frontiers | Frontiers in Education

TYPE Review
PUBLISHED 19 October 2023
DOI 10.3389/feduc.2023.1273423

OPEN ACCESS

EDITED BY
Manuela Heinz,
University of Galway, Ireland

REVIEWED BY
Kleopatra Nikolopoulou,
National and Kapodistrian University of Athens, Greece
Sánchez Herrera,
Universidad de Extremadura, Spain

*CORRESPONDENCE
Sima Zach
✉ simaz@l-w.ac.il

RECEIVED 06 August 2023
ACCEPTED 03 October 2023
PUBLISHED 19 October 2023

CITATION
Zach S, Shoval E and Shulruf B (2023) Cooperative learning in physical education lessons - literature review.
Front. Educ. 8:1273423.
doi: 10.3389/feduc.2023.1273423

Cooperative learning in physical education lessons - literature review

Sima Zach[1]*, Ella Shoval[1] and Boaz Shulruf[2,3]

[1]Levinsky-Wingate Academic College, Wingate Campus, Netanya, Israel, [2]Medical Education, University of New South Wales, Sydney, NSW, Australia, [3]University of Auckland, Auckland, New Zealand

Cooperative learning in physical education classes is perceived as beneficial. The aim of this article was to examine whether field studies that include cooperative learning in their physical education intervention programs provide applicable data—to allow teachers to choose the optimal teaching strategy in line with their teaching goals. A systematic review of 44 research studies, published between 2000 and 2020, was conducted. Data related to teaching strategies and outcomes were compiled and discriminant function analysis was conducted, to classify the articles according to positive outcomes reported/not reported. Our results suggest a partial association between a range of cooperative teaching strategies (including Jigsaw, Learning Team, Complex, and Complex Instruction, as well as the cooperative learning model and combined strategies) and learning outcomes in four domains (social, physical, affective, and cognitive). Our literature review reveals that while the published data is valuable, additional research is needed to complete the picture.

KEYWORDS

discriminant function analysis, cooperative learning, teaching strategies, learning outcomes, physical education, intervention studies, field research

Introduction

Field studies that examine the impact of educational intervention programs are referred to as applied studies, seeking to reveal what content, conditions, means, and methods lead to significant teaching. As such, their main purpose is to help teachers improve their educational endeavor (e.g., Pulgar et al., 2019; Ghanbari and Abdolrezapour, 2020).

Cooperative Learning (CL) is an active learning model in which students work in small groups to achieve shared learning goals. The Cooperative Learning Model (CLM) aspires to raise the level of student involvement in the learning, while encouraging social relationships that lead to improved achievements in the taught subject and in the students' affective and cognitive skills (Chiu et al., 2014). This approach is based on meaningful theory, validated by research that presents outcomes in a variety of human dimensions, school ages, and study fields (Dzemidzic Kristiansen et al., 2019). During the second half of the 20th century, CL evolved not only as an effective approach to teaching but also as a means for addressing social tension caused by the juxtaposition between socio-cultural status and achievements (Slavin, 2011). As this issue continues to be central to education systems, CL is especially meaningful in contemporary societies, where cooperation between and within groups has become an important means for facing scientific and technological challenges that are too complex to be solved by individuals (Capar and Tarim, 2015).

While expectations from the CLM are high, its application to teaching processes is complex, especially as it is not always in line with the more intuitive and associative manner in which many teachers teach (Page, 2017). Moreover, teachers testify that the organization of the CL class is complex and expresses concerns that the time needed to manage such learning may come at the expense of the learning itself (Buchs et al., 2017). Although teachers acknowledge the benefits of CL goals and outcomes, they usually lack the practical knowledge that is required for constructing a comprehensive teaching strategy that addresses students' norms and behaviors (Johnson et al., 2000). In this paper, we analyze the existing body of published research on applying CL in PE, to provide PE teachers with more focused data regarding the reported outcomes of this model. Our focus was on two topics: (1) the outcomes of applying the CLM; and (2) the relationship between teaching strategies and these outcomes. By analyzing the outcomes, PE teachers will be able to easily access and recognize the variety of teaching goals that are achievable via CL. As such, in order to examine CL methods and techniques that could lead to the desired outcomes, we begin by reviewing theoretical academic articles that laid the foundation for the CLM in PE, as well as articles that review and summarize research on CL in PE. Next, we review practical CL intervention articles, to analyze and present the range of strategies and their outcomes. Finally, we discuss the data that could serve PE teachers who are interested in teaching according to the CL teaching model.

