responsible for the analysis of procedural knowledge) and by respecting an interval of 21 days (Robinson & O'Donoghue, 2007). The concordance Kappa index (Cohen test) was applied in the calculations, and the intra and inter-evaluator reliability was verified, which was between 0.90 and 0.94 with a standard error of less than 0.002; according to the literature, this is equivalent to an excellent Kappa index (>0.8); the performed observations are consistent (Martínez-González et al., 2014).

Results

Figure IV shows the flow diagram of the procedure. A total of 36 children who fulfilled the selection criteria were randomized to either the DMGAC experimental group or the DMDI control group. In the DMGAC group, three participants stopped their participation owing to physical injuries that prevented them from completing 100% of the program. One participant suffered a fracture in the fifth metatarsal; he had to leave after participating in 33% of the program. Two more children participated only in 66% of the program owing to sprained ankle and back pain; both children had concussions while participating in other sports.

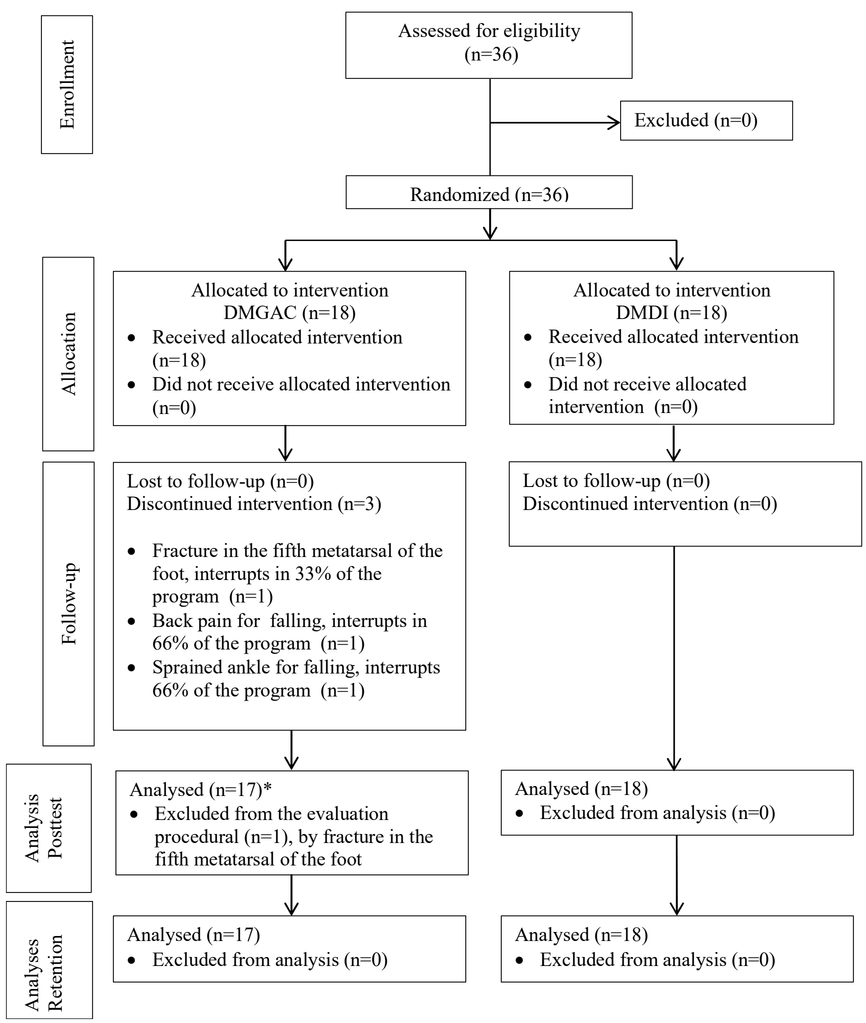


Figure IV. Flow diagram of the progress of the phases of the parallel randomized trial of two groups (Adapted from CONSORT in Cobos-Carbo & Augustovski, 2011)

Baseline data

Table II shows the baseline demographic characteristics for each group. The baseline data of the experimental and control groups are similar, without statistically significant differences ($p > 0.05$) in each of the known and measured variables, as in the unknown variables, owing to randomization stratified by sports experience at the beginning of the study.

