sustainability

MDPI

Article

Direct Instruction vs. Cooperative Learning in Physical Education: Effects on Student Learning, Behaviors, and Subjective Experience

José Francisco Guzmán [1,*] and Elisa Payá [2]

[1] Department of Physical and Sports Education, Faculty of Physical Activity and Sport Sciences, University of Valencia, 46010 Valencia, Spain
[2] Valencian Generalitat, Campanar's Children's and Primary Education Centre, 46015 Valencia, Spain; paya_eli@gva.es
* Correspondence: Jose.F.Guzman@uv.es

Received: 17 April 2020; Accepted: 21 May 2020; Published: 15 June 2020

Abstract: (1) Background: The objective was to analyze if cooperative learning (CL) can have benefits compared to direct instruction (DI) in learning, behavior, and subjective experience of pupils. (2) Methods: An intervention was performed with a counterbalanced within-subjects design. To perform the intervention, 75 schoolchildren aged 10 to 12 from four primary classes were divided into two groups, and two units were taught in each one, namely "games of the world" and "traditional games", exchanging the methodologies CL and DI. Dependent measures were learning and retention over time, behavior, interest–enjoyment, value–utility, and affiliation. They were measured after each unit. Six months later, conceptual retention was also evaluated. (3) Wilcoxon signed-rank tests were conducted to analyze differences between methodologies. CL resulted in greater conceptual learning and retention. Likewise, CL students communicated with each other to a greater extent, although the time spent doing the activity were similar for both methodologies. No significant differences were found for the psychological variables. (4) Conclusions: The study confirmed the higher ability of CLs to improve cognitive learning and retention, as well as improved communicative behavior with peers and teachers.

Keywords: education; communication; observation; switching replications design

1. Introduction

The question of sustainable development and teaching skills to solve problems cooperatively has become a priority. Goal 4 of the 2030 Agenda for Sustainable Development, and specifically Target 4.4 [1], aims to increase the number of people with skills for autonomous and effective entrepreneurship and development of decent jobs. To do this, it proposes to develop high-level cognitive and non-cognitive/transferable skills, such as problem solving, critical thinking, creativity, teamwork, communication skills, and conflict resolution. Therefore, it is convenient to study which teaching methodologies are most suitable for achieving this objective and what effects they have on different variables of the learners, such as conceptual and behavioral learning and subjective experience of the educational process. Pedagogical models determine the approach a teacher may take to achieve the learning objectives. Although they may be classified in different ways, several authors [2–5] distinguish three models in participation theory: teacher-centered (adult-run); student-centered (children-run); and cooperative or community-centered.

Direct instruction (DI) is one of the most widely used teacher-centered methodologies and has proven effectiveness in providing information and developing step-by-step skills. Its central purpose

is promoting student on-task behavior through explicit instruction, ongoing support, and student engagement in successful practice, being focused on the interaction between teachers and students [6]. Its key components include modelling, reinforcement, feedback, and successive approximations. The instructional design principles include framing of learner performance into goals and tasks, breaking these tasks into smaller component tasks, designing training activities for mastery, and arranging the learning events into sequences that promote transfer and achievement of prerequisite learning before moving to more advanced learning. Essentially, DI is "modelling with reinforced guided performance" [7]. Several studies have underlined the efficiency of DI in promoting student learning, some of them indicating that it is more effective than discovery, i.e., when the teacher does not provide instruction or feedback [8,9].

Cooperative learning (CL) was developed in the 1970s following concerns that students rarely had the opportunity to use their interpersonal skills in the traditional competitive and individual learning environments of schools [10–12]. Metzler [13] (p. 273) described it as taking "one large step beyond just learning next to one another to learning with, by, and for each other". To emphasize positive interdependence, in CL the teacher creates small, structured, and heterogeneous groups for the duration of the unit [14]. This allows students to become comfortable with one another and therefore more capable of helping each other to grasp the learning objectives of any given lesson [12,13,15–20]. Thus, CL shifts the focus for learning on the students, seeking to encourage them not only to learn from the experience in which they are involved, but also to help their peers share in this learning experience [21].

Five elements are essential to implementing CL successfully: (a) group goals; (b) interpersonal skills and small group skills; (c) individual accountability; (d) face-to-face promotive interaction; and (e) group processing [22]. Group goals refers to the need of team members to coordinate the efforts to achieve the team's objectives. Interpersonal skills and small group skills include listening, sharing decision-making, taking responsibility, learning to give and receive feedback, and learning to encourage each other. Individual accountability is the need for each student to account for the achievement of the objectives. These three elements consistently appear in most research studies [12,23]. Moreover, face-to-face promotive interaction refers to the existence of discussion within the group while members are in close proximity to each other. Finally, group processing is the opportunity to discuss, in a reflexive dialogue, the achievement of objectives and the maintenance of good relationships by group members [12,13,16,20,24].