The outcomes of CL in PE

Over the past two decades, the theoretical and review articles on CL in the field of PE have dealt extensively in both the goals and the outcomes of the CL model. Casey and Goodyear (2015), who analyzed 27 articles that aimed at exploring the empirical research on the use of CL in PE, reported on learning achievements in the physical, cognitive, and social domains, and even in the affective domains albeit to a lesser extent. The researchers reported that CL enhances academic learning through the physical and cognitive learning domains, as students acquire a certain level of physical competence and develop an understanding of movement techniques and tactics as a result of their engaging in CL activities. They claimed that one explanation for this enhanced academic learning is the increased opportunity for discussions and face-to-face interactions between students, which increases their opportunities for engaging in higher order thinking skills. The researchers also found social learning outcomes to include the development of interpersonal skills, interpersonal relations, the ability to listen and to speak coherently, while sharing ideas and constructing a new understanding together. Finally, they found that social learning outcomes also encompass students' ability to exhibit caring, empathy, respect, and support.

Bores-García et al. (2021), who later reviewed 15 studies that were conducted during 2014–2019, pointed to the contribution of CL to all dimensions of the human personality, while stating that the affective domain, however, had been inadequately addressed in the examined studies. Both studies (Casey and Goodyear, 2015; Bores-García et al., 2021) assert that short implementation durations would not yield sustainable learning outcomes, and claim that teachers struggle with implementing the model because of its complexity, and that more time is needed to assimilate it in school. Chiu et al. (2014) conducted content analysis on 15 articles that dealt with CL in the physical education curriculum. In line with the findings of Bores-García et al. (2021) and Casey and Goodyear (2015), they demonstrate that the main educational value that CL brings to the physical education curriculum is social responsibility. However, a slightly different point of view is expressed in a recent theoretical article (Montoya et al., 2020), where motivation was found to be the main educational value that arises from CL. In addition to presenting the varied outcomes of CL, researchers are concerned that a significant proportion of interventions are short-lived, and that in some interventional studies, the specific intervention plan is unclear (Casey and Goodyear, 2015; Bores-García et al., 2021), rendering the fidelity of the study of CL in PE somewhat obscure (Casey et al., 2015).

Strategies employed in CL in PE

The terms *teaching model* and *teaching strategy* are not synonymous. A teaching model presents achievable didactic teaching principles and defined teaching goals that are rooted in a defined educational approach (Joyce et al., 2015). A teaching strategy, on the other hand, is subject to the chosen teaching model and presents teaching methods, i.e., ways of teaching and techniques that makes it possible to comply with the didactic principles of the model (Joyce et al., 2015). Indeed, the CL model was originally created to deal with learning gaps in the heterogeneous classroom; its principles include creating a positive dependence on members of the cooperative group, creating a proactive interaction that allows each participant to contribute to the group, etc. One CL strategy is the Jigsaw model, in which the teacher divides the class into small heterogeneous home groups of four-seven children. For each topic, a different representative from each group is taught the material, so that they can then return to the home group and teach their new specialty to the other group members, thereby increasing the participation of each and every student in the group.

Bores-García et al. (2021) specify the CL teaching strategies used in the reviewed research studies (Jigsaw, Joint Action Studies in Didactics, and Learning Teams), yet most do not present such detailed data (e.g., Chiu et al., 2014; Casey and Quennerstedt, 2020; Montoya et al., 2020). Several researchers in the field of CL (e.g., Hastie and Casey, 2014; Casey et al., 2015; Dyson and Casey, 2016) present five fundamental CLM principles: (1) positive interdependence; (2) individual accountability; (3) group processing; (4) promoting face-to-face interaction; and (5) small groups and interpersonal skills. However, they claim that as implementing all five elements is too complex for teachers, the specific steps while applying the model should be further examined, to understand the outcomes. This argument, which points to the difficulty of applying CL principles, justifies the vast efforts that have been made by numerous researchers in designing detailed and interwoven teaching strategies in a manner that allows for expected outcomes to be achieved. The current study therefore strives to specifically examine the teaching strategies that are implemented in CL intervention studies in PE, their outcomes, and the relationships between the two.