Table II.
Baseline sociodemographic characteristics

	Gex (n = 18) M ± SD	Gc (n = 18) M ± SD
Age (years)	9.94 ± 0.79	10.13 ± 0.35
Percentage of fat (%)	15.79 ± 4.93	15.11 ± 6.45
Mass (kg)	33.61 ± 6.04	33.10 ± 5.00
Height (m)	1.39 ± 0.08	1.38 ± 0.46
Body mass index (kg/m^2)	17.16 ± 2.20	17.25 ± 2.09
Co-interventions (#)	0.50 ± 0.12	0.27 ± 0.10
TPI initial (points)	39.10 ± 5.71	38.02 ± 6.05
Learning disorders (#)*	3**	4***

Gex: Experimental group DMGAC; Gc: Control group DMDI; TPI: Tactical Performance Index
M: mean; SD: Standard deviation (±); *: number of individuals per group that have a learning disorder such as attention deficit and hyperactivity; **: one subject without treatment and two controlled (the first one is controlled with psychological therapy and the other one is medicated); ***: all subjects controlled with medications

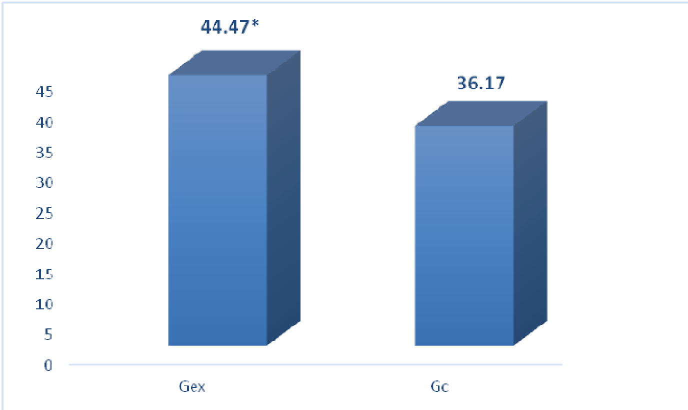
A total of 1854 tactical actions were evaluated; 590 were made at the baseline, 640 in the post-test, and 624 in the retention test. There was an increase in tactical actions of 8% in post-test and of 5.7% in the last evaluation compared to that in the pretest. Using the results of the tactical actions, an Index of Tactical Performance in the game was obtained according to ten tactical principles.

When comparing the experimental group with the control group in the pretest and post-test (Table III and Figure V), statistically significant differences were found with $p = 0.020$ (CI: 1.33; 14.05).

Table III.
Tactical performance index: Experimental group vs. control group

Test	Gex (n = 18)	Gc (n = 18)
Pretest	39.10 ± 5.71	38.02 ±6.05
Post-test	44.47 ± 6.44*	36.17 ± 11.45*

Gex: Experimental group DMGAC; Gc: Control group DMDI; values expressed with the mean and accompanied by standard deviation = ±; *: Statistically significant differences $p = 0.020$; Confidence interval: 1.33; 14.05



Gex: Experimental group; Gc: Control group
Figure V. Tactical performance index: Experimental group vs. control group

When calculating the effect size, it was determined that the tactical performance of 79% of DMDI soccer players was equal to or less than the average of DMGAC soccer players (Z = 0.80), which allows to infer that only 21% of DMDI participants have a superior tactical performance than the average of the DMGAC participants; specifically, the average of participants in the experimental group has a higher tactical performance index than 79% of the participants in the control group. In contrast, in the retention test was found that there were no statistically significant differences ($p = 0.93$) between both groups. The DMGAC group improved by 13% in the tactical performance index between pretest and post-test; 79% of DMGAC players achieved greater learning, according to the tactical performance index than DMDI players.

Regarding affective and motivational aspects, it seems that DMGAC has a tendency to increase intrinsic motivation (U = 160.50; p = 0.07). The motivation values decrease; however, they are not statistically significant between the groups (Table IV).

Table IV.

Experimental group vs. control group in motivation

	Test	Intrinsic Motivation	Extrinsic Motivation	Amotivation
Gco	Pretest	91.66(86.18-96.11)	66.11 (61.38-77.43)	21.25 (0.0-51.87)
	Post-test	88.47 (83.88-93-40)	61.66 (43.88-81.66)	7.05 (0.0-31.87)
	%	-3.48	-6.73	-66.82
Gex	Pretest	92.36 (86.31-98.05)	77.77 (55.90-92.56)	25 (1.87-50.62)
	Post-test	95.41 (86.38-100)	62.22 (36.59-81.25)	12.50 (0.0-25)
	%	3.30	-19.99*	-50*

Summarized values with medians, accompanied by interquartile range. Gco: Control group; Gex: Experimental group. %: Percentage difference between each pre-test and postest factor or subvariable. * Statistically significant intragroup differences p <0.01

It can be observed in Table 4 that both groups decreased the medians in the post-test. The value that decreased the most was the amotivation factor (66.82% and 50%) in each group and the least decreasing variable was the intrinsic motivation (3.48%) in the control group and a slight increase in the experimental group (3.30%).