A strong body of literature has explored the effectiveness of CL in increasing achievement in schools [21]. Johnson et al. [25] analyzed 164 studies conducted at all levels of schooling (46% in elementary, 20 in middle, 11 in high, and 24 in post-secondary and adult settings). Of them, 46% included 30 sessions or more, 52% lasted for 2 to 29 sessions, and 2% consisted of one session only. They had an inter-subject design, and the technique used to assign participants or groups to conditions varied: random assignment of participants (45%), random assignment of groups (25%), and non-random assignment of participants or groups (30%). Overall, the authors reported positive effects of CL on academic achievement (ability to apply and understand content), interpersonal skills and relations (communication skills and peer relations), enhanced participation (engagement with learning tasks), and psychological health (self-esteem and motivation). They also found it reasonable to hypothesize that the effectiveness of CL would tend to increase more where cooperation was the foundation on which classroom and school life was based. If CL would be used within a primarily competitive or individualistic school, for example, its effectiveness would be dampened by the overall culture of the school.

Furthermore, several studies analyzed CL in physical education (PE). In a review, Casey and Goodyear [26] analyzed 27 empirically-based interventional studies published in peer-reviewed papers written in English. Relative to the duration of the units, they reported that more than 50% used units lasting less than 10 lessons. They also reported that judgments about students' learning were made using different methodologies, namely qualitative (14 studies), quantitative (11), or mixed (2), quantitative studies being the only ones that compared student learning to a control group.

Subsequently, in over half of the studies, student learning in CL was not compared to other learners in different pedagogical approaches.

With regard to conceptual learning in PE, several studies showed that CL provided students with an enhanced game-related understanding of strategies and skills, and that they transferred them to other activities [17,27–33]. Regarding social learning in PE, several studies reported that CL developed interpersonal skills such as listening to team members, sharing ideas and beliefs, and constructing new understandings together [14,16,17,27–30,32,34–37]. In this line, Darnis and Lafont [36] highlighted the benefit of communication between peers for those who were initially less skilled, who could benefit from the information provided by those with more skills.

On the other hand, a number of studies showed that CL promoted students' active participation in PE, staying on task most of the lesson time [29,31,33,37]. Moreover, as units progressed, students increasingly spent more time in learning tasks and working together to learn without waiting for instructions from the teacher [16,17,27–29,31].

Finally, effects of CL on affective learning in PE were rarely considered in the reviewed studies, as there was limited evidence [38]. Some authors [38–42] suggested that affective learning in PE was largely associated with psychological components of self-confidence, self-esteem, motivation, and self-worth. Goodyear et al. [38] showed that students described as often being enthusiastic learners in traditional lessons became more motivated during CL. Other study [43], reported that CL produced an increase in intrinsic motivation and perception of cooperative learning climate compared to ID.

The objective of this study was to compare both methodologies, namely DI and CL. We were interested in conducting an integrated analysis of the cognitive, behavioral, and experiential benefits of each methodology. It was hypothesized that the unit conducted with CL would produce greater conceptual learning and retention, more negotiation and communication behaviors, and an emotional experience as good as or better than the unit carried out with DI.

2. Materials and Methods

2.1. Participants

The research was carried out with 75 primary education children aged between 10 and 12 from a state school, which performed two teaching units, one with CL and the other with ID. To apply a counterbalanced technique, participants were divided into two groups. Group 1 included children from two classes: 5th grade—class B, with 22 students of both sexes (12 boys and 10 girls); and 6th grade—class A, with 14 students (9 boys and 5 girls). Group 2 also consisted of two classes: 5th grade—class A, with 16 students of both sexes (10 boys and 16 girls); and 6th grade—class B, with 23 students (11 boys and 12 girls).

2.2. Design

Quantitative studies that analyzed the effect of CL in PE generally used non-equivalent groups designs, structured like a pretest–posttest randomized experiment but lacking random assignment [21]. The common procedure in this design is to pick two comparable classrooms as the treatment and control groups, which cannot assure that groups were comparable. That is, the non-equivalent group design is especially susceptible to the internal validity threat of selection. Any prior differences between the groups may affect the outcome of the study and, under the worst circumstances, this could lead authors to conclude that their programme did not make a difference when in fact it did, or that it did make a difference when in fact it did not.

Within-subject designs are an alternative to improve internal validity. They prevent the threat of biased selection given that all participants are submitted to all values of the independent variable. Moreover, the effect of order may be controlled with a counterbalanced procedure. In the present study a within-subject design was followed to analyze differences between two methodologies. We hypothesized that although the usual methodology in a school was DI, CL would have differential

effects on the behavior of students and the teacher, as well as on the retention of concepts and cognitive aspects such as interest–enjoyment, value–utility, and affiliation. The study was also characterized by using an observational methodology to analyze students' behavior. It was coded into several categories and the time taken by students to perform each of them in the session was quantified.

2.3. Procedure

The Ethics Committee of the University approved the study. The authors assured parents that study data would be anonymously presented, and they agreed in writing to participate.

