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Tactical Games Model as curriculum approach at elementary school: Effects on in-game volleyball technical improvements

FRANCESCO SGRÒ[1] ✉, ROBERTO COPPOLA[1], PATRIZIA TORTELLA[2], MARIO LIPOMA[1]

[1]*Faculty of Human and Society Sciences, University of Enna "Kore", Enna, Italy*
[2]*Faculty of Educational Sciences, University of Bolzen, Bolzen, Italy*

ABSTRACT

Objective: To assess the effects of a tactical games model (TGM) instructional plan on technical volleyball performances of elementary school students by taking into account for sex. Method: Thirty-nine fourth-grade students participated in a 15-week unit developed according to TGM. Their improvements in technical in-game skills were assessed by means of Team Sport Assessment Procedure indexes: volume of play, efficiency index, and performance score. A 2(sex) x 3(time) ANOVA with repeated measure was used to verify the students' improvements. Effect size measures were used to interpret main effects and post-hoc analysis. Results: An overall large improvement resulted at the end of the instructional period, and this improvement seems to remain at least until the end of summer vacation. In pre-post training comparison, the improvements had similar moderate to large effect for both groups, while outcomes 'differences were negative between post-training and the end of summer vacation. Girls seem to achieve greater and well-established improvements throughout the instructional plan. Implications: Teachers have to take into account sex when designed their lessons because these factors can enhance student's learning processes. Furthermore, the results suggested the need to design developmentally adequate learning experiences during summer vacation for avoiding detrimental effect on students' learning scores.
Keywords: Physical education; TSAP; Sex differences; Motor Competence; Longitudinal data.

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✉ **Corresponding author.** *Faculty of Human and Society Sciences, Laboratory of Performance and Human Movement Analysis. University of Enna "Kore", Cittadella Universitaria, 94100, Enna, Italy*.
E-mail: francesco.sgro@unikore.it
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INTRODUCTION

Physical education (PE) and sport pedagogy are two scientific areas which addressed teaching and learning processes of concepts and skills related to sports and games. Indeed, physical education curriculums worldwide deal with learning aims related to the aforementioned elements and several national guidelines suggest developing adequate sport skills and attitudes throughout the school curriculum (D'Elia, 2019; 2020; Sgrò, Quinto, Platania, and Lipoma, 2019). About sport-based learning aims, Sidentop (1998) specified that throughout the physical education lessons and, if possible, the sport education curriculum a student may became a competent sport-person if he/she acquires adequate skills and game knowledge. Anyway, two significant issues have been identified in literature for reaching these aims: there are few sport education curriculums worldwide and the methods used to teach sport concepts and skills throughout PE curriculum are mainly oriented to the "*technical proficiency*" principle (Metzler, 2005). As a consequence, PE lessons are used for teaching technical skills and they are taught without a connection with the other gameplay components (Sgrò, Barca, Schembri, and Lipoma 2019) and are similar to volleyball training session (Notarnicola, et al., 2012; Greco, et al., 2019). In this perspective, the teachers use a command-oriented teaching style and formal games are normally proposed to establish a competitive learning context. As a consequence, the students' involvement is often minimal and the Sidentop's expectations is very hard to meet (Mitchell, Oslin, and Griffin, 2013). The worst consequences of this scenario resulted in the low level involvement of the less skilled students, who are often overlapping with the girls (Rovegno, Nevett, and Babiarz, 2001). In this respect, Allender and colleagues (2006) identified the bad experiences during school years as the most important explanation of the low level participation of the girls in sport and physical activities long life and the aforementioned issues can be considered as a possible reason of this evidence.

To challenge these issues related to PE teaching-learning process, several authors have addressed the use of a teaching method, named game-centred approach, which supports learning context based on the use of small-sided games (SSGs) for carrying out fun and educative lessons and for supporting full participation and involvement of the students (Dyson, Griffin and Hastie, 2004). By using the SSGs, all the students can be oriented to work on their zone of proximal development and move toward a learning progression beyond differences of sex (Van Acker, Carreiro da Costa, Bourdeaudhuij, Cardon, and Haerens, 2010). In this respect, few studies have addressed the effects of the game-centred approach by considering the sex as a mediating factor. Pritchard and colleagues (2014) verified as the use of the Sport Education Tactical Model (STEM) provided different effects on students' basketball gameplay performances (i.e., decision-making, skill-execution, and support) if applied in a single-gender or in a coeducational middle school class, respectively. They concluded that the use of STEM provided significant improvements in all the students, meanwhile limited gameplay performances differences resulted between boys and girls. Mesquita and colleagues (2005) proposed the use of the *Step-Game Approach* (SGA) to teach volleyball in middle school students (mean age: 13.5 years) and verified significant differences in tactical and technical improvements for girls. Araujo and colleagues (2016) used an hybrid approach (i.e., Sport Education and SGA) to teach volleyball in middle school students (mean age: 11.8 years) and verified, with longitudinal collection of data (i.e. pre-, post-training, and retention test tath was performed one week after post-training assessment) similar improvements in gameplay components (i.e., decision-making, skill-execution, and game involvement) for boys and girls at the end of the proposed instructional unit. Sgrò and colleagues (2018) used the Team Sport Assessment Procedures (TSAP) proposed by Grehaigne and colleagues (1997) for assessing baseline level of basketball and volleyball technical performances in middle school students (mean age: 12.90 years). They verified that boys performance resulted significant higher of girls' performance for all indexes both in volleyball and basketball.