In the control group the differences between pretest and post-test were not statistically significant according to a Wilcoxon signed-rank Test. In the experimental group there were statistically significant differences between the pretest and post-test of the factor corresponding to extrinsic motivation (Z = −2.983, p <0.01), similar to the amotivation factor having differences between medians (Z = −2.357, p <0.01).

The U Mann–Whitney Test was applied to establish intergroup differences. There were no differences in any of the three sub-variables, intrinsic motivation, extrinsic motivation and amotivation between the experimental group and the control group; however, intrinsic motivation the differences approximated to statistical significance, that is, there is tendency towards the effect, although it does not reach p value of less than 0.05 (U= 160.50; p = 0.07).

Regarding the self-perception of tactical sports skills in school-age players, there were no significant differences (Table V). Children tend to overestimate their performance (Aburachid et al., 2013). When the young players were asked to estimate their tactical level in a scale from 1 to 10, all of them pointed to a performance level between 8 and 9, both in pretest and post-test. However, their perceptions were not verified by coaches´ perceptions and a tactical performance assessment with FUT-SAT.

Table V.

Experimental group vs. control group in TACSIS

	Test	Positioning and deciding	Knowing about ball actions	Knowing about others	Acting in changing conditions	TACSIS Total
Gco	Pretest	5.00 (4.55–5.36)	5.00 (4.68–5.25)	4.40 (3.40–5.00)	4.87 (4.00–5.31)	4.86 (4.44–5.11)
	Post-test	5.00 (4.55–5.58)	5.00 (4.43–5.31)	4.30 (3.80–4.70)	4.87 (4.25–5.56)	4.81 (4.43–5.18)
	%	0	0	−2.27	0	-1.02
Gex	Pretest	5.00 (4.38–5.36)	5.00 (4.43–5.50)	5.00 (4.15–5.45)	5.25 (4.68–5.75)	5.00 (4.52–5.36)
	Post-test	5.05 (4.86–5.44)	5.00 (4-68–5.50)	4.90 (3.95–5.50)	5.12 (4.50–5.56)	4.95 (4.67–5.34)
	%	1	0	−2	−2.47	−1

TACSIS: Tactical Skills Inventory Sports; %: Percentage difference between each pretest and post-test factor

The highest median obtained by the experimental group was for *Acting in Changing* (5.25), while the control group obtained its best result for *Positioning and Deciding* and *Knowing about Ball Actions* (5.00).

In relation to the percentage between the pretest and post-test, the experimental group had a gain of 1% in *Positioning and Deciding*, and higher values are observed in the experimental group than in the control group in the post-test.

According to the Wilcoxon signed-rank test, there were no intragroup differences either in the control group (Z = −0.237, p > 0.05) or in the experimental group (Z = −0.327, p > 0.05). There were also no significant intergroup differences (U = 124.50; p = 0. 23).

Discussion

This study reinforces the results obtained by Lefteratos & Tsangaridou (2010). A review conducted from 1995 to 2010 on alternative teaching models (*Sport Education* y *Teaching Game for Understanding*) showed that game-centered Didactic Models improve declarative knowledge, decision-making skills, and motivation because interaction and participation of students are constant. Other studies verified an increase in game performance after applying sport education model and TGfU in didactic units for physical education classes (Morales-Belando et al., 2018; Rocamora, et al., 2019). Harvey & Jarrett, (2014) argue that GCA has greater tactical transfer and development of decision-making and execution skills. Thus, these models promote the ability to play, to make appropriate decisions, tactical awareness, and efficient execution of skills (Hastie & Wallhead, 2016).

A total of 79% of the DMGAC group achieved greater learning measured in the tactical performance index than the DMDI members. This result was obtained after the experimental group consisting of school-age players received a stimulus that consisted of 12 sessions distributed over 12 weeks of the intervention with a duration of 70 min per session (a total of 840 min). The DMDI group (with the main focus on teacher´s intervention and the learning of technical skills) did not obtain differences in learning after the program because their learning objectives were different. However, the transfer of technical skills to the game is again refuted, as demonstrated by the field test. In the retention test, there were no differences between the didactic models because the time without the stimulus was nine weeks owing to an unusually long vacation period. It could not be demonstrated which model produced a longer-lasting learning. However, a stimulus–response relationship is observed as one of the criteria of Bradford Hill (2015) to explain causality. If a stimulus is applied, the response increases directly; however, when the stimulus is removed, the effects disappear. Longitudinal research on models of teaching also recognizes that learning is complex and requires time (Gréhaigne et al., 2005).

