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Original Article

Game-play development according to the context of practice and students' sex and skill level: an action-research study in two invasion-games sport education seasons

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Abstract
This study conducted an examination of students' game-play development (performance and involvement) in two invasion sport-based games (handball; football) and contexts of practice (competition and team practice) according to sex and skill. A between-group comparative analysis was also conducted to examine differences in the impact of the Sport Education (SE) program on students' game-play development while taking into account the total time of participation along the units in the game form in which students were evaluated. A quasi-experimental pre/post-test approach combined with an action-research methodology was used. One entire seventh-grade class of 10 girls and 16 boys (M_{age} 12.3 ± 1.3) participated in two consecutives SE seasons: handball (8 lessons = 12x45-min) and football (9 lessons = 14x45-min). Game-play performance (Performance Index) and game-play involvement (Rate of Play) were assessed in the competition and team practice context for pre-test and post-test, in both sport-based games (handball and football). Paired samples T-Test were conducted as a within-groups analysis in each season and context of practice according to sex and skill. T-Test analysis and analysis of covariance (ANCOVA) were used to analyze differences between groups. The results suggested that student participation in SE facilitates game-play development in the various groups. Nonetheless, although there was a relatively equitable performance development and participation in games for sex and skill-ability, there was a slight benefit for boys and higher-skilled students. The study showed that students' game-play development was dependent on the context of participation. The competition context may be generally more favorable, particularly if teachers include strategies for promoting democratic, positive, and safe learning environments.
Key words: Student-centered models; **Physical Education**; **Tactical learning**; **Team practice**; **Competition practice**.

Introduction

The teaching and learning of sport-based games in physical education (PE) is a particularly prominent avenue to realize the integral education of every human being through the mastery of bodily and movement activities (Whitehead, 2007). In this vein, the effective teaching and successful learning of sports-based activities has long been a critical concern of practitioners and researchers in PE (Hastie & Mesquita, 2016).
Nonetheless, a growing body of research has consistently showed that children's game-play development is not a clear-cut outcome of children mere participation in games. Indeed, typically taught skills-drill, one-size-fits all approaches exclusively focused on motor and physical outcomes may do little, either to student multidimensional development, or to their explicit improvement of skills, fitness, or understanding of sport (Ennis, 2014). On the contrary, the learning of sport-based activities is strongly influenced by multiple and interrelated teaching and learning mechanisms of the motor, cognitive, social, and affective domains (Rovegno et al., 2001). Overall, there is extensive evidence that the quality of social relationships occurring between students (more equitable interactions free of discrimination and stereotypes) (Dyson & Casey, 2016) and the efficient collaborative problem-solving interactions and exchange between students (e.g. peer-teaching tasks) of knowledge, cultural identity and meaning (Ward & Lee, 2005) strongly impact on children's motor development. Also influential to student game-play improvement and participation are the developmentally appropriate nature of the learning tasks and activities (e.g., modified small-sided games) (Farias et al., 2018b) and the enhanced cognitive and active engagement of students in decision-making processes (e.g., managerial of sporting activities, identification of game problems and design of learning tasks) (Farias et al., 2020).

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The continual pursuit of improved education programs has set in motion a renovation of the PE curriculum towards implementation of several student-centered teaching models (Tannehill et al., 2013). The student-centered based curriculum aims not only at students' development of motor skills outcomes but that this process builds upon children's holistic development of interpersonal (democratic social interactions), cognitive (critical-thinking, decision-making) and personal skills (creativity, autonomy, responsibility) (Dyson et al., 2004; Silva et al., 2021). Amidst other well-established models, such as Cooperative Learning (Dyson & Casey, 2016) and several game-based approaches (e.g., Tactical Games model; Mitchell et al., 2020), in the last two decades Sport Education (SE) (Siedentop et al., 2020) has been a top pedagogical choice of the PE educational community. The 'popularity' of SE largely stems from its potential to simultaneously cover a diverse range of educational outcomes and promote a close cultural connection between the PE activities it presents to students and the societal constructions of sport they hold in their out-of-school lives. Indeed, SE prioritizes the development of students' skillful and intelligent participation in game-play activities (Competence). This experience is parallel to the development of a positive disposition to participate in PE and general physical activity (Enthusiasm) and the development of a healthy sport culture based on democratic interactions and equal participation contexts (Literacy) (Siedentop et al., 2020). Thus, SE applies in schools six major structural characteristics of sport, namely: (a) teaching units are reshaped into seasons; (b) students are affiliated with persistent teams that develop a unique identity; (c) records are taken of the teams' motor and social achievements; (d) students play different sporting roles (coach, referee, director); and (e) there is formal and regular competition unfolded in a marked climate of (f) festivity and celebration. Moreover, the singularity of SE comes largely from the particular internal pedagogical dynamics through which the learning of sport-based games takes place. Specifically, students learn the games in persistent learning teams through team practice sessions and regularly apply those game-play skills during formal competition events. In addition, the learning of sport content results mainly from extensive participation in small-sided games that are modified to meet the needs of students. Instruction takes the form of task presentations shared by the teacher and peer-coaches. With the teacher's scaffolding and sustained transfer of responsibility to students, a good deal of content delivery takes place during peer-teaching tasks and collaborative problem-solving activities where teams establish strategy and action plans to improve their game-play.

Presently, there is extensive evidence of student development of literacy and enthusiasm in SE (e.g., Bessa et al., 2020) and the consequent realization of social, affective, and cognitive outcomes (Bessa et al., 2019). Although less explored by research, existing research seems to indicate that SE can also positively impact on students' motor competence. In one of the few existing longitudinal studies, Farias et al. (2018b) showed a progressive improvement in time in students' development of game-play performance and participation across consecutive units of invasion games. Somewhat similarly, the study by Araújo et al. (2019) in volleyball showed that students achieved significant improvements in game-play from their first experience at the seventh-grade through to the end of the ninth-grade season. However, despite the positive results trend of the studies mentioned above, other research has consistently suggested that student development of game-play competence and participation is a nonlinear process that is highly dependent on multiples contextual and structural factors related to students' sex, skill-level, the nature of instructional processes and of the sport content, and the context of student game-play participation (e.g., Hastie et al., 2011).

