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Research article

Sport Education and Direct Instruction Units: Comparison of Student Knowledge Development in Athletics

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Abstract
This study conducted a comparative analysis of students' knowledge development on athletics in Sport Education and in a Direct Instruction unit taking into account sex and initial skill level. The participants were an experienced Physical Education teacher and two sixth-grade classes totaling 47 students (25 boys and 22 girls). Each class was randomly placed in either Sport Education or Direct Instruction classes and participated in 20, 45-minutes lessons focused on shot put, hurdles and triple jump. Knowledge on athletics was assessed through a 25-items written and video-based test. The inter-group differences and improvements across time in the knowledge test were analyzed through the Mann-Whitney and Wilcoxon tests, respectively. There were significant knowledge improvements in both instructional approaches irrespective of students' gender and skill level. In Direct Instruction, the type of task organization, the high rates of repetition of movement patterns and feedback by the teacher were beneficial to student learning. In Sport Education, the autonomy granted to students in the control of the pace of task transitions by making on-going judgments on achievement of performance criteria, implicated students affectively and cognitively with the learning content. It was further supported that several models and teaching strategies should be taken into consideration when teaching Physical Education. Different approaches should be perceived as alternatives and teachers should retain the best in each according with the moment in the unit, student developmental stage, and the specific learning objectives in the task.

Key words: Physical Education, instructional models, cognitive outcomes, video-based assessment.

Introduction

While debate on educationally beneficial outcomes for students in Physical Education has spanned across a variety of learning domains (affective, fitness, and social outcomes) (Casey and Goodyear, 2015), student performance remains positioned at the center of the research interests (Harvey and Jarret, 2014; Rink et al., 1996). Nevertheless, both cognitive (knowledge) and motor performance (skills) conditions contribute to students' performance improvements (Farias et al., 2015). Indeed, in any physical activity where cognitive and motor domains are recruited inextricably, the alignment between a student's knowledge repertoire and her/his motor response may not be as straightforward as expected (French and Thomas, 1987). In line with these premises, research has advocated that an examination of the cognitive domain outside the practice field is critical for a more comprehensive measure of student performance (Blomqvist et al., 2001).

Despite the fact that the ways through which students' performance can be expressed and examined are highly sport specific (Rink et al., 1996), less attention has been paid to individual sports involving closed skills (Metzler, 2011), such as gymnastics or athletics. Traditional methods of knowledge testing have targeted principally low-order cognitive aspects (knowledge, comprehension, and application) through paper-and-pencil assessment of factual information on team sports (declarative and procedural knowledge) (Rink et al., 1996). The emergence of instructional perspectives, which place high emphasis on the cognitive domain of performance (Bunker and Thorpe, 1982; Griffin et al., 1997), has innovated the methods toward video-based assessment of game understanding (what, when and why to do) in team (Blomqvist et al., 2005; Oslin et al., 1998) and single games (Blomqvist, Luhtanen, Laasko, and Keskinen, 2000). In athletics, there was also a shift from a focus on content knowledge, such as rules and technical terminology of technique, to assessment of cognitive aptitudes such as analysis, application, and evaluation, and student ability to provide feedback on motor performance through video-based observations (Hastie et al., 2013).

The examination of students' improvements has long been grounded on assumptions on how students learn best (Rink, 2001) and cannot be dissociated from the specific instructional approaches used to produce such outcomes (O'Sullivan, 2013). Such instructional approaches for teaching Physical Education have been located in a continuum of teacher's directedness separating more teacher-centered (related to skills-based approach to content) from more student-centered approaches (emphasis on cognitive processes and social interactions) (Metzler, 2011; Rink, 2001). A classic example of a teacher-centered approach is the Direct Instruction (DI) model in which the teacher acts as the sole instructional leader who takes all the decisions on content development, class management and student engagement patterns (Metzler, 2011). The main priority in DI is the psychomotor domain because its underlying assumption concerning student performance is that some level of proficiency in elementary skills is necessary before proficient engagement in more complex game situations or tasks can be achieved (Rink, 1993). Thus, DI is designed for creating immediate success and "development of movement patterns and skills performed by students" (Metzler, 2011, p. 43). The high structured learning tasks permits close supervision by the teacher who "critically observes and

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analyses the movement patterns and skills performed by students" and provides "high rates of feedback on performance" (Metzler, 2011, p. 43). The skills are learned through teacher-directed instruction, shaping and modeling. Social interactions and affective outcomes are not explicitly addressed by DI curriculum and it is known to appeal to low-order cognitive processes. Thus, students' cognitive processes are recruited when they receive information from the teacher and internalize that information (McMorris, 1998). Also, when they are taught directly on rules and terminology or receive instruction and feedback on skills criteria as a means "to help them learn motor-skill patterns more quickly and proficiently" (Metzler, 2011, p. 179).