The authors prepared two 7-session units for "traditional games", one with DI and the other with CL. Likewise, two 7-session units were prepared for "games of the world", one with DI and the other with CL. The two classes assigned to Group 1 received the "traditional games" unit with DI, and the "games of the world" unit with CL. On the other hand, the two classes assigned to Group 2 received the "traditional games" unit with CL, and the "games of the world" unit with DI (Figure 1).

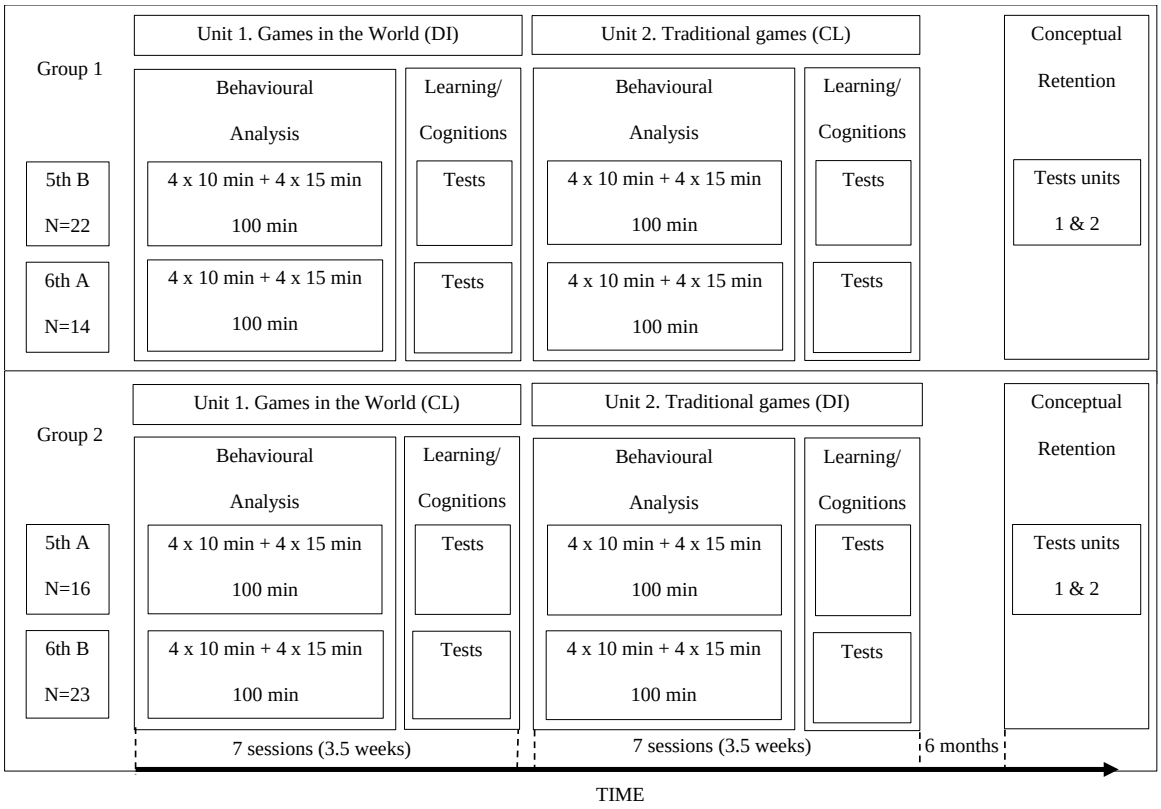

Figure 1. Characteristics of the experimental groups, methodologies, and duration of the units performed by each group, and characteristics of the behavioral, cognitive and learning measures (DI: direct instruction; CL: cooperative learning).

When the unit was taught with DI, sessions were arranged as follows: (1) the teacher gathered the students, explained the game, sorted the groups and distributed the materials; (2) the children played the game while the teacher observed, corrected, and solved doubts; (3) once the children learned to play, the teacher gathered them again to explain the next game; and (4) the process was repeated with the next game. During the seven sessions, pupils played eight games; two were classified as having high difficulty, two as medium, and four as low.

When the unit was performed with CL, three captains were chosen in the first session; together with the teacher, they formed three heterogeneous teams. The teacher then gave the teams the following information: (a) the objective of each team was to play at least five games properly, a high-difficulty one, a medium-difficulty game, and three low-difficulty games; (b) instructions were printed on plastic laminated cards, their color being related to the difficulty level; finally, (c) the materials needed to practice were made available on the playground porch so that each team could take them at any time.

After these explanations, in all sessions except for the last one, teams worked as follows: (1) they freely chose a game and read the rules; (2) they chose an area to play, picked and placed the materials and allocated roles according to the game; (3) they practiced the game, being able to reflect and investigate on the rules to modify them if they considered it appropriate to improve it and make it more fun, the teacher acting as a guide; (4) when they thought they had managed to master the game, they asked the teacher to be evaluated. The teacher watched them practice for a few minutes, asked questions, and if they were positively evaluated, they could move on to another game and repeat the process. If they were unsuccessfully assessed, they could continue practicing or change games. Both teacher and students played active roles.