Specifically, research in several sport-based games (e.g., Araújo et al., 2016; Mahedero et al., 2015: volleyball; Mesquita et al., 2012: football) reported residual pre-/post-test game-play improvement in boys and higher-skilled students and more pronounced improvements in girls and lower-skilled students. Conversely, the study by Farias et al. (2015) (football) showed game performance improvements in both girls and boys. On the other hand, the studies by Hastie et al. (2009) (badminton), Araújo et al. (2016) (volleyball) and Farias et al. (2015) (football) suggested that boys and higher-skilled students tend to outperform girls and lower-skilled students. In addition, the study by Hastie et al. (2017) showed that the game-play participation (rate of play) and performance of students in the various game-play events held along a handball season corroborated a superior performance of boys and higher-skilled students over girls and lower-skilled students. However, in Farias et al.'s (2015) study in football, the superior performance of boys found at the beginning of the unit faded away at the end of the unit. It should be noted that all these studies examined the evolution of game-play performance and participation only in an isolated teaching unit. Thus, there is still a dearth of information on the effect of students' sex and skill-level on their game-play performance and participation in games during their consecutive participation in several SE seasons.

In addition, research by Farias et al. (2018a) and Farias et al. (2019) argued that the different types of instructional interactions and level of students' active engagement in instructional processes employed during SE seasons can impact differently on children's game-play development. These studies suggested it might be easier for students to improve decision-making and have greater skill efficacy in handball-based games than in football-based games. Nonetheless, it was also shown that students' game-play development may benefit from their participation in consecutive seasons of games within the same category (i.e., invasion games). Importantly, the results suggested that even in feet manipulation-based games the more active involvement of students in more sophisticated instructional and content development SE processes (student-led questioning, task presentation,

game-problem identification, and task design) seems to be more favorable to game-play performance (e.g., decision-making) than lesson interactions in which students predominantly assume lower instructional responsibility. As a potential limitation of such research, the results did not consider the potential differential effect of students' sex or skill level.

Finally, although there remains a marked lack of research on this topic, two studies have shown preliminary evidence to suggest that the context of student participation in game-play activities (team practice or formal competition events) can be a highly impacting factor in the development of their game-play performance and participation. Namely, Hastie (1998) found higher percentage of game-play success and engagement (on-the-ball participation) for both boys and girls in the competition phase of a floor hockey SE season. These findings were not corroborated in the study by Hastie & Sinelnikov (2006) also in an invasion games (basketball) SE season. While most groups (boys/girls; higher-/lower-skilled students) tended to show lower game-play success during formal competition game-play, both the higher-skilled boys and girls showed higher game-play success and engagement than the lower-skilled boys and girls. This developmental trend was recently confirmed by Hastie et al.'s (2017) study in handball. However, Hastie et al. (2017) did not use a pre-/post-test protocol to verify students' potential game-play progression over time, nor did they differentiate the results obtained as a function of the context of game-play participation (team practice/formal competition events).

As per the literature review provided above, the effect of sex and skill level as well as context of student participation in game-based activities on the trend of students' development of game-play performance and participation lacks further empirical clarification, especially in the context of invasion games where the results seem to be inconsistent. Therefore, the purposes of this study were to: i) examine student development of game-play performance and involvement in different sport-based games (handball; football) and contexts of practice (competition and team practice) according to their sex and skill-level; and ii) to conduct a comparative examination (boys/girls; higher-skilled/lower-skilled) on their development of game-play performance and involvement in different sport-based games (handball; football) and contexts of practice (competition and team practice).

Material and Methods

Participants and setting

In light of the 'naturalistic' facet of the present research (see 'Design'), this study developed across the implementation of two consecutive seasons of SE: handball (8 lessons = 12x45-min) and football (9 lessons = 14x45-min). The research was carried out during compulsory PE lessons (one 45-mins session and one 90-mins session per week) occurring in the second school term (13 weeks) in an Elementary School in Northern Portugal. The school had approximately 750 students enrolled from fifth to the ninth grades in compulsory PE.

One entire seventh-grade class of 10 girls and 16 boys (M_{age} 12.3 ± 1.3) participated in the research. A high percentage of students had background experience, and/or were participants in extracurricular sporting activities. Prior to the research, students had participated in a 16-lesson volleyball SE season.

The class teacher was also included as an author in this article. The teacher's eligibility was based on the fact that he was currently placed in a real context of practice (the school where this study took place) and given his previous participation in other research projects focused on the implementation of student-centered models (Farias et al., 2021). The teacher had 12 years of experience teaching PE, both at an elementary and secondary level. In the past seven years, he had been implementing model-based practice (SE, Tactical Games model, Game-step approach, etc.) in the day-by-day of his PE teaching practice regarding different curriculum sport-based games (invasion games, net/wall games, etc.).

Contextual requisites. The sport content of the SE seasons (handball and football) was defined according to the mandatory curriculum guidelines set by the school's PE department for the seventh-grade. This allowed to preserve some of the contextual conditions of the implemented program; namely, the focus in two games with similar tactical structure and within the same category (invasion games) (Mitchell et al., 2020).

It should be noted that the participants had been involved in a SE volleyball season in the first term. However, authorization for data collection was only obtained from the school's board immediately before the start of the second term. Hence, the present investigation was 'delimited' to the events taking place in the second term. The length of the two SE units (26 x 45-min lessons) coincided with the total number of lessons available in the second term.

Design

Although this study preserves a quasi-experimental pre-/post-test approach to data collection, it also centers on a research (and pedagogical) environment where the teaching-learning process of games took place in a naturalistic way. That is, the development and participation of students in game-play was investigated during the implementation of SE by a teacher during the 'natural' exercise of his professional practice, as it could happen in any real-life PE class.