Research within DI is equivocal regarding students' cognitive outcomes. Students improved procedural and declarative knowledge assessed through written tests in rugby (Browne et al., 2004), while no improvements were found in badminton (Lawton, 1989), soccer (Mitchell, Oslin, and Griffin, 1995), and volleyball (Pritchard et al., 2008).

On the opposite side of the directness continuum lie the student-centered approaches for teaching Physical Education. Here, it is rejected the notion of learning as transmission and internalization in favor of looking at learning as a cognitively and socially active construction by students within a complex and culturally situated process (Kirk and Macdonald, 1998). Learning is a guided discovery process with tasks organized to enact cooperative work, problem solving, critical reflection and face-to-face interaction (Dyson et al., 2004). The Sport Education (SE) model (Dugas, 1994) is a high expression of a student-centered approach. SE has a multidimensional perspective on student learning as it simultaneously considers psychomotor (competence), affective (enthusiasm), and cognitive (literacy) outcomes. The primary features of SE include seasons instead of short units ("more time to learn"), affiliation ("work toward common goals"), formal competition ("games become meaningful"), keeping records ("built-in feedback"), culminating events ("recognition of excellence"), and festivity ("celebration") (Van der Mars and Tannehill, 2010, p. 307). As the actual season progresses, the students take greater responsibility for the organization and conduct of the unit by adopting leadership and management positions (role playing such as referees, coaches, statistician, or sports director are assigned to students). The instruction evolves through student face-to-face interaction and most of task presentations for knowledge and skill development take place through peer teaching and student-led cooperative activities within team practice sessions (Dyson et al., 2004). Students are also responsible for monitoring their teammates' learning and are held accountable on learning achievements through on-going performance records. The season concludes with formal competition events. The existing research on knowledge and skill development, although scarce, showed improvements in students' knowledge development (Farias et al., 2015; Hastie et al., 2009).

Some research has offered either a comparative or a combined examination of DI and SE in a variety of team sports. The outcomes were however somewhat inconclusive. Pritchard et al. (2008) conducted a comparative analysis between DI and SE in volleyball. Results revealed no significant difference between models for skills and knowledge while SE was more efficient in promoting quality game play. In rugby (Browne et al., 2004), results indicated that students in both groups (DI and SE) made significant improvements in knowledge of rules and in game skills.

Recently, other studies have begun to respond to the requests for more research on non-game-like activities such as aquatics, gymnastics, or in the case of this study, in track and field athletics. Nevertheless, to date, this is a poorly investigated area (Hastie et al., 2011b; Wallhead and O'Sullivan, 2005). The students' knowledge in track and field has been studied by Hastie et al. (2013), namely on the shot put, hurdles, and triple jump. The results showed that, while both groups (DI and SE) improved significantly in technical performance (examination of specific movement components) and performance measures (time and horizontal distance records), only the SE group made significant improvements in content knowledge. Nevertheless, this study did not consider students' sex and skill-level, which probably could interfere on the learning students' outcomes. Indeed, some students' characteristics, such as sex and skill level have been shown to be factors that hold considerable influence in student opportunities to participate in the activities and, consequently, have an effect on learning outcomes (Araújo et al., 2014). The fact that Hastie et al. (2013) observed positive results to the class as a whole, does not mean necessarily that both groups (boys and girls; higher and lower skill-level students) were given the same opportunities to learn.

The present study is part of a larger research project, which investigated the impact of two instructional approaches (DI and SE) on students' learning outcomes in athletics. Based on the same original dataset, while Pereira et al. (2015) published their results on the pupils' technical performance, the current study focused on students' content knowledge. Specifically, Pereira et al. (2015) found that, "while SE and DI approaches could both lead to improvements in the development of technical performance in track and field" (p. 125), the performance measures were markedly distinct when student sex and skill level were taken into account in the analysis. Girls and less skilled students improved technical performance in SE but not in DI.