In the final session, each student suggested a game, depending on the unit. Each team chose a game from those proposed by their members. Afterwards, each team explained the rules of their game to the other groups, who then played the games.

The behaviors carried out by the students during the classes were recorded and codified. Moreover, conceptual learning and cognitive variables were measured after each unit. Finally, retention of conceptual learning was also measured after a six-month period. The measuring instruments are described in the following section. To avoid unconscious influence on students by the teacher, tests were administered by a different teacher.

2.4. Measures

2.4.1. Measurement of Students' Behavior during Classes

Students' behavior was recorded with a video camera. A total of 800 min were analyzed, in which the behavior of 32 students was coded. The distribution of observed students and time can be seen on Figure 1. Fifteen minutes of each session were recorded in the morning and 10 min in the afternoon due to the shorter duration of classes. Recordings were distributed in the first, second, or third part of the class.

The following categories were defined for coding student behaviors: (1) "Adopting agreements", when the child was in dialogue with other classmates to reach a common understanding; (2) "Reading/listening", when the child listened to the reading of a game by another classmate or read the game; (3) "Preparing materials", when the child prepared the materials to start a game; (4) "Doing the activity", when the child practiced the game; (5) "Talking to the partner about the activity", when the child dialogued with peers; (6) "Talking to the teacher about the activity", when the child talked to the teacher about the activity; (7) "Talking to the teacher about social relationship issues", when the child talked to the teacher to ask for help in solving problems with his/her classmates; (8) "Listening to the teacher", when the child listened to the teacher's explanations; and (9) "Playing something else", when the child engaged in playing a game that had nothing to do with the unit.

The score obtained in each variable was calculated through the expression:

$$(M\ (behavioral\ variable) = (time\ (in\ seconds)/Total\ observed\ time\ (in\ seconds))\ \times\ 100)$$

Coding reliability was verified with a repetition of the coding of 4 students three months later, differences smaller than 5 percent being found for all variables.

2.4.2. Measurement of Subjective Experience of Practice

The intrinsic motivation test (IMI) was utilized. Used in multiple studies [44–49], this multidimensional measure seeks to assess the subjective experience of participants in an activity. It is composed of seven subscales that measure interest–enjoyment, perceived competence, effort, value–utility, pressure–tension, perceived choice, and affiliation. To facilitate questionnaire completion by children, three items for each dimension were selected and the seven response options were replaced by five options represented by expression faces. Alpha values slightly inferior to 0.70 may be accepted with a small number of items or participants [50]. Thus, reliability was acceptable for interest–enjoyment subscales (alpha = 0.67), value–utility (alpha = 0.61), and affiliation (alpha = 0.73). Moreover, the confirmatory factorial analysis of the three dimensions was acceptable (χ^2/gl = 2.62; IFI = 0.90, TLI = 0.83, CFI = 0.90, NFI = 0.85, RMSEA = 0.10).

2.4.3. Measurement of Conceptual Learning after the Units

A test was used to evaluate the conceptual learning after each unit. It consisted of four free open-ended questions. In the first question, children were asked to list the materials needed to play a particular game. The second question required students to enumerate the rules of a game. The third called for the rules of another game. Finally, the fourth required adequate behaviors to avoid interpersonal conflicts in a third game.

The questions were evaluated as follows: one point was awarded for each material, rule, or behavior properly associated to the specific topic by the student. Therefore, a test could be marked with X points depending on the right concepts the student managed to include. The number of points to be obtained was not limited.

2.4.4. Measurement of Conceptual Learning after Time

In order to evaluate the students' retention of learning, a test composed of two free open-ended questions was administered six months later. In the first question, they were asked to enumerate games, materials, rules, and behaviors to avoid conflicts, and they had to remember the "popular games" unit; in the second one, they were asked what they remembered about the "games of the world" unit. The reliability of the two measures was analyzed through the comparison of the intra-evaluator agreement, which assessed the tests twice with a time of two months of interval, with the differences in score being less than 5%.

2.5. Data Analysis

To check for normality in the distributions of scores for each type of methodology, Kolmogorov–Smirnov or Shapiro–Wilks normality tests were performed depending on number of students. As the distributions were not adjusted to the normal, non-parametric tests (Wilcoxon signed-rank test) were conducted to analyze differences between methodologies. Finally, the effects size were calculated.

3. Results

For the behavioral analysis, significant differences were found in preparing materials, reading/listening, paying attention to the teacher, talking to partners about the activity, and adopting agreements. CL was characterized by students spending more time preparing materials, reading/listening, talking to partners about the activity, and adopting agreements. On the other hand, DI students devoted more time to paying attention to the teacher. No differences were found in talking to the teacher (about the activity or social relationship problems), doing the activity, or playing a different game. For the cognitive variables, significant differences were not found for any of the variables analyzed. Finally, in both the exam and the reminder, the scores obtained by CL students were higher than those of their DI peers (Table 1).