Action-research methodology. An action-research methodology was used to help the participant teacher pursuit the progressive improvement of his teaching practice (Farias et al., 2018a). It was assumed that such

(potentially) improved teaching practice would impact positively on students' gradual game-play development (Iserbyt et al., 2016).

The action-research methodology entails a set of epistemological benefits for the understanding of game-play performance and participation of children in PE. Firstly, the participant teacher was recruited as a collaborator of the research team. This touch of 'insider' action-research (Farias et al, 2018a) is an important means of accessing, and understanding in greater depth the complexity of contexts where pedagogical interactions occur (Bryman, 2016). Secondly, it provided the research team with the opportunity to keep pace with the teacher's ongoing critical reflection about his own teaching, thoughts, and considerations related to the daily unfolding of instruction and student game-play development. Thirdly, the detailed self-accounts of the pedagogies used allowed to establish a better understanding of the causality factors that typically inform process-product research. Fourth, the focus on a quasi-experimental pre-test/post-test data collection protocol addressed one of the typical 'shortcomings' of action-research studies generally exclusively centered on qualitative data. Thus, it presents objective measures (quantitative) of the potential evolution of the game-play performance and participation of the participating students as they participated in their teacher's action-research journey.

From an operational point of view, the research programme comprised two iterative action-research cycles (one cycle per each season – handball and football) of planning, acting and monitoring, reflecting, and fact finding (McTaggart, 1991). Guided by the objectives of the study, the procedures in the first (handball) and second (football) action-research cycles were informed by the pedagogical interventions deemed necessary by the teacher at each point of his perception on the effects of his instruction on students' ongoing game-play and involvement.

To meet the action-research methodological requirement of providing rich and detailed descriptions of the pedagogies taking place during the intervention programs and to integrate the reflective process as a habitual praxis of the teacher, he kept a field diary from the beginning of the school year in order to map and document his daily teaching experiences (and student responses to such practice). The teacher regularly conducted post-lesson reflections on: (a) the nature of the dynamics and pedagogical activities implemented in the lesson (e.g., student-led task presentation); (b) the students' behavioral responses to the implemented activities (e.g., their manifestations of satisfaction/dissatisfaction or effort/lack of commitment); and (c) the students' game-play responses (e.g., appropriateness and success of game-play actions). In short, the features of the SE season implemented in handball (the first action-research cycle) resulted from the reflection process previously held by the teacher-researcher on the course of his teaching in the first term. In addition, the fact-finding emerging at the end of the first action-research cycle (handball) informed the planning of the general plan of action to be implemented in the second action-research cycle (football).

Research team role and interactions. In addition to the teacher-researcher, the research team included two experienced teacher educators who had a wide professional/research background in student-centered teaching models (e.g., SE, Tactical Games Model, Game Sense). The experts worked as 'specialist consultants' (Bryman, 2016). To examine an intact teaching-learning context and to preserve the routine circumstances and real-time issues that the teacher and his class faced on a day-to-day basis ('as naturalistically occurring events emerged'; Rovegno et al., 2001), it was agreed that the teacher should be given full decision-making autonomy. Thus, he was the chief responsible for making decisions on the structure, planning and practical implementation and ongoing managing of the SE season. In keeping with the study's quasi-experimental features, the research leaders only asked the teacher for the following requirements: (i) to start and end each season through a competition lesson; (ii) that in these events the teams played against the same opponents; (iii) that the second and penultimate lessons in each season should include team practice of the same 3v3 game form; and (iv) that the seasons should include the model-fidelity benchmarks of SE (e.g., Hastie & Mesquita, 2016).

Procedures

The participant students were clustered into two ability levels (i.e., n = 13, higher-skilled; n = 13, lower-skilled) based on the pre-test assessment of their game-play performance (i.e., performance index, PI; see data collection and analysis).

Before the study, consent to proceed with the study was gathered from the University's Ethical Committee Review Board. To get the permission for data collection, the research team provided detailed explanation of the study's goals and methodological procedures to all stakeholders (school principal, the school's physical education department, participants' legal guardians, and the participant students). Consent forms were signed by all participants and those involved in the project.

Program implementation

The SE features. Table I and II presents an overview of the two SE seasons. On the onset of the program, students were allocated into three teams (two teams of nine students, one team of eight students). The teams were formed to be heterogeneous (to allow peer-teaching interactions) but balanced with one another with respect to the number of girls and boys, players' skill-level and experience on handball and football. To facilitate and increase the time of student participation in the two seasons' 3v3 game form, each team (A, B, C) was divided in two sub-teams of four to five players. A regular round robin competition schedule generally unfolded,

on a rotational basis, through two simultaneously matches (A1vB1; A2vB2) with the third team taking up managerial duties (C1: court 1; C2: court 2).

The teacher included in the program all the 'non-negotiable' features described by Hastie and Mesquita (2016): (1) the season spanned a long period of time (handball: 12-lesson x 45-min; Football: 14-lesson x 45-min); (2) students were affiliated in persistent learning teams; (3) a modified version of the formal version of the sports were developed to create developmentally appropriate competition and game-play practice; (4) students undertook other responsibilities besides the role of players; and (5) there were extensive application of peer-teaching tasks and group problem-solving activities.

In addition, the students carried out similar managerial roles on rotational basis (referee, equipment manager, practice manager, score keeper, record keeper). A cohort of six students also performed peer-coaching roles (coach and co-coach). There was made an effort to capitalize on the personal skills and continually development of positive peer-leadership and peer-instruction of a cohort of six coaches and co-coaches. These students were kept in coaching roles across the two seasons (Farias et al., 2018a). To enhance game-play routines among teams, all students were kept affiliated into the same learning groups across the two seasons.

Table I. Overview of the SE handball season' features.