Therefore, given the limited information provided by prior research on Physical Education with respect to cognitive learning and its scarce focus on athletics, the purpose of the current investigation was to examine the effects of SE and DI on students' content knowledge in three track and field events (hurdles, triple jump, and shot put), taking into account their sex and skill level. Results were examined in light of students' sex and skill level, two variables deemed critical in the study of learning outcomes in a wide range of Physical Education settings (Araújo et al., 2014; Gutiérrez and Garcia-Lopez, 2012).

Methods

Participants

Twenty-five boys and 22 girls of the sixth-grade aged between 10 to 13 years old (average age of 10.9 ± 0.8) of a northern school of Portugal participated in this study. The 47 participants were from two distinct classes involved in different instructional models: the SE model (9 boys and 10 girls) and the DI Model (16 boys and 12 girls), in track and field athletics. A female teacher with 19 years of experience oriented the track and field lessons in both the SE and DI classes. In addition, prior to the study the teacher participated in a workshop on SE aimed at in-service teachers' professional development. Two teachers and researchers with extensive experience in instructional models for teaching Physical Education conducted the workshop along two stages. The first stage included formal lectures to discuss the following topics: (1) instructional models and teaching styles in the context of Physical Education; (2) conception, purposes and characteristics of the SE model; (3) practical implementation of SE in track and field; and (4) research in SE (domains and empirical investigations). The second stage consisted of practical application of SE in the school context. The participants applied different SE units throughout the school year, track and field athletics included, under regular supervision by the team responsible by the workshop.

The ethical committee of the authors' university approved the present study. Furthermore, the parents or legal guardians of each student signed the informed consent letter to allow the participation of their child in the study.

The track and field athletics units

The SE season: The season was designed according to the features suggested by Siedentop et al. (2011). Students were enrolled in a 20-lesson season comprising all key features that confer validity to the SE model (seasons, persisting teams, formal competition, record keeping, festivity and a culminating event). In the first lesson, students were briefed about the educational goals and instructional procedures in SE. From lessons two to seven, the students learned the shot put, hurdles, and triple jump content. After guided practice exercises conducted by the teacher where she provided verbal and visual demonstration of content to the whole class, students practiced the events and roles in team practice sessions. In this period, the teacher together with the student-coaches shared the monitoring of student learning. Lessons eight and nine saw formal competition events. From lessons ten to sixteen, the students carried on with refinement practice of the three events based on student-coaches' led instruction and monitoring. Lessons seventeen to twenty were reserved for additional formal competition moments and for the culminating event (see Table 1).

During the season, students both performed and were held accountable on the observed behaviors in their roles as student-coaches, statistician, and officials (starters, timekeepers, and finishing judges assigned for running events and for taking measures in the jumps and throws) (Hastie et al., 2013). For example, the officials' efficiency and inherent knowledge on rules and protocols of athletics were scored and added to the teams' championship counts while the statisticians were tasked to monitor the progress in the achievement of performance

Table 1. Unit plans for the two instructional approaches (Pereira et al., 2015).

Lesson	Direct instruction	Sport Education
1	Triple jump, hurdles, and shot put formal introduction	Explanation of the model and competition format Allocation of teams and individual roles Teacher-directed introduction of the three skills
2	Hurdles formal instruction and practice	Student-directed instruction: Warm-up Teacher-directed instruction: Triple jump skills
3 -7	Triple jump, hurdles, and shot put formal instruction and practice	Student-directed instruction: Warm-up Teacher-directed instruction: Triple jump, hurdles, and shot put skills; formal instruction on rules and scoring protocols for events Within-team event practice and role practice (shared teacher- and student-directed monitoring)
8	Individual competition on shot put	Formal competition Day 1 and Day 2 Student within-team event and role practice: Student-directed instruction (shared teacher- and student-directed monitoring) - Warm-up/skills practice (triple jump, hurdles, and shot put)
9	Individual competition on long jump and hurdles	Formal competition Day 2 Student within-team event and role practice: Student-directed instruction (shared teacher- and student-directed monitoring) - Warm-up/skills practice (triple jump, hurdles, and shot put)
10-16	Triple jump, hurdles, and shot put formal instruction and practice	Student within-team event and role practice: Student-directed instruction (shared teacher- and student-directed monitoring) - Warm-up/skills practice (triple jump, hurdles, and shot put)
17	Free-choice practice on all three events	Formal competition Day 3 Student within-team event and role practice: Student-directed instruction (shared teacher- and student-directed monitoring) - Warm-up/skills practice (triple jump, hurdles, and shot put)
18	Free-choice practice on all three events	Formal competition Day 4 Student within-team event and role practice: Student-directed instruction (student-directed monitoring) - Warm-up/skills practice (triple jump, hurdles, and shot
19	Individual competition on all three events	Formal competition Day 5 Student within-team event and role practice: Student-directed instruction (student-directed monitoring) - Warm-up/skills practice (triple jump, hurdles, and shot put)
20	Individual competition on all three events	Finals competition Festive event