Table 1. Descriptive of behavioral, cognitive and conceptual variables, normality tests according N, results of Wilcoxon tests, and effect sizes.

Variables	N	M	SD	Max	Min	K−S [1]	S−W [2]	Sig	Z [3]	Sig	Abs (r)
Preparing the material (DI) [4]	32	0 [a]	0	0	0		–	–	−3.516	<0.001	0.440
Preparing the material (CL) [5]	32	13.95 [a]	22.80	76.67	0		0.663	<0.001			
Reading/listening (DI)	32	0 [a]	0	0	0		–	–	−4.286	<0.001	0.536
Reading/listening CL)	32	7.48 [a]	6.32	18.83	0		0.900	0.006			
Attending the teacher (DI)	32	20.24 [a]	12.46	39.50	0		0.895	0.005	−4.517	<0.001	0.565
Attending the teacher (CL)	32	2.09 [a]	2.03	7.22	0		0.873	0.001			
Talking partners activity (DI)	32	2.19 [a]	1.84	8.33	0		0.878	<0.001	−4.541	<0.001	0.568
Talking partners activity (CL)	32	11.43 [a]	7.09	28.78	0.56		0.978	0.237			
Adopting agreements (DI)	32	0.37 [a]	1.05	4.44	0		0.400	<0.001	−3.883	<0.001	0.485
Adopting agreements (CL)	32	4.7 [a]	4.7	19.67	0		0.877	0.002			
Talking teacher activity (DI)	32	0.93 [a]	1.29	5.89	0		0.718	<0.001	−4.229	<0.001	0.529
Talking teacher activity (CL)	32	4.97 [a]	3.88	16.83	0		0.866	0.001			
Talking teacher problems (DI)	32	0.57 [a]	1.29	5.00	0		0.509	<0.001	−1.255	0.209	0.157
Talking teacher problems (CL)	32	1.01 [a]	2.33	8.11	0		0.495	<0.001			
Doing the activity (DI)	32	56.05 [a]	18.70	82.33	0		0.920	0.020	−1.249	0.212	0.157
Doing the activity (CL)	32	49.83 [a]	25.71	100	1.65		0.939	0.068			
Playing something else (DI)	32	0.75 [a]	1.41	5.67	0		0.587	<0.001	−0.566	0.571	0.071
Playing something else (CL)	32	2.52 [a]	6.04	30.33	0		0.484	<0.001			
Interest−enjoyment (DI)	75	4.17 [b]	0.95	5	1	0.209		<0.001	−0.874	0.382	0.072
Interest−enjoyment (CL)	73	4.27 [b]	0.74	5	1.67	0.207		<0.001			
Value−utility (DI)	75	3.90 [b]	1.04	5	1	0.145		<0.001	−1.322	0.186	0.109
Value−utility (CL)	73	4.07 [b]	0.81	5	1.68	0.134		0.002			
Affiliation (DI)	75	4.15 [b]	0.84	5	1	0.154		<0.001	−0.328	0.743	0.027
Affiliation (coop.)	74	4.08 [b]	0.90	5	1.33	0.182		<0.001			
Conceptual learning (DI)	70	12.06 [c]	3.81	27	2	0.148		0.001	−3.816	<0.001	0.321
Conceptual learning (CL)	71	14.28 [c]	3.82	27	5	0.101		0.101			
Conceptual retention (DI)	33	3.03 [c]	3.27	11	0		0.844	<0.001	−4.921	<0.001	0.483
Conceptual retention (CL)	71	12,15 [c]	5,25	29	4		0.925	0.025			

[1] Kolmogorov–Smirnov; [2] Shapiro–Wilks; [3] Z (Wilcoxon sign ranges test); [4] Direct Instruction; [5] Cooperative learning; [a] Percentage of observed time; [b] between 1 and 5; [c] Equal to or greater than 0.

4. Discussion

The present study compared the effects of DI (teacher-centered) and CL (community-centered) on students' behaviors, cognitions, and conceptual learning (immediate and after a period of time). The main contributions of the study lie in the methodology used and in the analysis of students' behavior. The within-subject design allowed the internal validity threat of selection to be controlled, since all students participated in the two experimental conditions. Moreover, a counterbalanced procedure was performed to control the effect of order.

Observational methodology was used to measure students' behavior. CL students spent more time preparing materials, reading/listening to rules, talking to peers, and adopting agreements, while DI students spent longer listening to the teacher. It is worth noting that the practice time for the activity was high and similar in both methodologies (around 50 percent of the observed time); no significant differences being found. The same applies to the time dedicated to playing games other than those prepared for the session, which was short and similar (around two percent of the observed time), which indicates that students worked properly in both methodologies.