Season 1. Handball					
			Lesson Content		
Lesson	Time	BGF practice context	Practice task	BGF	Tactical concepts and skills
1	90-min	Competition	-	3v2+GK	Creating/using space in the attack Scoring
2	45-min	Team Practice	2v1	3v2+GK	
3	90-min	Team Practice	3v1	3v2+GK	
4	45-min	Competition	3v3 3v1	3v2+GK	Defending space/closing space
5	90-min	Team practice	3v1+1	3v2+GK	Passing Dribbling Control Support Shooting Cover Adjust
6	45-min	Competition	-	3v2+GK	
7	45-min	Team practice	-	3v2+GK	
8	90-min	Competition	-	3v2+GK	

Note. BGF: basic game form; GK: goalkeeper

Table II. Overview of the SE football season' features

Season 2. Football					
			Lesson Content		
Lesson	Time	BGF practice context	Practice task	BGF	Tactical concepts and skills
1	90-min	Competition	-	3v2+GK	Creating/using space in the attack Maintaining ball possession Attacking the goal Scoring Defending space Passing Dribbling Control Support Shooting Cover Adjust
2	45-min	Team practice	3v1	3v2+GK	
3	90-min	Competition	2v1	3v2+GK	
4	45-min	Team practice	3vs0	3v2+GK	
5	90-min	Competition	3v2	3v2+GK	
6	45-min	Team Practice	3v1+1	3v2+GK	
7	90-min	Competition	2v1 3v0	3v2+GK	
8	45-min	Team practice	-	3v2+GK	
9	90-min	Competition	-	3v2+GK	

Note. BGF: basic game form; GK: goalkeeper

Content development. The two invasion games seasons contained the following content development features: (i) the sport content of the two sports was developed in a problem-solving basis; (ii) there was extensive practice of small-sided games; (iii) the teams practiced, on a day-by-day basis, a 3v3 basic game form that was representative of handball and football; (iv) the game form of the two seasons kept an identical 3v3 format, framed in a 3v2 plus dynamic goalkeeper format (two goals, 20m x 15m full-pitch size); (v) the teams developed their game form game-play ability during team practice sessions; (vi) the formal competition events were exclusively focused on game-play of that same game form; (viii) the formal competition events were set accordingly with a championship schedule; (viii) the teams refined game-play skills and tried to solve the tactical problems encountered during the team practice and competition practice of the main 3v3 game form through participation in other small-sided-games (e.g., 3vs1; 2vs1) (Mitchell et al., 2020).

Importantly, as presented in Table I and II, there were two principal sites of student participation in the main 3v3 game form. The teams either participated in 'internal' game-play practice during team practice sessions or played the 3v3 game form against other teams during competition events that were spread across the lessons of each season.

Teacher's instruction, student responsibility and mediation strategies. As per the action-research based development of teaching practice, there were differences in the instructional dynamics implemented in the two seasons.

In handball, the teacher set the frame of tactical problems to be solved at a class level, the teams were tasked to select the small-sided games that best suited their teams' game-play development and to present those tasks to their teams with the teacher's assistance, and the feedback and monitoring of students' practice was shared by the teacher and the peer-coaches of each team.

In football, the teacher transferred to the teams a higher level of instructional responsibility. Students themselves were tasked to identify the most relevant tactical problems to be solved by their teams, the teacher taught students how to design personally suitable small-sided games and most of these tasks were presented by the peer-coaches with the teacher's assistance, and, either led by their peer-coaches or during collaborative problem-solving group discussions, students themselves monitored and provided feedback on their players' practice.

Participation requisites and equity. Table I and II shows the outline of students' participation along the units (team practice or competition) in each season's main game form. In seeking to promote equitable game-play participation among students the teacher used a sophisticated set of strategies for indirect mediation of equity, inclusion, and fair-play development. A detailed description of these strategies (e.g., active promotion of group reflection about social justice issues) may be found in Farias et al. (2021).

Data collection

The entire dataset included videotaped records of the 17 lessons (handball: 8 lessons = 12x45-min; football: 9 lessons = 14x45-min). Two crossed-angled cameras were strategically placed in the gym to capture all lesson events.

Coding of game-play performance and rate of play. A total of 48 games of 8-min each were considered for game-play coding purposes. Each student was assessed during participation in two games at each assessment point. That is, 10 minutes of interrupted game-play was fully coded for each student; the initial 5 minutes of uninterrupted play of the first and second game.

Within the whole dataset, for the competition data, six inter-team games were coded in every assessment point (each sub-team played 2 games: A1vB1; A2vB2; A1vC1; A2vC2; B1vC1; B2vC2; 6 games x 4 assessment moments = 24 games). Six intra-team games were also coded in every assessment point for the team practice data (each subteam played 2 games: A1vA2 + A1vA2; B1vB2 + B1vB2; C1vC2 + C1vC2; 6 games x 4 assessment moments = 24 games). This allowed to evaluate students' game performance in identical baseline conditions (i.e. playing against the same opponents) (see Farias et al., 2019).

Regarding the competition context, in handball and football, lesson 1 was considered for pre-test and lesson 8 and 9, respectively, were considered for post-test measures. Regarding the team practice measures, lesson 2 in each season was considered for pre-test assessment and the penultimate lesson in each season (handball: lesson 7; football: lesson 8) was considered for post-test measures.

Following the coding protocol used by Hastie et al. (2017) for assessing game-play in invasion games, three different game-play activities were registered at any time that a player: (a) made contact with the ball (pass, catch, or dribble); (b) was the target of a pass but did not receive it (targeted: due to overthrow or interception); (c) was available to receive a pass but the pass was not made in his/her direction; or (d) was involved in a shot on goal (either as a shooter or goalkeeper). In agreement, the students' game-play performance (performance index: PI) and game-play involvement (rate of play: RoP) were examined. The PI was computed based on two indexes: efficiency index and volume of play: (efficiency index x 10) + (volume of play/2). The RoP was calculated using the formula, successful game actions + unsuccessful game actions/participation time.