Nevertheless, there are few evidences about the effect of standalone GCA approach by taking into account the students' sex as a factor. Furthermore, there are limited evidence about the use of these approaches to teach volleyball to elementary school children. Finally, according to the indication provided by Harvey and Jarret (2014), there is the need of more studies to assess long-term measurements of the effects related to these teaching strategies. Therefore, in a longitudinal perspective, the aim of this study was to assess the effects of an instructional plan, designed by using the Tactical Game Model (Mitchell, et al., 2013), on elementary school students' volleyball skills according to their sex. In this respect, we hypothesized that the plan lead to significant and moderate-to-large improvements for all the students at the end of the plan.

METHOD

Participants

According to Harvey and Jarrett suggestion (2014), thirty-nine students from two intact classes were sampled to participate in this study. They were 19 girls and 21 boys and their average age was 8.9 years old. The students were at the fourth year at the start of the current study while they reached the fifth year at the end of the project. They followed two physical education lessons per week, each one was 60-minutes long, and these lessons were carried out by using a skill-oriented teaching approach. Before the project started, each student provided an informed consent signed by their parents or legal guardians. The Board of the School and the Ethical Committee of the University of Enna "*Kore*" approved the design, the procedures and the methodological choices here used.

Instructional plan characteristics

The instructional plan was designed by the PE teacher according to the Tactical Game Model framework defined by Mitchell and colleagues (2013). She was trained on the use of this method for six months. Specifically, the plan was developed according to the indications provided for the levels no. 1 and 2 of tactical complexity and it was carried out from January to May. Each lesson was designed to address a specifical tactical problem related to the following game's phase: scoring, preventing, or restarting. About scoring, the tactical problems were: maintaining a rally and attacking; the problems related to the preventing were defending the space and defending against setting up an attack; finally, serve was the problem addressed for the restarting. Each lesson was developed by followed this schema: Game 1 - Practical Task - Game 2 - Closure. The activities proposed during the games were organized by means of small-sided games. Students were grouped according to the skill's level provided by their teacher and they stay in each group until they maintain the same skill's level. The game form used in this plan started from 2*vs.*2 and, during the last lessons, ended with 4*vs*4 games played in adapted court. Beyond the game forms, other adjustments were provided for supporting developmentally adequate learning phases, especially during the first lessons. In the practical task students performed technical skills strictly related to the lesson's tactical problem by means of in-game learning experiences. Closure was used to verify students 'understandings about tactical awareness. The validity of the designed plan was verified by an external research, who had several years of experience on the use of the TGM, by means of the use of the benchmarks for faithful implementation proposed by Metzler (2005).

Assessment method and procedures

The Team sport Assessment Procedure (TSAP) (Grehaigne, et al., 1997) was the method used for assessing the volleyball technical in-game performance of the students throughout the plan. The TSAP has been validated for reflecting students' technical learning changes and progression in participants aged from ten to 18-years (Arias-Estero and Castejon, 2014; Sgrò, et al., 2018). The framework for applying TSAP has showed in the Figure 1.