In a meta-analysis [51] that compared the effects on learning of minimally guided discovery methods and explicitly guided techniques, the authors concluded that optimal teaching methods involved some kind of meaningful guidance, instruction, or feedback, and proposed that a key point was to analyze the role that peers may develop in the process, and how mutual help could contribute to learning. In this study, relationships with peers comprising reading/listening to rules, talking, and adopting agreements comprised 23.61% of the observed time in CL, and 2.56% in DI. These results illustrate that CL promotes social interaction between peers related with understanding and playing the games, which could promote a deeper analysis of them and a facilitation of acquisition and retention, which are discussed later.

Another study [8] compared conceptual learning in DI and autonomous practice, reporting an advantage to DI over discovery that was lost when performance was measured after a 12-week period. They explained their results arguing that engagement with task was the main contribution to retention of performance. In the present study no differences were found between DI and CL in motivation since the values in the cognitive variables interest–enjoyment, value–utility, and affiliation were similar. These results could be attributed to the contents of the subject, "games", with a high motivational power in itself.

Finally, in terms of conceptual learning and its retention over time, results showed significantly greater learning with CL, in line with previous studies reporting a positive relationship between conceptual learning and the use of CL [17,27–32]. It was assumed that having to read and understand the rules of the game in an autonomous and cooperative way would cause children to generate their own knowledge and better understanding of it, which would facilitate memorization. In addition, the possibility of modifying the rules allowed students to explore relations between them and the technical–tactical dynamics of the game, enriching their knowledge. The generation effect [52], according to which memory is improved when the learner generates the learning materials, could help to explain the effect of CL on conceptual learning.

Similarly, the results showed that the retention of conceptual learning with CL compared to DI was much greater—up to four times. These findings were in agreement with the belief that greater involvement and participation of students in their own learning occurred in CL. Students working in cooperation not only learned from the teacher but also from each other, from the context and by reflecting about themselves. The learning situations provoked by CL allowed students to be more engaged in their tasks and to better implement their senses, and they also generated spaces for individual and group reflection. The authors believe all this contributed to greater learning retention.

Finally, the results of the study provided support to indicate CL was an effective methodology to improve students' conceptual learning and behavior, although the methodology students were accustomed to was DI. Thus, the hypothesis by Johnson et al. [23] according to which the effectiveness

of a CL unit would be dampened by the overall culture of the school was not confirmed in our study, since a single unit of CL produced significant effects on learning and behavior.

Thus, the results of the study support the assertion that CL is an appropriate methodology for achieving the skills proposed in Target 4.4 of the 2030 Agenda for Sustainable Development [1], since in this study, in which the intra-subject design controlled the threat to the validity of the study by differential selection, CL led to greater learning and retention of concepts over time; while students developed a greater number of behaviors related to communication and negotiation skills, the motor practice time remained similar and the experience was equally positive.

Furthermore, the student's behavioral assessment instrument was shown as a useful tool, which could be used by teachers to assess the development of the unit, as well as to identify needs and deficiencies of students. CL methodology frees the teacher to be able to specifically attend to the students who may need some individualized attention.

Future research could be directed to carry out individualized interventions on the specific needs identified with behavioral observation. Likewise, it would be convenient to analyze differences between methodologies in behavior, cognitive variables, and conceptual learning in more arduous contents such as the acquisition of technical skills, whose learning requires a greater amount of practice that may be boring or cause fatigue. Moreover, student interviews could provide information about their subjective opinions to understand how interactions with peers contribute to learning.

5. Conclusions

The study supported the educational potential of CL in comparison with DI, linking it directly with student behaviors related to self-management and autonomous improvement of the knowledge of the game, which resulted in greater conceptual learning and retention.

Author Contributions: Conceptualization, J.F.G. and E.P.; methodology, J.F.G. and E.P.; validation, J.F.G. and E.P.; formal analysis, J.F.G.; investigation, E.P.; resources, J.F.G. and E.P.; data curation, J.F.G.; writing—original draft preparation, J.F.G.; writing—review and editing, J.F.G.; visualization, J.F.G.; supervision, J.F.G.; project administration, J.F.G. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. United Nations Resolution Adopted by the General Assembly on 25 September 2015 [Without Reference to a Main Committee (A/70/L.1)] 70/1. Transforming Our World: The 2030 Agenda for Sustainable Development. Available online: http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E (accessed on 21 October 2015).
2. Bloch, M.; Lave, J.; Wenger, E. Situated Learning: Legitimate Peripheral Participation. *Man* **1994**, *29*, 487. [CrossRef]
3. Moore, P. Reading Recovery teacher training: Communities of learners engaged in inquiry. *Netw. News* **1998**, 1–5.
4. Rogoff, B. Observing sociocultural activity on three planes: Participatory appropriation, guided participation, and apprenticeship. In *Sociocultural Studies of Mind*; Cambridge University Press (CUP): Cambridge, UK, 1995; pp. 139–164.
5. Rogoff, B.; Matusov, E.; White, C. Models of teaching and learning: Participation in a Community of Learners. In *Handbook of Education and Human Development*; Olson, D.R., Torrance, N., Eds.; Blackwell: Cambridge, UK, 1996; pp. 388–414.
6. Magliaro, S.G.; Lockee, B.B.; Burton, J.K. Direct instruction revisited: A key model for instructional technology. *Educ. Technol. Res. Dev.* **2005**, *53*, 41–55. [CrossRef]
7. Joyce, B.R.; Weil, M.; Wald, R. The teacher-innovator: Models of teaching as the core of teacher education. *Interchange* **1973**, *4*, 47–60. [CrossRef]
8. Dean, D., Jr.; Kuhn, D. Direct instruction vs. discovery: The long view. *Sci. Educ.* **2007**, *91*, 384–397. [CrossRef]