Coding of individual time of participation in 3v3 game-play. In total, 66, 3v3 games (32 team practice games and 34 competition games) occurred across the 17 lessons. To control the possible effect of students' playing time (in minutes of active play) on the evolution of their performance and participation in the game (see data analysis), the time of participation in the 3v3 games was recorded on a student-by-student, and lesson-by-lesson basis. The time count of a student's game-play participation began each time that student was lined-up to play and at the first game-play action of any in-game player (see Farias et al., 2021).

Requisites of coding uninterrupted participation time and game-play. The time count was stopped in the following events (Farias et al., 2015): (1) the ball went out of bounds; (2) the teams swapped courts; (3) the teacher, peer-coaches or any team member stopped the game to explain, provide instructions, or skill demonstration; (4) to assist injured players; (5) to manage disciplinary situations; (6) when students or the teams swapped roles (player-managerial); and (7) when the student whose practice time was being coded left the field to swap places with a substitute player.

Coders training and reliability. Intra-observer and inter-observer procedures were used for achieving reliability of the coding processes. In relation to game-play coding, the research team set up the successful and unsuccessful criteria for every category of the instrument. Secondly, using data not included in the final dataset, two coders (one member and a coder not related to the study) coded together one minute of 3v3 game-play of each student and in each sport. The collaborative coding proceeded until over 90% the game-play actions coded

presented an agreement between them. Then, the member of team research coded all game-play actions. A randomly selected sample of the coded data (25% of database exceeding the 15% value recommended by Hopking, 2000) was re-coded by the two coders three weeks apart from the first coding. Intra- and inter-reliability (Cronbach's) were higher than 0.90 showing a strong agreement (Van der Mars, 1989). Similar procedures were followed for the time of participation dataset. Intra- and inter-reliability (Cronbach's) were higher than 0.96.

Data analysis

Descriptive statistics were calculated for PI and RoP according to sex (girls and boys) and skill-level (higher-skilled and lower-skilled) for each season. Statistical analysis was conduct using IBM-SPSS 21.0 software package. Paired samples T-Test were conducted to analyze differences across two points in time (pre-test and post-test), in each season (sport-based games: handball and football) and context of practice (team practice and competition) according to the independent variables sex (boys and girls) and skill-level (higher-skilled students and lower-skill). T-test analysis was conducted to examine differences between groups (boys/girls; higher-skilled students and lower-skilled) in game-play performance and involvement in both SE seasons using Δ scores (Δ = post-test - pre-test). According to previous literature on possible differences in pre-test scores between sex (e.g., Farias et al., 2015) or skill ability (Hastie et al., 2017) and total participation time differences trends in SE seasons (Farias et al., 2021), it was also conducted an analysis of covariance (ANCOVA) using Δ scores as a dependent variable, sex or skill as fixed factors, and total time participation (team practice or competition) and pre-test scores as covariates. Statistical significance was assumed for $p < .050$. Cohen's d was calculated and interpreted using Cohen (1988) intervals small (.20), medium (.50) and large (≥.80) effect for t-test analysis, while partial eta squared (η_p^2) for ANCOVA using small (.01), intermediate (.06) or strong (≥.14) effect.

Results

Table III presents a representation of the score decrease and increase events in the two units. Tables IV to VII present the descriptive statistics and the statistically significant scores for game-play performance (PI) and game-play involvement (RoP) across the two data collection points (pre-test and post-test) and its effect (Δ = post-test – pre-test) in each of the two SE seasons (handball and football), regarding the two game-play contexts (team practice and competition). Model 1 corresponds to a T-test analysis that was used to assess between-group statistically significant differences. Model 2 represents an ANCOVA analysis that was used to check the differences between-group when adjusted by pre-test scores and total participation time in each context (team practice or competition).

Table III. Representation of the pre-test/post-test mean scores trend.

		Sex				Skill-level			
		Boys		Girls		Hskill		LSkill	
		Hand.	Foot.	Hand.	Foot.	Hand.	Foot.	Hand.	Foot.
Team practice	PI	⇑ *	⇑ *	⇑ *	⇑	⇑ *	⇑ *	⇑ *	⇑
	RoP	⬆	⬆	⬆	⇑ *	⬆	⬆	⇑	⇑
Competition	PI	⬆	⬆ *	⬆	⬆	⇑	⬆ *	⬆ *	⬆ *
	RoP	⬆	⬆ *	⬆ *	⬆	⬆	⬆ *	⬆	⬆

Note. Hand.=Handball; Foot.= Football; PI = performance index; RoP = rate of play; Hskill = higher-skilled students; Lskill = lower-skilled students. * Within-group analysis (pre-test/post-test: differences significant at $p < .050$); ⬆ mean score increment in time; ⇑ mean score decrease.

Within-group analysis

Regarding the team practice data, the overall trend of the descriptive statistics showed a pre- to post-test decrease in the PI mean scores of all groups. Conversely, the trend was opposite in the RoP mean scores with a pre- to post-test increase in most groups (except for the lower-skilled students in handball and football and girls in football). In the competition context, in both SE seasons, both the PI and RoP mean scores of all groups tended to increase from pre- to post-test (expect for the PI scores of the higher-skilled students, who decreased in time in the handball competition context).

As showed in Table IV despite the trend of the descriptive statistics, only six statistically significant effects were found in the handball season. In team practice, both boys and girls and both higher-skilled and

lower-skilled students showed a statistically significant decrease from pre- to post-test in the PI scores. In the competition context, the girls significantly improved their RoP and the lower-skilled students significantly increased their PI from pre- to post-test

As shown in Table VI, there was found eight statistically significant effects in the SE football season. In the team practice context, there was a significant pre- to post-test decrease in the PI scores of boys and higher-skilled students and a significant pre- to post-test decrease of the RoP scores of girls. In the competition context, there was a significant pre- to post-test increase in the PI mean scores of boys and higher- and lower-skilled students. Boys and higher-skilled students also significantly increased their RoP scores.