Bunker & Thorpe (1982) state that the conventional didactic model (DMDI) generates a poor motivational climate, which is evident by the fact that as the age increases, the dropout rate also increases. In contrast, GCA promote motivation and increase the participation rate (Harvey & Jarrett, 2014; Méndez et al., 2010; Wallhead et al., 2013). This study confirms these results; the intrinsic motivation increased in DMGAC because an increase in the participation in the game (Wallhead et al., 2013), extrinsic motivation, and amotivation decreased; however, these values are not statistically significant (Table IV).

The TACSIS survey does not seem to reflect the tactical performance measured *in situ* (Nortje et al., 2014). The obtained results indicate that there was no clear relationship between the self-estimated level of tactical skills with the TACSIS and the tactical performance index (offensive or defensive) reached during the intervention period with DMGAC. It is also possible that the TACSIS measurement better represents the decision-making process in relation to the 11 vs. 11 game scenario (Nortje et al., 2014). Although in this study with young players there was a tendency of the experimental group to have better medians, there were no differences between the groups in the perception of sport tactical ability. The obtained results serve as the basis of the implementation and development of a didactic model with theoretical and empirical support, which helps the didactic processes that are performed in extracurricular sport stings such as at sports initiation schools and sports clubs. It seems appropriate that DMGAC is implemented for teaching sport games for educational purposes, and (unlike TGfU and related GCA) DMGAC can be also used for teaching sport games for competitive purposes. DMGAC is more successful in providing more learning value than DMDI when investing the same amount of time and resources. The positive effects on the learning of cognitive, procedural, and emotional competences requires a pedagogical tool with high educational value that adheres to the formative principles of conscious participation in the formation process, autonomy, understanding, responsibility, and cognitive development, which are promoted today as guiding principles for the training of integral football players.

A great challenge is the implementation by teachers and coaches of “new” didactic models, given that teachers return to previous practices due to insecurity (Mohr & Townsend, 2002). That problem seems to be common in the implementation of other "new and alternative" pedagogical approaches (Reid & Harvey, 2014). The main idea of DMGAC coincides with that of the coaches surveyed in the studies of Vilar et al., (2010); they believe that the tactical component should lead the teaching process of sport games. This study does not consider the principles of play in the same way as considered by Bunker & Thorpe (1986a), because tactical principles are common to all games. The principles regarded in this research are the fundamental principles of football (Costa et al., 2009), which generates greater specificity in the learning contents.

Conclusions and recommendations

In this study, DMGAC increased the tactical performance index with statistically significant differences compared with DMDI after 12 intervention sessions. Regarding motivation, there was a tendency for increasing intrinsic motivation in the experimental group DMGAC (U = 160.50; $p = 0.07$); in addition, the experimental group obtained higher scores in the perception of tactical sports skills, although there were no statistical differences between both groups. This study contributes to innovation in the area of sports didactic through empirical support, which allows researchers to be at the forefront of knowledge in relation to the subject. DMGAC proved to be a better model for learning tactical performance than the predominant model of context. However, it is recommended to replicate the study and compare the learning effects of DMGAC with a didactic model that has similar learning objectives (Metzler, 2011), e.g., Teaching Game for Understanding, Tactical Games Approach, and Play Practice Approach. It is recommended to replicate the study in other age groups of football players and other sport games. Future studies should increase the number and frequency of teaching sessions and perform a retention test after shorter periods of non-intervention.

Limitations

The retention test was performed nine weeks after the end of the intervention. This occurred because the participants were in the school vacation season. This long time of recess before the retention assessment prevents observing the learning effects of didactic models as a function of time.

The intervention time that was used in this study was the minimum recommended by previous studies. Thus, the learning effects of the alternative didactic model failed to verify effects on motivation (amotivation and extrinsic motivation) and on the perception of tactical skills.

The sensitivity of the instrument used to assess the perception of tactical sports skills (TACSIS) should be reviewed.

Declarations of Competing Interest None

Acknowledgment

We would like to thank Montessori School for helping in this research and their students who participated in a training and assessment of skills in football.

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