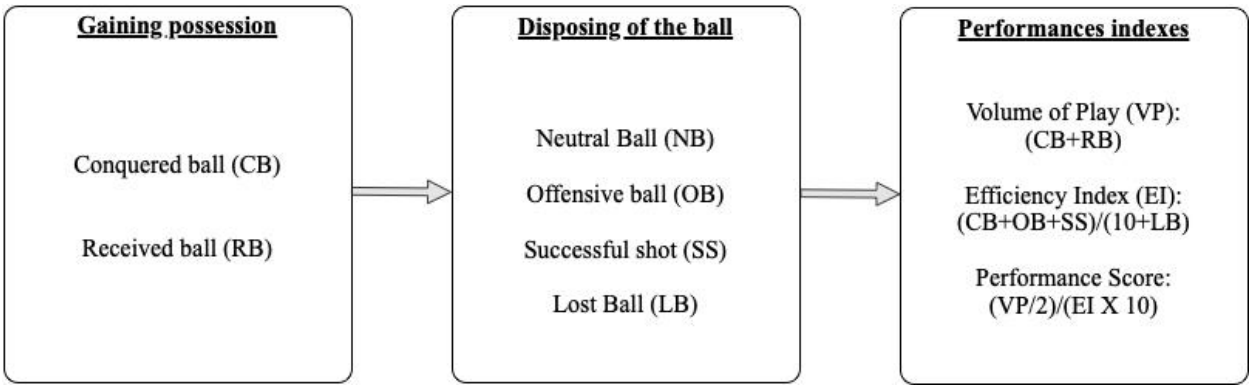

Figure 1. Team Sport Assessment Procedure framework.

The three indexes used for assessing students' learning changes are related to the following academic aims: the level of involvement of each students in the game' dynamics (VP), the level of technical efficacy of each player (EI), and an index which reflect the global level of in-game performance (PS).

The assessments were performed in the gym of the school and they were scheduled with this timing: during the first week of the study (PreT), in the lessons after the end of the instructional period (PostT), and in the first school week after the summer vacation (ReT). During the assessments, the team and the matches schedule remained the same. Each team was composed by four player and was a mixed-ability team according to the students' evaluation provided by the PE teacher before the project started. Each match was 10 minutes long, it was played in an adapted court, and it was recorded by means two action cameras located in the corners of the court. Two operators, who were trained on the use of the TSAP for one month, saw the videos of each match and assessed the performance of each student according to the components showed in the Figure 1. The software they used for the assessment procedures were: Kinovea, as advanced and performance-analysis oriented video player, and Excel for collecting performance data of each student in a separate sheet. Before they started their assessment procedures, the operators reached a consistent common interpretation of the criteria used for describing the TSAP components.

Data validity

With the aim to use valid data, the following procedures were performed. First, because the study time was very long and there were more than one assessment, we used only the data of the students who participated to the 85% of the lessons and completed all the assessments organized in this study. Second, the reliability of the assessments provided by the operators was verified. In this respect, the experts were separately when they saw the videos and rated the students 'performances; then, for each assessment and operator, the PS scores of 8 players randomly selected were assessed by using an agreement statistical figure. If the result of this test was higher the 0.80, the level of reliability for using TSAP was verified (Grehaigne, et al., 1997).

Data analysis

Reliability of experts' scores was assessed by means of intraclass correlation coefficient.

The values estimated for each TSAP index within each assessment were checked for verifying the assumptions required for the ANOVA. If they were met, 2 (sex) x 3 (time) ANOVA with repeated measures was performed. Main and interaction effects were estimated and, if necessary, multiple comparisons were performed by using Bonferroni-Holm post-hoc test. The interpretation of the results was based on the use of dichotomies null hypothesis testing, effect size measures (i.e., eta-squared and Cohen's *d* measure), and,

separately for between- and within-group analysis, we reported mean and 95% confidence interval (CI) and mean differences and relative 95%CI, respectively.

According to Cohen's thresholds, eta-squared was interpreted as follow: 0.01 = small, 0.06 = medium, and 0.13 = large. Following similar indications, *d* measure was considered as follows: 0.2 = small, 0.5 = medium, and 0.8 = large.

All the analysis were performed by means of JASP (JASP, Ver. 0.12.1) and the alpha test was set to .05.

RESULTS

The level of inter-observer agreement exceed for all the assessments the thresholds identified by the TSAP authors. All the students met the criteria identified about validity of data, but six participants resulted univariate outlier and their data were removed. Because all the other assumptions were meet, ANOVA with repeated measure was performed by considering a final group of participants with 16 boys and 18 girls. Table 1 show the results of repeated measures ANOVA. Because main effect was found for time, the table also show the results of within-group analysis for all the indexes in PreT-PostT and PostT-ReT comparisons, respectively.

Figure 2 outlines the game performance improvements of the students, grouped by sex, throughout the study.

According to the interpretation of the confidence interval length (i.e., the arms of the CI of the boys overlap the ones of the girls), there were not between-group differences in any of the assessment.