criteria by team members.

Information about task organization and learning content were provided to students in advance through a 'handbook' containing sample-learning tasks. The task cards contained schematic drawing of circuits and stations with exercises of increasing complexity. Additionally, weekly meetings between the teacher and the student-coaches were arranged outside the school time to develop their knowledge both on domain-specific athletics' content on particular instructional strategies related to task presentation, structure and management. The teams' practice sessions were organized in circuits including different stations of different levels of complexity. Students were granted autonomy to manage their engagement patterns. For instance, each lesson comprised an initial moment for team debate and analysis of students' performance based on their observations in previous lessons and information kept in records. Students were stimulated to make judgments against the intended performance criteria and then to decide on which task was more suitable to their current performance and when to make a transition to the next level. While in the initial lessons the teacher provided support to the student-coaches on task organization, students were primarily responsible for the management and organization of the class and tasks in almost every lesson.

The DI unit: Students in the DI group participated in a non-team-based, teacher-directed lesson format. During lessons one through sixteen the teacher directed the instruction focused on informing, refining, and application tasks relating to the selected events of hurdles, shot put, and triple jump. These lessons were interspersed with individual competition events (lessons eight and nine). Lessons seventeen to twenty included free-choice practice and individual competition on all three events. The teacher established the learning content, defined the model of technical movement, time and modes of student engagement in task and the moment for transitions. The teacher was responsible for the main managerial control. However, students were occasionally summoned to take distance measures in the long jump and shot put trials (distances, techniques, etc.) and take time measures during the hurdle's trials. No formal records were taken of these measures. Most of the practice was organized in lines of five-to-eight students. This kind of organization enabled high rates of practice trials and repetition of movement patterns and proximity feedback by the teacher (Hastie et al., 2011a).

Instructional and treatment validity

During the intervention phase of the study, the first author attended every lesson as an outsider observer to monitor the level of alignment between the teachers' procedures and instruction with those accepted as key pedagogical benchmarks in each of the two models (Metzler, 2011). After each class, the investigator discussed with the teacher some details of his observations regarding instructional procedures (Pritchard et al., 2008). A thorough account of instruction and treatment validity itemizing the teacher's and learner's processes, and the contextual and operational requirements is provided in the first study of this project (Pereira et al., 2015).

Data collection

Students' knowledge of the rules and technic execution of the three athletics events (shot put, triple jump and hurdles) was the dependent variable of this study. This variable was analyzed through the use of a test already validated and applied in Portuguese Physical Education context (Hastie et al. 2013). Firstly, it was created an initial draft of the knowledge test based on reference handbooks specific to track and field, as well as on the methodologies derived from (Hastie et al., 2013). After this phase, an experienced team of Physical Education teachers assured that the topics were in an appropriate match with the Portuguese curriculum orientations. Then, a panel of experts validated the test by rating each test item (question and answer) against four criteria: relevance, clarity, correctness, and technical soundness (van Vuuren-Cassar and Lamprianou, 2006). The test items that reached scored between 3.5 and 5 for clarity, relevance, and technical soundness were retained. Regarding correctness, each test item required to scored between 4 and 5 (absolute agreement).