Methods

Search sources

In this study, we conducted a systematic review of 44 research studies (from 2,576 initial studies) that were published over a 20-year period, from January 2000 to April 2020. The search for sources focused on field research articles in which there was an examination of the impact of CL intervention programs that entailed physical activity on processes and achievements. Our review included quantitative studies, qualitative studies, and mixed-method studies. The search was conducted via seven electronic databases, including ERIC, Google Scholar, SPORTDiscus, EBSCO host, and Web of Science, ProQuest, and ScienceDirect. The descriptors used for the search included "cooperative learning" or "collaborative learning"; "school" or "class"; and "physical education," "physical activity," or "movement."

Exclusion criteria

The exclusion criteria included the following: (1) duplicated articles, (2) articles that were not published in journals that are indexed in the Journal Citation Report (JCR) or in the Scimago Journal Rank (SJR); (3) articles written in languages other than English; (4) articles that do not address an intervention program; and (5) articles that address an intervention program yet do not mention any of the CL teaching or learning process examined in this study. The search summary, using the Prisma framework (Page M. J. et al., 2020; Page M. et al., 2020), is presented in Figure 1 as flow chart.

Procedure

The article sorting process resulted in our identifying 44 articles that met all of our inclusion criteria. As past PE teachers, we chose to gather data that could help teachers understand how CL research might help them while considering this method for their purposes. Therefore, the data were examined in relation to: (1) *outcomes in social, physical, affective, and cognitive domains*; and (2) *type of CL teaching strategy* – (a) Jigsaw (JIG); (b) Learning Team (LT); (c) Complex Instruction (CI); (d) Student Team – Achievement Division (STAD); (e) Performer and Coach Earn Rewards (PACER); (f) Cooperative Learning Model Teaching Strategy (CLM); and (g) combined teaching strategies (Combined). Data were also examined regarding *the learning process*, including the intervention duration and students' previous experience in CL. Finally, we also examined the *research method* (qualitative, quantitative, or mixed methods) and *the participants* in the article (students vs. teachers; individual vs. group level).

Given the nature of the data that was reported in the reviewed articles, whereby conducting a meta-analysis was not suitable due to inconsistency of reported data between studies, we decided to focus on the presence or absence of various key features. As such, we recorded the data in a binary manner. *The outcome of each intervention* served as the dependent variable, whereby when the reported outcome was positive and statistically significant, the variable received a value of 1. When the reported outcome was either negative, not significant, or no outcome was reported, the variable received the value of 0. In addition, teaching strategies and additional discrete variables (e.g., type of study, class, grade, etc.) that may have impacted the outcome were similarly recorded, whereby their presence was marked with a value of 1 and their absence was marked with a value of 0. Compiling the data in this manner enabled us to address the following important generic question: Which teaching strategies that were reported as having been implemented in the studies are associated with the reported positive outcomes? Moreover, applying this type of analytical approach in research is the best option in cases where conducting a meta-analysis is not a possible option (Garson, 2012). Finally, the advantage of applying this approach is that it minimizes the number of articles that are excluded from the analysis due to missing data.

Data analysis

Discriminant Function Analysis (DFA) (Haas et al., 2004; Garson, 2012) was used to identify the possibility of classifying (or discriminating between) articles that report positive outcomes and those that do not report such outcomes through features of the interventions or relating to the specific studies. The DFA was conducted separately for each of the four domains of outcomes (social, physical, affective, and cognitive). The predictors applied in our analysis included: (1) type of research method (qualitative, quantitative, or mixed); (2) the level at which the student data and the teacher data were reported (individual or group average); (3) teaching strategy reported (yes or no); (4) duration of the intervention in academic hours (≥24 h, yes or no); and (5) whether the students had previously experienced CL prior to the study (yes or no). The results of the DFA in this review paper are reported using a standardized and unstandardized linear function for each outcome, the two centroids and the cut-off point for classification. We also report the percentage of correct classification, thereby indicating the predictive power of each DF.