No significant effect was found for the interaction term sex x time. Anyway, with the aim to go beyond the null hypothesis testing, post-hoc analysis on time effect distinctly for boys and girls were performed and revealed significant improvements both for boys and girls from PreT to PostT, and a decline in their scores between PostT and ReT, as shown in the Table 2.

DISCUSSION AND CONCLUSION

Although several studies showed the priority to teach and assess fundamental movement skills during kindergarten and elementary school years (Sgrò, Quinto, Pignato, and Lipoma, 2016; Sgrò, Quinto, Messana, Pignato, and Lipoma, 2017, Haga, et al., 2018; Schembri, Quinto, Aiello, Pignato, and Sgrò, 2019), the relevant role of sport and games concepts and skills is well-established worldwide (Mitchel, et al., 2013; Harvey and Jarret, 2014; Sgrò, et al., 2020). In this respect, the purpose of this study was to assess the effect of instructional plan built by using the Tactical Game Model on the volleyball improvements of elementary school students by taking into account for their sex. With the aim to provide data which improves the current literature with evidence beyond the results of null hypothesis testing, results have been estimated and presented by considering mean or mean differences and the relative 95% confidence intervals.

According to the data show in Figure 2 and provide in Table 1, within-group analysis revealed large improvements across the assessments, while between-group analysis resulted without statistical difference for each of the assessment . With the aim to go beyond the lack of statistical difference for sex*time interaction results, data in Table 2 show, for boys and girls respectively, the differences of outcomes' means between couple of assessments. The improvements from PreT to PostT resulted similar for both groups in all the outcome's variables.

Table 1. Game performance by student's sex.

	Boys [n = 16]			Girls [n = 18]			Time effect						Sex*Time interaction	
									PreT-PostT comparison		PostT-ReT comparison			
	PreT	PostT	ReT	PreT	PostT	ReT	*F*		*MD*		*MD*		*F*	
	M(*SD*)	M(*SD*)	M(*SD*)	M(*SD*)	M(*SD*)	M(*SD*)	*p*	η^2	*95% CI*	*ES*	*95% CI*	*ES*	*p*	η^2
VP	9.50	13.25	12.37	8.33	11.77	11.67	10.98	0.14	-3.60	0.74	0.49	0.10	0.10	0.001
	(3.92)	(3.60)	(5.13)	(3.73)	(3.56)	(3.82)	<.001		[-5.35, -1.84]		[-1.87, 2.86]		0.89	
EI	0.52	1.01	0.87	0.48	0.97	0.78	33.51	0.37	-0.49	1.56	0.16	0.40	0.09	0.001
	(0.18)	(0.30)	(0.40)	(0.12)	(0.33)	(0.22)	<.001		[-0.63, -0.36]		[-0.01, 0.34]		Ns	
PS	10.57	16.77	14.91	8.95	16.10	13.76	27.45[a]	0.29	-6.68	1.24	2.10	0.39	0.13	0.001
	(3.97)	(4.50)	(6.28)	(2.91)	(4.63)	(3.98)	<.001		[-8.95, -4.41]		[-0.16, 4.36]		ns	

Note: PreT: Pre-Training Assessment; PostT: Post-Training Assessment; ReT: Retention Assessment. VP: Volume of Play; EI: Efficiency Index; PS: Performance Score; M: mean; SD: standard deviation; MD: mean differences; 95%CI: 95% confidence interval; ES: Cohen's measure.

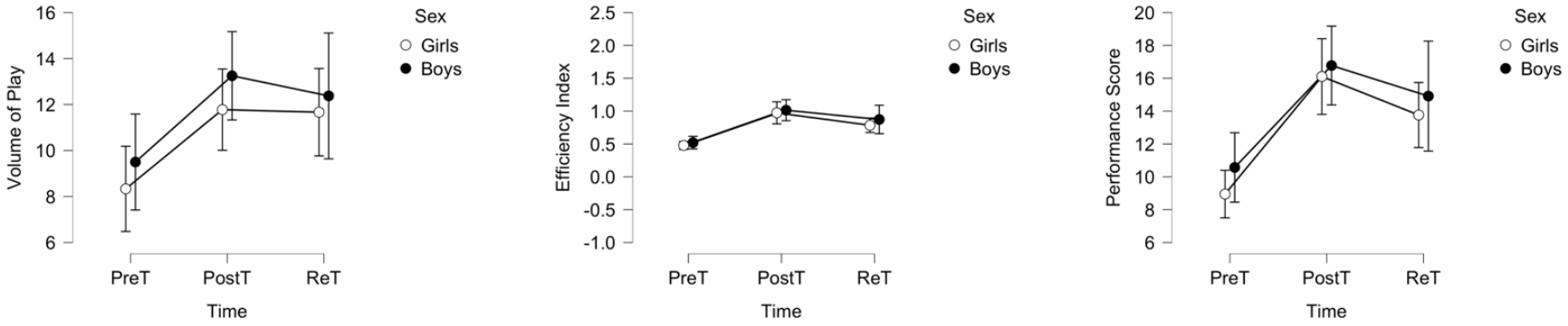

Figure 2. Students' outcome variables, grouped by sex, across the three assessment points.