The test consisted of 25 items that assessed knowledge in the following dimensions of the three events: knowledge of rules (3 questions) and techniques execution (9 questions), and video-based analysis of techniques (6 questions) and feedback selection (7 questions). Students were first given the question sheet for all items and afterwards they watched the video clips at both normal and slow speed, and they were able to provide answers where appropriate. The students watched each video clip separately (20 – 45s per question, depending upon the difficulty of the question), and had five more minutes to complete the test if needed. The total time for the test was 20 minutes. Since the test was a task completed within the Physical Education lesson, it had less impact on students than a formal assessment. One point was granted when students selected the most appropriate option out of three (A, B, or C). For example, in relation to hurdles, a question regarding rules was "an athlete will be declassified during a race if: …"; a question about knowledge on techniques was "what should be the trunk position during the hurdle's transposition (aerial phase)?"; a question for video-based analyses of technique was "what do you think about the position of the front leg and the opposite arm?"; a question about feedback provision was "what should the athlete change to cross over the hurdle faster?" In both units the test was applied in the first and last lessons.

Data analysis

The exploratory data analysis yielded non-normality of the distribution of data. The means and standard deviations (descriptive statistics) were calculated. Therefore, non-parametric statistics were used, namely the Mann-Whitney test for two independent samples (sex and skill level), to test the differences between groups in two assessment moments, the pre-test (PreT) and the post-test (PosT). The skill level groups were determined through a non-hierarchical cluster analysis using the k-means method with the number of clusters being fixed at two (Cluster 1: higher skilled; Cluster 2: lower skilled). The utilization

of the Wilcoxon test to each sex and skill level was necessary to test intra-group differences from the PreT to the PosT. In order to prevent a potential inflated error rate, a multiple-group comparison (Bonferroni correction) was used to adjust the alpha value, initially set at .05. The IBM Statistical Package for the Social Sciences, version 20, was used to data analysis.

Results

Analysis by sex

Table 2 shows the descriptive statistics of the PreT and PosT scores in the three track and field events (shot put, triple jump and hurdles) and in the total of scores of the three events of boys and girls. The table comprises the data from the two units.

Table 3 shows the results from the Mann-Whitney test comparing knowledge measures of girls and boys in the three track and field events and in the total of scores of the three events at the two assessment moments (PreT and PosT). In the SE unit, girls presented higher values than boys in the hurdles event at the PosT. No significant differences were found in the remaining scores between girls and boys. In the DI unit, there were significant differences between girls and boys in the shot put and in the total of scores of the three events, with girls showing higher values at the PosT.

Table 4 shows the improvements of girls and boys from PreT to PosT in the two units. In the SE model, both boys and girls showed statistically significant improvements in the shot put, triple jump and in the total of scores of the three events. In the DI unit, girls showed statistically significant improvements from PreT to PosT in the shot put and hurdles events and in the total of scores of the three events. Boys improved significantly in the triple jump event and in the total of scores of the three events.

Analysis by skill level

Table 5 shows the descriptive statistics of the PreT and PosT scores in the three track and field events (shot put, triple jump and hurdles) and in the total of scores of the three events related to the analysis grouping students according with their initial skill level (higher and lower skill-level). The table comprises the data from the two units.

Table 6 shows the results from the Mann-Whitney

Table 2. Means (±standard deviations) of the two assessment moments for both boys and girls.

		Boys (n = 9)		Girls (n = 10)	
		PreT	PosT	PreT	PosT
SE	SP	1.6 (1.7)	5.2 (1.0)	2.3 (1.0)	5.0 (2.1)
	TJ	1.7 (.7)	5.0 (1.6)	1.8 (.8)	4.3 (1.0)
	H	2.9 (1.5)	3.4 (.7)	3.4 (1.6)	4.9 (.9)
	Total	6.1 (2.3)	13.7 (2.0)	7.6 (2.4)	14.2 (2.5)
		Boys (n = 9)		Girls (n = 10)	
		PreT	PosT	PreT	PosT
DI	SP	4.2 (1.6)	4.9 (1.4)	4.7 (.4)	6.3 (1.1)
	TJ	1.8 (1.2)	3.6 (1.2)	2.6 (1.0)	3.6 (.9)
	H	2.9 (1.5)	3.9 (1.8)	2.9 (1.4)	4.7 (1.1)
	Total	8.9 (2.3)	12.4 (2.6)	10.2 (.9)	14.7 (1.8)

SP = shot put; TJ = triple jump; H = hurdles

Table 3. Differences between boys and girls in the two assessment moments.