Between-groups analysis

The between-group analysis compared the PI and RoP scores of different groups (boys versus girls; higher-skilled versus lower-skilled students) in each SE season (handball and football) and context (team practice and competition).

Regarding the handball season, as presented in Table V, data from Model 1 showed statistically significant between-group differences in only one event related to the PI variable in the competition context. The time effects of the intervention program on PI were statistically significant higher in lower-skilled students when compared to their higher-skilled peers [higher-skilled = -5.30(21.87), lower-skilled = 21.25(33.30); T (24) = -2.402; p = .024; d = .57]. Model 2 found two significant main effects related to the PI variable. In the team practice context, although the mean scores of both lower- and higher-skilled students decreased from pre- to post-test, the effect was significantly higher for lower-skilled students when compared to higher-skilled students [higher-skilled = -18.75(3.44), lower-skilled = -37.21(3.44); F (1, 22) = 11.765; p= .002; η_p^2= .348]. In the competition context, the effects of the program were significantly higher for boys when compared to the effect on girls [boys =16.62(5.41); girls = -5.87(6.96); F (1, 22) = 6.109; p =.022; η_p^2= .217].

Regarding the football season, as presented in Table VII, data from Model 1 showed statistically significant between-group differences in only one event related to the RoP variable in the team practice context. While the mean scores of boys increased from pre- to post-test and the mean scores of girls decreased in time, the effect was significantly higher for boys when compared to girls [boys = .76(1.80), girls = -.82(.87); T (22,947) = 2.988; p = .007; d =.04].

Model 2 found two significant main effects related to the team practice context. In RoP, the boys/girls differences shown by Model 1 remained in the ANCOVA analysis [boys = .77(.40), girls = -.84(.52); F (1, 22) = 5.489; p = .029; η_p^2= .200]. Additionally, in the PI variable, although the mean scores of both lower- and higher-skilled students decreased from pre- to post-test, the effect was significantly higher for higher-skilled students when compared to lower-skilled students [higher-skilled = -7.27(1.57), lower-skilled = -2.39(1.57); F (1, 22) = 4.755; p = .040; η_p^2 = .178].

Table IV. Analysis within-group of game-play performance and involvement in handball.

			Pre-test	Post-test	Paired samples T-test		
Context		Grouping	M(SD)	M(SD)	*t*	*p*	*d*
Team practice	PI	Boys	52.53(26.76)	28.08(14.88)	4.068	.001	1.13
		Girls	52.95(37.19)	19.34(10.47)	2.783	.021	1.23
	RoP	Boys	9.07(4.50)	10.32(7.87)	-.685	.504	.19
		Girls	7.05(4.02)	8.47(1.40)	-1.271	.236	1.08
	PI	Hskill	65.64(26.25)	33.76(13.17)	3.696	.003	1.53
		Lskll	39.75(29.68)	15.67(6.87)	2.960	.012	1.26
	RoP	Hskill	8.47(4.44)	11.22(8.51)	-1.332	.208	.41
		Lskill	8.11(4.44)	7.99(1.60)	.104	.919	.04
Competition	PI	Boys	51.13(29.85)	62.49(22.83)	-1.259	.227	.43
		Girls	41.66(16.11)	44.21(20.49)	-.402	.697	.14
	RoP	Boys	9.65(5.65)	11.49(2.89)	-1.146	.270	.41
		Girls	7.74(3.10)	9.84(1.48)	-2.348	.043	.86
	PI	Hskill	68.18(17.52)	62.88(13.73)	.874	.399	3.60
		Lskill	26.78(10.89)	48.03(28.80)	-2.300	.040	.98
	RoP	Hskill	8.70(3.69)	10.73(2.43)	-1.833	.092	,65
		Lskill	9.14(5.94)	10.97(2.74)	-1.301	.323	.39

Note. The data are presented as means (standard deviation) in T-test and marginal means (adjusted by total time participation in team practice or competition and pre-test values) and standard error in ANCOVA. PI = performance index; RoP = rate of play; Hskill = higher-skilled students; Lskill = lower-skilled students; Δ = pre-test/post-test difference.

Table V. Analysis between-group of game-play performance and involvement in handball.

			Δ Model 1 T-test			Δ Model 2 ANCOVA		
Context		Grouping	M(SD)	*p*	*d*	MM(SE)	p	ηp2
Team practice	PI	Boys	-24.46(24.05)	.459	.29	-25.08(3.28)	.174	.082
		Girls	-33.61(38.19)			-32.61(4.17)		
	RoP	Boys	1.25(7.30)	.948	.03	1.79(1.54)	.632	.011
		Girls	1.42(3.52)			.55(1.97)		
	PI	Hskill	-31.88(31.10)	.517	.26	-18.75(3.44)	.002	.348
		Lskll	-24.08(29.32)			-37.21(3.44)		
	RoP	Hskill	2.74(7.43)	.234	.44	3.92(1.67)	.051	.162
		Lskill	-.12(4.05)			-1.30(1.67)		
Competition	PI	Boys	11.36(36.09)	.488	.30	16.62(5.41)	.022	.217
		Girls	2.55(20.04)			-5.87(6.96)		
	RoP	Boys	1.83(6.39)	.902	.05	2.51(.65)	.178	.081
		Girls	2.10(2.83)			1.01(.83)		
	PI	Hskill	-5.30(21.87)	.024	.57	17.72(9.34)	.246	.061
		Lskill	21.25(33.30)			-1.78(9.34)		
	RoP	Hskill	2.03(4.00)	.925	.04	1.90(.75)	.945	.000
		Lskill	1.83(6.41)			1.97(.75)		

Note. The data are presented as means (standard deviation) in T-test and marginal means (adjusted by total time participation in team practice or competition and pre-test values) and standard error in ANCOVA. PI = performance index; RoP = rate of play; Hskill = higher-skilled students; Lskill = lower-skilled students; Δ = pre-test/post-test difference.

Table VI. Analysis within-group of game-play performance and involvement in football.