Table 2. Students' performance differences throughout the study grouped by sex.

		Time Effect			
		PreT – PostT comparison		PostT – PreT comparison	
		MD 95% CI	ES	MD 95% CI	ES
Boys [n = 16]	VP	-3.75 [-7.44, -0.05]	1.03	0.87 [-2.81, 4.57]	0.21
	EI	-0.49 [-0.74, -0.24]	1.98	0.14 [-0.18, 0.46]	0.39
	PS	-6.20 [-10.29, -2.11]	1.46	1.86 [-2.23, 5.95]	0.34
Girls [n = 18]	VP	-3.44 [-6.92, 0.03]	0.97	0.11 [-3.37, 3.59]	0.03
	EI	-0.50 [-0.73, -0.26]	1.97	0.19 [-0.11, 0.49]	0.67
	PS	-7.16 [-11.01, -3.30]	1.84	2.34 [-1.51, 6.20]	0.54

Note: PreT: Pre-Training Assessment; PostT: Post-Training Assessment; ReT: Retention Assessment. VP: Volume of Play; EI: Efficiency Index; PS: Performance Score; M: mean; SD: standard deviation; MD: Mean Difference; 95% CI: 95% Confidence Interval for Mean Difference; ES: Cohen's d measure.

The parameter resulted with the highest effect difference for the scores of boys and girls was the performance score (i.e., mean difference of girl was 7.16 while the ones of boys was 6.20, while the length of 95%CI was similar). For what concern PostT-ReT comparison, the differences for all the outcomes resulted with less amplitude of the ones estimated in the other comparisons (i.e., the values of mean differences and effect size were the lowest). The volume of play of girls was the score with the lowest changes in this assessment point (i.e. difference of relevant mean was 0.10). Overall, the changes in the statistics related to efficiency index seems to assert that this outcome has been the most affected by the training and the best precision estimate (i.e., the effect size was the highest and the length of 95%CI was the lower in all the assessments and in the relative comparisons). According to the effect size measures, the girls seem to achieve greater improvements from the instructional plan. Previous studies affirmed the need to adequately considered gender differences when designing physical education teaching-learning processes (Gutierrez and Garcìa Lopez, 2012), even if contradictory evidences resulted by researches which addressed how sex differences influenced students 'improvements in sport-related PE curriculum (Araùjo, Mesquita, and Hastie, 2014; Harvey, et al., 2016). For example, Pritchard and colleagues (2014) concluded that game performance of boys and girls were similar at the end of a sport education tactical model teaching curriculum, while Mesquita and colleagues (2005) outlined greater technical and tactical improvements of girls when the *Step-Game Approach (SGA)* was used to teach volleyball to students of low secondary school. On the contrary, when the TSAP was used to assess volleyball middle school students' performances, the efficiency index of boys resulted higher than the one of girls (Sgrò, et al., 2018). Recently, Araùjo and colleagues (2016) proposed the use of a hybrid teaching approach (i.e., Sport Education and SGA) to teach volleyball and their results confirmed as boys and girls provided similar improvements in a longitudinal perspective. Overall, the previous evidences somewhat supported the current results. Anyway, the current evidences have to be considered of interest in the extent to which they provide quantitative data related to the standalone use of a tactical approach in elementary school and they were supported by statistics useful for their practical interpretation both for research than for teachers. Indeed, by strictly considering the comparison pre-post training, the effect size measures supported the educational validity of the provided plan.

By considering as a limit the lack of results about the tactical awareness and the relationship between the psychomotor and affective domains of learning, future studies should be designed for taking into account the forecited elements with the aim to provide a more completed educational perspective of the effects related to the provided plan.

In conclusion the current results provide two practical implication for the PE teacher at elementary school students. First, the use of the TGM seems to be adequate to provide learning experiences beyond the differences of sex, even if aims related to a technical perspective of the sports and games are considered. Second, the summer vacations provide similar negative effect on the PE learning aims here analysed beyond the difference of student's sex, therefore it is necessary for the teachers organize educational activities for supporting the learning processes also during this vacation time.

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