		SE (n=19)			DI (n=28)		
	Event	Mann-Whitney	*p*	*TE*	Mann-Whitney	*p*	*TE*
PreT	SP	-1.264	.206	.29	-1.238	.216	.23
	TJ	-.589	.556	.13	-1.822	.068	.34
	H	-.955	.339	.22	-.024	.980	.01
	Total	-1.070	.285	.24	-1.636	.102	.31
PosT	SP	-.765	.445	.17	-2.473	.013*	.47
	TJ	-1.187	.235	.27	-.072	.942	.01
	H	-2.881	.004*	.66	-1.195	.232	.22
	Total	-.224	.823	.05	-2.521	.012*	.48

*Statistical difference y the Mann-Whitney test (p < 0.013)

Table 4. Comparative analysis between the two assessment moments for both boys and girls.

			SE (n=19)			DI (n=28)		
		Event	Wilcoxon T	*p*	*TE*	Wilcoxon T	*p*	*TE*
Boys	PreT–PosT	SP	-2.692	.007*	.90	-1.354	176	.39
		TJ	-2.680	.007*	.89	-3.170	002*	.79
		H	-.855	.393	.28	-1.695	090	.42
		Total	-2.680	.007*	.89	-3.529	001*	.88
Girls	PreT–PosT	SP	-2.527	.012*	.80	-2.565	010*	.74
		TJ	-2.687	.007*	.85	-2.401	016	.69
		H	-2.111	.035	.67	-2.690	007*	.78
		Total	-2.524	.012*	.80	-2.956	003*	.85

*Bonferroni adjusted significant differences (p < 0.013)

Table 5. Means (±standard deviations) of the two assessment moments for both higher and lower skill level students.

		Higher skill level (n = 8)		Lower skill level (n = 11)	
		PreT	PosT	PreT	PosT
SE	SP	1.9 (1.8)	5.7 (.7)	2.0 (1.2)	4.7 (1.8)
	TJ	1.7 (.7)	5.1 (1.2)	1.7 (.8)	4.4 (1.4)
	H	3.3 (1.6)	3.9 (.9)	3.1 (1.6)	4.4 (1.2)
	Total	6.9 (2.4)	14.7 (2.3)	6.8 (2.5)	13.4 (2.1)
		Higher skill level (n = 8)		Lower skill level (n = 11)	
		PreT	PosT	PreT	PosT
DI	SP	4.6 (1.3)	5.5 (1.3)	4.0 (1.2)	5.5 (2.0)
	TJ	1.8 (1.1)	3.5 (1.1)	2.9 (1.0)	3.7 (.9)
	H	3.0 (1.6)	4.1 (1.7)	2.5 (.7)	4.6 (1.4)
	Total	9.5 (2.2)	13.1 (2.4)	9.4 (1.4)	13.9 (3.0)

SP = shot put; TJ = triple jump; H = hurdles

Table 6. Differences between higher and lower skill level students in the two assessment moments.

		SE (n=19)			DI (n=28)		
	Event	Mann-Whitney	*p*	*TE*	Mann-Whitney	*p*	*TE*
PreT	SP	-.278	.781	.06	-1.436	.151	.27
	TJ	-.252	.801	.06	-2.156	.031	.41
	H	-.420	.675	.10	-.402	.688	.07
	Total	-.457	.648	.10	-.857	.391	.16
PosT	SP	-1.707	.088	.39	-.260	.794	.05
	TJ	-1.266	.205	.29	-.767	.443	.14
	H	-.844	.398	.19	-.314	.753	.06
	Total	-1.330	.184	.30	-.490	.624	.09

*Statistical difference y the Mann-Whitney test ($p < 0.013$)

Table 7. Comparative analysis between the two assessment moments for both higher and lower skill-level students.

			SE (n=19)			DI (n=28)		
		Event	Wilcoxon T	*p*	*TE*	Wilcoxon T	*p*	*TE*
Boys	PreT–PosT	SP	-2.388	.017	.85	-2.263	.024	.51
		TJ	-2.388	.017	.85	-3.424	.001*	.76
		H	-.755	.450	.27	-2.073	.038	.46
		Total	-2.371	.018	.84	-3.835	.001*	.86
Girls	PreT–PosT	SP	-2.816	.005*	.85	-1.886	.059	.67
		TJ	-2.952	.003*	.89	-2.070	.038	.73
		H	-2.197	.028	.66	-2.546	.011*	.90
		Total	-2.807	.005*	.85	-2.536	.011*	.90

*Bonferroni adjusted significant differences ($p < 0.013$)

test comparing knowledge measures of higher and lower skill-level students in the three track and field events and in the total of scores of the three events at the two assessment moments (PreT and PosT). No differences were found between groups both in SE and in DI in the two assessment moments.