9. Klahr, D.; Nigam, M. The Equivalence of Learning Paths in Early Science Instruction: Effects of Direct Instruction and Discovery Learning. *Psychol. Sci.* **2004**, *15*, 661–667. [CrossRef]
10. Johnson, D.; Johnson, F. *Joining: Group Theory and Group Skills*; Pearson: Upper Saddle River, NJ, USA, 2009.
11. Kagan, S.; Kagan, M. *Kagan Cooperative Learning*; Kagan: San Clemente, CA, USA, 2009.
12. Slavin, R.E. Research on Cooperative Learning and Achievement: What We Know, What We Need to Know. *Contemp. Educ. Psychol.* **1996**, *21*, 43–69. [CrossRef]
13. Metzler, M.W. *Instructional Models for Physical Education*; Holcomb Hathaway: Scottsdale AZ, USA, 2005.
14. Casey, A.; Dyson, B.; Campbell, A. Action research in physical education: Focusing beyond myself through cooperative learning. *Educ. Action Res.* **2009**, *17*, 407–423. [CrossRef]
15. Barrett, T. Effects of Cooperative Learning on Performance of Sixth-Grade Physical Education Students. *J. Teach. Phys. Educ.* **2005**, *24*, 88–102. [CrossRef]
16. Dyson, B. Cooperative Learning in an Elementary Physical Education Program. *J. Teach. Phys. Educ.* **2001**, *20*, 264–281. [CrossRef]
17. Dyson, B. The Implementation of Cooperative Learning in an Elementary Physical Education Program. *J. Teach. Phys. Educ.* **2002**, *22*, 69–85. [CrossRef]
18. Dyson, B.; Rubin, A. Implementing Cooperative Learning in Elementary Physical Education. *J. Phys. Educ. Recreat. Dance* **2003**, *74*, 48–55. [CrossRef]
19. Grineski, S. *Cooperative Learning in Physical Education*; Human Kinetics: Champaign, IL, USA, 1996.
20. Johnson, D.W.; Johnson, R.T. *Cooperative Learning Lesson Structures*; Human Kinetics: Edina, MN, USA, 1991.
21. Dyson, B. Integrating cooperative learning and tactical games models: Focusing on social interactions and decision-making. In *Teaching Games for Understanding: Theory, Research, and Practice*; Human Kinetics: Champaign, IL, USA, 2005; pp. 149–168.
22. Johnson, D.W. Cooperation in the Classroom. *Contemp. Psychol.* **1991**, *36*, 1106–1107. [CrossRef]
23. Antil, L.R.; Jenkins, J.R.; Wayne, S.K.; Vadasy, P.F. Cooperative Learning: Prevalence, Conceptualizations, and the Relation Between Research and Practice. *Am. Educ. Res. J.* **1998**, *35*, 419–454. [CrossRef]
24. Dyson, B.; Griffin, L.L.; Hastie, P. Sport Education, Tactical Games, and Cooperative Learning: Theoretical and Pedagogical Considerations. *Quest* **2004**, *56*, 226–240. [CrossRef]
25. ArrayExpress a Database of Functional Genomics Experiments. Available online: http://www.ebi.ac.uk/arrayexpress/ (accessed on 12 November 2012).
26. Casey, A.; Goodyear, V. Can Cooperative Learning Achieve the Four Learning Outcomes of Physical Education? A Review of Literature. *Quest* **2015**, *67*, 56–72. [CrossRef]
27. Casey, A. 'Seeing the trees not just the wood': Steps and not just journeys in teacher action research. *Educ. Action Res.* **2013**, *21*, 147–163. [CrossRef]
28. Casey, A.; Dyson, B. The implementation of models-based practice in physical education through action research. *Eur. Phys. Educ. Rev.* **2009**, *15*, 175–199. [CrossRef]
29. Dyson, B.; Strachan, K. Co-operative learning in a high school physical education programm. *Waikato J. Educ.* **2017**, *6*, 19–37. [CrossRef]
30. Dyson, B.; Strachan, K. The ecology of cooperative learning in a high school physical education program. *Waikato J. Educ.* **2004**, *10*, 117–139.
31. Dyson, B.P.; Linehan, N.R.; Hastie, P.A. The Ecology of Cooperative Learning in Elementary Physical Education Classes. *J. Teach. Phys. Educ.* **2010**, *29*, 113–130. [CrossRef]
32. Hastie, P.; Casey, A. Using the jigsaw classroom to facilitate student-designed games. *Phys. Educ. Matters* **2010**, *5*, 15–16.
33. O'Leary, N.; Griggs, G. Researching the pieces of a puzzle: The use of a jigsaw learning approach in the delivery of undergraduate gymnastics. *J. Furth. High. Educ.* **2010**, *34*, 73–81. [CrossRef]
34. André, A.; Deneuve, P.; Louvet, B. Cooperative Learning in Physical Education and Acceptance of Students with Learning Disabilities. *J. Appl. Sport Psychol.* **2011**, *23*, 474–485. [CrossRef]
35. André, A.; Louvet, B.; Deneuve, P. Cooperative group, risk-taking and inclusion of pupils with learning disabilities in physical education. *Br. Educ. Res. J.* **2012**, *39*, 1–17. [CrossRef]
36. Bayraktar, G. The effect of cooperative learning on students' approach to general gymnastics course and academic achievements. *J. Edu. Res. Rev.* **2011**, *6*, 62–71.
37. Goudas, M.; Magotsiou, E. The Effects of a Cooperative Physical Education Program on Students' Social Skills. *J. Appl. Sport Psychol.* **2009**, *21*, 356–364. [CrossRef]