It is important to note that the analysis reported in this paper is of *articles* (i.e., research reports) rather than of the actual *studies*. As such, most independent variables are classified as being present or lacking. Regarding the dependent variable of outcomes, we assumed that positive outcomes are more likely to be reported while negative or non-significant outcomes are more likely to be omitted (Marks-Anglin and Chen, 2020; Page M. J. et al., 2020; Page M. et al., 2020).

Results

Table 1 presents each of the 44 articles reviewed in this article in chronological order. Of all the articles, 21 were quantitative studies, 21 were qualitative articles, and two used mix methods. In 21 studies, the number of subjects reported was less than 50, which is a relatively low number of participants. Moreover, about a quarter of the studies that had a low number of subjects were quantitative. Only four studies reported that the students had previous experience in CL. In 20 studies, the duration of the intervention program was at least 24 academic hours (i.e., lessons).

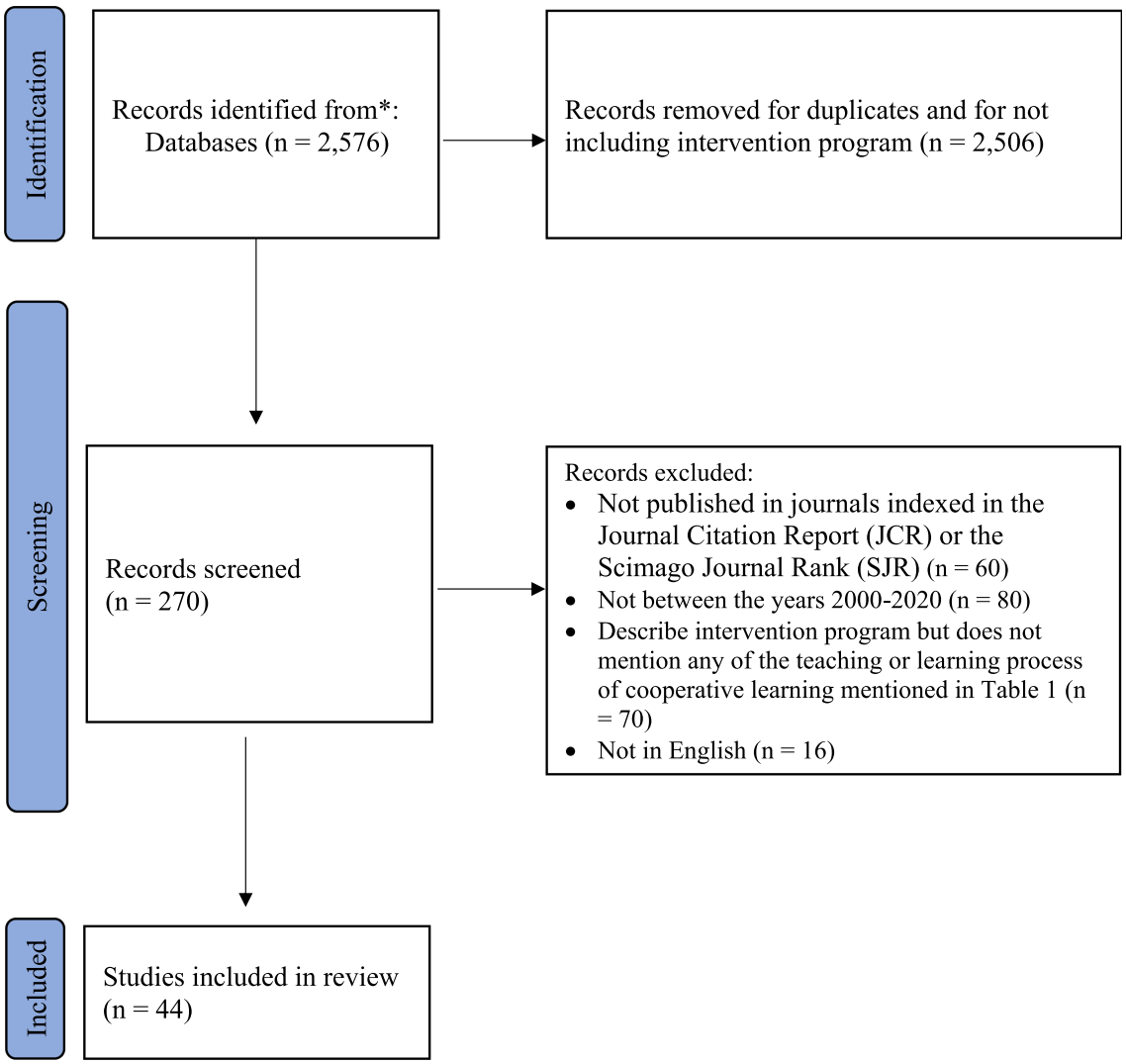

FIGURE 1
Flow chart of studies identification via databases.