Table 7 shows the improvements of students of lower and higher skill-level from PreT to PosT in the two units. In the SE model, although the higher skill-level group increased considerably their scores in all measures, statistically significant improvements were found only for the lower skill-level group. The lower skill-level group improved significantly in the shot put, triple jump and in the total of scores of the three events.

In the DI unit, the higher skill-level group presented statistically significant improvements in the triple jump event and in the total of scores of the three events. The lower skill-level group improved significantly in the hurdles event and in the total of scores of the three events.

Discussion

The purpose of the current investigation was to examine the effects of SE and DI on students' content knowledge in three track and field events (hurdles, triple jump, and shot put), taking into account their sex and skill level. The results in this study showed that regardless of students' sex, both DI and SE were efficient in the promotion of improvements in students' content knowledge of athletics. Notwithstanding, students' skill-level showed to be a differentiating factor for students' knowledge improvements during their participation in the SE unit.

Improvements related to students' sex

In our study, the students' sex was not a differentiating factor in the progress of athletics' knowledge acquisition, either in SE or DI. In fact, both boys and girls improved from the pre-test to the post-test in SE and DI. Prior research on SE that considered sex in the analysis of students' improvements (Araújo et al., 2016; Hastie, 1998a; Hastie, 1998b; Hastie et al., 2009; Pereira et al., 2015) has shown equivocal outcomes (Araújo et al. 2014). Specifically, the studies have reported either higher learning opportunities for boys (Hastie, 1998a, 1998b; Hastie et al., 2009), higher learning opportunities for girls (Mesquita et al., 2012; Pereira et al., 2015), whereas in the study by Araújo et al. (2016) it was found a match. The learning environment sustained throughout this SE

unit, seemed to have promoted improvements broadly to both boys and girls.

The positive impact of SE pedagogy on student cognitive outcomes irrespectively of their sex, either in team (Browne et al., 2004; Farias et al., 2015), individual sports (Hastie et al., 2009), or non-game-like activities such as athletics (Hastie et al., 2013), seemed to have been positively related with cooperative team practices, for it encouraged questioning, integration, and application of cognitive concepts among students (Derri, Emmanouilidou, Vassiliadou, Tzetzis, and Kioumourtzoglou, 2008). In parallel, in our study, a particular set of pedagogies in SE may have provided optimal conditions for both boys and girls to learn the subject matter of the shot put, hurdles, and triple jump. There was a strong accountability embedded in the learning content every time students were engaged in managerial roles (Hastie, 2000). For example, students of both sexes needed to know the rules and protocols of athletics under the penalty of failing a contribution to the championship scoring sheets (Hastie et al., 2013). Likewise, statisticians were tasked to monitor the achievement of performance criteria by team members, which informed the coaches on the timing and pace of task transitions at a team level. All students were also afforded augmented opportunities for learning through observation of peer practice. In the context of team sports, Hastie et al. (2009) and Farias et al. (2015) proposed that such observation of teammates game-play helped students to develop game concepts (tactical awareness), as it involved analysis and evaluation of performance, and following application by students in their own practice of the concepts observed. The positive impact of the learning by observation might be even more evident by the use of video observation. This strategy reduced the reliance on students' memory, allowed a greater range of behaviors to be analyzed (Carson, 2008), but at the same time with more detailed analysis (Byra, 1997).

In addition, in the current study, the autonomy and control of the pace of task transitions handed over to both boys and girls during team practice sessions also encouraged them to analyze and reflect critically on each teammate's performance. This was based on group analysis of the information kept in records (statistics on achievement of performance criteria) (Pereira et al., 2015). Thus, boys and girls were affectively and cognitively implicated with the learning content when making evaluative judgments against specific motor criteria.

With regard to the DI approach, different aspects could help explain the positive outcomes found for all students regardless of sex. Indeed, the technical nature of the closed skills in athletics, appeals to knowledge development through low-order cognitive processes (Metzler, 2011). An emphasis is placed on memorizing factual information related with rote repetition of specific motor elements in the movement patterns. The teacher's use of direct instruction and modeling of performance seemed to have been appropriate for the internalization of rules, terminology and motor skills criteria in girls and boys. Given that all students were at an early age and stage of development, the prescriptive nature of the information used in the DI approach may have been particularly appropriate for promoting knowledge improvements (Rink and Hall, 2008).