38. Goodyear, V.; Casey, A.; Kirk, D. Hiding behind the camera: Social learning within the Cooperative Learning Model to engage girls in physical education. *Sport. Educ. Soc.* **2012**, *19*, 712–734. [CrossRef]
39. Darnis, F.; Lafont, L. Cooperative learning and dyadic interactions: Two modes of knowledge construction in socio-constructivist settings for team-sport teaching. *Phys. Educ. Sport Pedagog.* **2013**, *20*, 459–473. [CrossRef]
40. Bailey, R.; Armour, K.M.; Kirk, D.; Jess, M.; Pickup, I.; Sandford, R. The educational benefits claimed for physical education and school sport: An academic review. *Res. Pap. Educ.* **2009**, *24*, 1–27. [CrossRef]
41. Kretchmar, R.S. Teaching games for understanding and the delights of human activity. In *Teaching Games for Understanding: Theory, Research, and Practice*; Griffin, L., Butler, J.I., Eds.; Human Kinetics: Champaign, IL, USA, 2005; pp. 199–212.
42. Pope, C. Once more with feeling: Affect and playing with the TGfU model. *Phys. Educ. Sport Pedagog.* **2005**, *10*, 271–286. [CrossRef]
43. Fernandez-Rio, J.; Sanz, N.; Fernandez-Cando, J.; Santos, L. Impact of a sustained Cooperative Learning intervention on student motivation. *Phys. Educ. Sport Pedagog.* **2016**, *22*, 89–105. [CrossRef]
44. Deci, E.L.; Eghrari, H.; Patrick, B.C.; Leone, D.R. Facilitating Internalization: The Self-Determination Theory Perspective. *J. Pers.* **1994**, *62*, 119–142. [CrossRef] [PubMed]
45. McAuley, E.; Duncan, T.; Tammen, V.V. Psychometric Properties of the Intrinsic Motivation Inventory in a Competitive Sport Setting: A Confirmatory Factor Analysis. *Res. Q. Exerc. Sport* **1989**, *60*, 48–58. [CrossRef] [PubMed]
46. Ryan, R.M. Control, and information in the intrapersonal sphere: An extension of cognitive evaluation theory. *J. Pers. Soc. Psychol.* **1982**, *43*, 450. [CrossRef]
47. Ryan, R.; Connell, J.P.; Plant, R.W. Emotions in nondirected text learning. *Learn. Individ. Differ.* **1990**, *2*, 1–17. [CrossRef]
48. Ryan, R.; Koestner, R.; Deci, E.L. Ego-involved persistence: When free-choice behavior is not intrinsically motivated. *Motiv. Emot.* **1991**, *15*, 185–205. [CrossRef]
49. Ryan, R.M.; Mims, V.; Koestner, R. Relation of reward contingency and interpersonal context to intrinsic motivation: A review and test using cognitive evaluation theory. *J. Pers. Soc. Psychol.* **1983**, *45*, 736. [CrossRef]
50. Cortina, J.M. What is coefficient alpha? An examination of theory and applications. *J. Appl. Psychol.* **1993**, *78*, 98–104. [CrossRef]
51. Alfieri, L.; Brooks, P.J.; Aldrich, N.J.; Tenenbaum, H.R. Does discovery-based instruction enhance learning? *J. Educ. Psychol.* **2011**, *103*, 1–18. [CrossRef]
52. Slamecka, N.J.; Graf, P. The generation effect: Delineation of aphenomenon. *J. Exp. Psychol. Hum. Learn* **1978**, *4*, 592. [CrossRef]