			Pre-test	Post-test	Paired samples T-test		
Context		Grouping	M(SD)	M(SD)	t	p	d
Team practice	PI	Boys	20.48(7.65)	13.61(9.11)	4.003	.001	.87
		Girls	17.09(12.21)	15.52(9.81)	.540	.602	.14
	RoP	Boys	5.23(1.24)	5.98(2.12)	-1.686	.112	.43
		Girls	4.28(.67)	3.47(.99)	2.973	.016	.96
	PI	Hskill	19.42(8.63)	11.53(7.65)	4.651	.001	.97
		Lskll	18.94(10.78)	17.16(10.10)	.720	.485	.17
	RoP	Hskill	5.06(1.34)	5.45(1.87)	-.917	.377	.30
		Lskill	4.66(.91)	4.57(2.38)	.166	.871	.04
Competition	PI	Boys	11.11(7.67)	25.35(10.40)	-4.304	.001	1.56
		Girls	6.36(4.17)	16.13(17.23)	-2.035	.072	.78
	RoP	Boys	3.18(1.42)	4.96(1.62)	-3.461	.003	1.17
		Girls	2.65(1.39)	3.26(1.98)	-.956	.364	.36
	PI	Hskill	14.64(5.54)	26.56(14.52)	-2.817	.016	1.08
		Lskill	3.92(2.30)	17.05(11.90)	-3.645	.003	1.53
	RoP	Hskill	3.87(1.02)	5.03(1.45)	-2.674	.020	.93
		Lskill	2.08(1.17)	3.58(2.12)	-2.108	.057	.88

Note. The data are presented as means (standard deviation) in T-test and marginal means (adjusted by total time participation in team practice or competition and pre-test values) and standard error in ANCOVA. PI = performance index; RoP = rate of play; Hskill = higher-skilled students; Lskill = lower-skilled students; Δ = pre-test/post-test difference.

Table VII. Analysis between-group of game-play performance and involvement in football.

			Δ	Model 1 T-test		Δ	Model 2 ANCOVA	
Context		Grouping	M(SD)	p	d	MM(SE)	p	ηp2
Team practice	PI	Boys	-6.87(6.86)	.106	.65	-5.29(1.60)	.663	.009
		Girls	-1.57(9.20)			-4.09(2.07)		
	RoP	Boys	.76(1.80)	.007	.04	.77(.40)	.029	.200
		Girls	-.82(.87)			-.84(.52)		
	PI	Hskill	-7.88(6.11)	.053	.80	-7.27(1.57)	.040	.178
		Lskll	-1.78(8.90)			-2.39(1.57)		
	RoP	Hskill	.39(1.53)	.482	.18	.34(.48)	.601	.013
		Lskill	-.08(1.84)			-.03(.48)		
Competition	PI	Boys	14.24(13.24)	.436	.31	15.03(3.50)	.284	.052
		Girls	9.77(15.18)			8.51(4.51)		
	RoP	Boys	1.78(2.06)	.171	.57	1.92(.46)	.055	.157
		Girls	.62(2.04)			.40(.58)		
	PI	Hskill	11.92(15.26)	.831	.08	19.61(5.03)	.116	.109
		Lskill	13.12(12.98)			5.43(5.03)		
	RoP	Hskill	1.17(1.57)	.694	.15	2.19(.60)	.090	.125
		Lskill	1.50(2.57)			.48(.60)		

Note. The data are presented as means (standard deviation) in T-test and marginal means (adjusted by total time participation in team practice or competition and pre-test values) and standard error in ANCOVA. PI = performance index; RoP = rate of play; Hskill = higher-skilled students; Lskill = lower-skilled students; Δ = pre-test/post-test difference.

Discussion

This study examined the impact of student participation in an action-research/SE program on students' (pre-test/post-test) development of game-play performance (PI) and game-play involvement (RoP) in two sport-based invasion games (handball; football) and in two contexts of practice (competition and team practice) considering the participants' sex and skill-level. This study also conducted a between-group comparison on the effect of the program on students' game-play development and participation (post-test/pre-test differences). As an innovative methodological feature, the effect of the program took into account the total time over the two units that students participated in the game form (3v3) in which they were evaluated (pre-/post-test).

Overall, particularly in PI, the trend of the results was similar in the two sport-based games. There was a general pre-/post-test decrease in the PI mean scores in all groups in the context of team practice (handball: statistically significant for all groups; football: statistically significant for boys and higher-skilled students) but there was an increase in the PI scores of all groups in the competition context (handball: statistically significant for the lower-skilled students; football: statistically significant for all groups, except for girls). Conversely, both in handball and football, most groups increased their RoP scores both in competition (statistically significant for boys and higher-skilled students) and Team practice contexts (except for girls in football, and lower-skilled students in handball and football).

In the same vein, the comparison between the groups considering the pre-test scores and the total playing time of the students throughout the two units suggests that the effect of the program tended to be similar for all groups, as only four of 16 possible significant effects events were found. Namely, in handball, the program had a statistically different effect only on PI, both in team practice (the decrease in scores was more significant for lower-skilled students) and in competition (the increase in scores was more significant for boys). In football, there were found significant effects only in the context of team practice. The decrease in the PI scores was more significant for higher-skilled students than for lower-skilled students and the effect on RoP was more significant for girls than for boys (girls decreased their scores while boys increased their scores).

However, although the overall trend of the results suggests some degree of balance in the effects of the program on the different groups in their pre/post-test development of the PI and RoP scores, still, the benefits were slightly more pronounced for boys and higher-skilled students than for their respective counterparts. In total, out of eight possibilities (see Table III), boys showed six episodes of mean scores increments (three in each sport) and two decrease events (one in each sport) while girls showed five increment (three in handball, two in football) and three decrease events (one in handball, two in football). The higher-skilled students showed five increment (two in handball, three in football) and three decrease events (two in handball, one in football) while the lower-skilled students showed four increment (two in each sport) and four decrease events (two in each sport).