Improvements related to skill-level

The results of the present study suggest that the SE was particularly beneficial to lower skill-level students and not so much to their higher-skilled counterparts. On the contrary, in the DI unit, both higher and lower skill-level students showed knowledge improvements. Such outcomes may find explanation on the level of complexity of the learning content to which students were exposed to in SE. More to it, the demands of the formal competition sessions of the SE unit may not have been adjusted to students of higher ability level (Araújo et al., 2016). More specifically, given that in SE students were given high autonomy in managing task progressions and selecting participants for competition, it is possible that due to lacks in instructional and pedagogical knowledge the student-coaches were not capable to match the task complexity to the higher-skilled students. Furthermore, considering that there was not 'graded competition' (competition differentiated by skill level), the higher-skilled students may not have been 'challenged' appropriately to their ability level. This suggests the need for teachers in the SE provide a closer assistance to student-coaches in the moment of adjusting tasks, progressions, and the competition demands to the ability level of participants. This could be achieved, for example, through a differentiation of the performance within the tasks according to students' skill-level. In addition, future implementations of SE should take into account that when there are marked discrepancies in students' ability level, the notion of 'graded competition' should be considered (Siedentop et al., 2011). That is, each team creates sub-teams who then compete within their skill-level.

Moreover, because the competition scorings of all students added to the teams' points, it is also possible that some sense of mastery of the learning content with ease by the higher-skilled students may have channeled their efforts to strengthen the teaching of lower-skilled teammates. Specifically, they may have placed a higher emphasis on the lower-skilled teammates' progressions in detriment of their own improvement. In the DI unit, for the reason that students participated in the motor development tasks (with no participation in 'nonplaying' roles) at a class level and with closer monitoring and supervision by the teacher, the students are more likely to have had similar time of motor skills practice irrespective of their skill level. Specifically, in the DI class, the rote repetition of the practice trials was frequently organized in lines to allow a more favorable way for the teacher's active supervision and proximity feedback (Hastie et al., 2011). In keeping in mind that the teacher directed the entire process (students in a large part of the activities just needed to stay in lines and follow her commands along task transitions), and considering the nature of athletics as highly reliant in systematic repetition of movement patterns, students of both skill-levels may have benefited of high opportunities to participate.

Conclusion

The combined and integrated analysis of the partial contributions from the present study and Pereira et al. (2015) allow a holistic and deeper understanding of students' learning (knowledge and performance) within SE and DI. With respect to performance, only boys and higher-skilled students improved in the DI. In SE, the performance improvements spanned also to girls and lower-skilled students (Pereira et al. 2015). In contrast, in the present study whilst all students' improved their knowledge in DI, in SE all groups improved with the exception of the higher-skilled students. In an overview, this study highlights that there may not be one single most appropriate instructional approach to teach all varieties of sports and activities.

Future research on SE should further insight on what specific aspects inherent in group dynamics and functioning of teams contribute most to the teaching and learning process and how such interplay impacts on students' cognitive and motor development. Moreover, to date little is known on how students learn the managerial duties in SE or how teachers are 'scaffolding' the process for students to become autonomous. A deep examination to these topics taking into account students of different ages would be highly recommended (Hastie, et al., 2011). With regard to the DI model, a deep examination of students' interactions and affective outcomes would be highly relevant. Particularly, studies that can provide knowledge about the way the nature of the interactions between participants in DI classes affect inclusion, student engagement, and motivational responses, and by consequence, learning achievement (Rink, 2001).

In summary, future studies should span its focus to multidimensional measures of learning outcomes (cognitive, motor and affective) and across a range of team sports and physical activities comprising different managerial dynamics and length of the units, both in DI and SE.

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Key points

- The results in this study showed that regardless of students' sex, both DI and SE were efficient in the promotion of improvements in students' content knowledge of athletics.
- Both boys and girls improved from the pre-test to the post-test in SE and DI.
- SE was particularly beneficial to lower skill-level. On the contrary, in the DI unit, both higher and lower skill-level students showed knowledge improvements.

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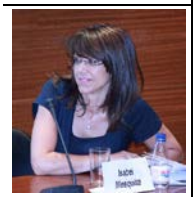

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