This trend of results both corroborates and refutes results of previous research on the learning of invasion games in SE. For example, the study by Pritchard et al. (2014) in basketball showed similar increases in both boys' and girls' performance variables (decision-making, skill execution). However, whereas in the present study girls showed increments in their game participation (RoP), especially in the competition context, in Pritchard et al. (2014) girls did not progress in their game involvement (an equivalent to RoP). This dissimilarity might be explained by the different format of the game forms in which the students' game-play was measured in the two studies. Pritchard et al. (2014) used a 3v3 with attack/defense numerical equality while the present study used a 3v3 but with a dynamic goalkeeper, which in practice always generated situations of numerical superiority (3v2) in the attack. It is thus suggested that with younger students (6th and 7th graders), participation in modified games that enclose facilitating rules may not only positively impact student performance but also their rate of participation in games, in particular, girls. The study by Hastie et al. (2017) in handball supports this premise and suggested that this type of modified game forms provide more time for players in attack to support properly, maintain possession or attack the goal more effectively.

In football, specifically, the findings in the present study partially corroborate the results by Mesquita et al. (2012) and Farias et al. (2015). Mesquita et al. (2012) showed a lack of improvement in boys' game-play performance and skill execution, while girls showed an increase in these components as well as in decision-making. In Farias et al. (2015), girls improved in four of the seven performance variables measured and boys only in two. In both studies, the authors argued for a possible ceiling effect on boys, who entered, and ended up with slightly higher scores than girls. However, this argument was not supported by statistical analysis. Conversely, in the present study, when controlling eventual pre-test differences and total time of participation along the two units in the assessed game form, the comparative statistical analysis showed a more equitable effect of the program among the groups. This suggests that the pedagogical measures implemented in this study (see methods) to ensure equity in the time of participation in the main game form of the units for all students may have been a potential differentiating factor. Indeed, based on the recommendations of very recent research (Farias et al., 2021), during the action-research, the teacher promoted an active mediation of the inclusive, democratic, and equitable participation of all students in the learning activities. This assumption reinforces the need for teachers to put into practice strategies such as the explicit organization of tasks with equal participation time, balanced recognition and scoring of game-play performance goals and inclusive social behaviors, or even the integration in the content development of explicit moments of group reflection on social justice issues that occur in the gym (Farias et al., 2020).

The present study also generated singular results regarding the variation of students' game-play performance and participation in different contexts of practice, revealing a complex interplay between RoP and PI in different students. Namely, in the context of team practice of the two units, all groups had a score decrease in their PI. Yet, their scores increased both in the PI and in the RoP in the competition context. In addition, apart from girls (only in football) and lower-skilled students (in handball and football), the remaining groups (and girls in handball) also increased their RoP in the context of team practice. These results may seem paradoxical, given that the context of competition is expected to place greater contextual pressure on students, which, intuitively, is expected to negatively affect their playing effectiveness. In fact, the studies by Hastie and Sinelnikov (2006) in basketball showed that almost all higher- and lower-ability boys and girls tended to show slightly lower game-play success rates in competition events when compared with team practice contexts. The apparent breakthrough found in the present study may be due to two key pedagogical facets of the implemented program. On the one hand, there was a strong concern on the part of the teacher to value all aspects of students' merit (not only in performance but also in personal and social development), both in the context of practice and competition. This type of self-referenced accountability context creates a learning climate where students feel more secure in making decisions, including when playing games (e.g., Perlman & Go Karp, 2010). On the other hand, these results may be the consequence of the strong pedagogical bend and focus on strengthening the peer-teaching activities and collaborative problem-solving taking place between students in the two SE units. The participation in team practice events was used for teams to train their game-play skills for subsequent application in competition events. In this case, the pre-test scores of the various groups of students in the two units in the context of team practice were high from the onset. Possibly, a facilitating context may have been created within the teams, with less pressure on-the-ball and on fellow opponents to facilitate learning and the game success of all team members. As the season progressed (i.e., in the post-test), it is possible that the teams have started to recreate within the context of team practice a setting of higher game-play pressure, similar to the circumstances that they would probably find in the last competition events. This may explain the post-test decrease in PI scores during team practice game-play where students might have experienced more pressing game-play conditions.

It should be stressed that the explanatory inferences made about the causality of the results need further empirical validation from future investigation that should also tackle potential methodological limitations of the present study. For example, variations in the interplay between PI and RoP development were complex to interpret. Further, students having improved their game participation (RoP) in the context of team practice even when they did not improve their PI suggests that the volume of participation in games may not always be a predictor of improvements in game-play performance. Such questions might only be answered by using mixed-

methods research. More eclectic data collection protocols may help crossing the identification of process-based factors related to the social and instructional interactions that occur within the teams, during different contexts of participation, with the behavior and patterns profile of students' participation in the game. In this sense, although the naturally occurring data in this study have benefited the understanding of the research problem in a real context of SE application, future research may benefit from randomized controlled trials that confront wider sampling of participants. Likewise, the present findings did not fully corroborate the results of prior research equally focused on invasion games, which suggests that more complex factors than the mere nature of the PE subject-matter may be influential in students' learning of sport-based games. Future research should not only continue the study of long-term learning in different individual and team sports, but should also carry out comparative studies taking into account different sports or school years typically disregarded by the research (e.g., primary and secondary PE).

Conclusions

This study showed evidence that the participation in SE teaching units facilitates the performance development (PI) and participation in games (RoP) of students of different sex and skill level. However, in general, girls and lower-skilled students benefited slightly less from the implemented program than boys and higher-skilled students. Further, the outcomes of this study strongly suggest that PE teachers should manage carefully the context of students' participation in game-play activities and the sport being taught. The game-play competition context may be more favorable for the emergence of higher PI scores whereas the team practice context is favorable to increments both in PI and RoP scores. In any case, the SE seasons should contain explicit strategies to promote democratic, positive, and safe learning contexts as pedagogies that encourage equity in game-play development.

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