Outcomes of CL in PE

The prevalence of the four examined domains was similar among the articles. Some studies examined variables from two different domains, while a number of qualitative articles only examined processes, not outcomes. Among those that presented positive outcomes, 14 articles presented positive social outcomes, including seven relating to behavioral changes, two dealing with attitudes toward friends and the class, and two dealing with both behavioral changes and attitude changes. Ten articles addressed the physical domain, with a focus on motor abilities in skills, fitness, and games. In the affective domain there were a total of 12 articles, of which seven dealt with improving motivation for coping or succeeding and five dealt with changes in perceptions and attitudes. Finally, in the cognitive domain, 10 articles were identified, of which four showed improvements in academic achievements and six showed improvement in thinking skills.

Associations between CL strategies in PE and outcomes

When examining the strategies that were applied in the review research studies, only three teaching strategies were addressed in more than one article. Of the 44 articles reviewed, the JIG strategy was applied in five studies, LT was applied in five studies, and CI was applied in two studies. Ten articles applied general CLM principles, while 20 intervention programs (almost half of all programs) employed the Combined strategy. Moreover, in several studies, the researchers incorporated principles of non-CL strategies, such as the Sport Education Strategy (Montoya et al., 2020) or the Self-Learning Strategy (Benkhaled et al., 2015).

Table 2 shows that overall, the DFA yielded acceptable-to-high levels of correct classification (68.2–81.8%). The *positive* DF coefficients were found to be associated with four positive outcomes in the *affective* and *cognitive* domains, while *negative* DF coefficients

10.3389/feduc.2023.1273423

TABLE 1 Studies on CL in PE conducted during 2000–2020.

ID	References	Research method	No. of participants	Previous CL experience	No. of intervention hours	Teaching strategies	Outcomes
1	Bjørke and Mordal Moen (2020)	Qualitative	41	No	24	CLM	Social: Capable of working alongside their peers Affective: Changed their attitudes toward CL
2	Tiberi et al. (2020)	Quantitative	33	No	8	Combined	Cognitive: Improvement in student reading Comprehension
3	Baena-Morales et al. (2020)	Quantitative	177	Yes	>24*	JIG	Social/Affective: Jigsaw as a good method for developing social competences; Differences between the genders in relation to CL
4	Nopembri et al. (2019)	Quantitative	810	No	56	Combined	Affective: Increase in stress coping problem-solving skills Cognitive: Increase in problem-solving skills
5	O'Leary et al. (2019)	Qualitative	36	No	12	JIG	Affective: Change in their perceptions of social, cognitive, and motor ability to learn
6	Hortigüela Alcalá et al. (2019)	Mixed methods	179	No	27	Combine	Affective: Motivation increased significantly Social: Partial interaction increase
7	Sánchez-Hernández et al. (2018)	Qualitative	~25	No	8	JIG	Social: Shift in class climate between genders
8	Bodsworth and Goodyear (2017)	Qualitative	36	No	8	CLM	Cognitive: Process of reflection and collaborative inquiry facilitated the learning
9	Altınkök (2017)	Quantitative	68	No	12	CLM	Physical: Development of basic motor skills
10	Huang et al. (2017)	Quantitative	170	No	30	LT	Physical: Improved basketball skills Cognitive: Improved critical thinking skills
11	Fernandez-Rio et al. (2017)	Quantitative	249	No	32	Combined	Affective: Increase in intrinsic motivation, identified regulation, and perception of class climate
12	Wallhead and Dyson (2017)	Qualitative	3	No	27	Combined	Social: Improved student interactions Cognitive: Facilitates problem-solving tasks. Improved interpretation of the knowledge at hand
13	Dyson et al. (2016)	Qualitative	12	No	<24*	CLM	**

(Continued)

TABLE 1 (Continued)

ID	References	Research method	No. of participants	Previous CL experience	No. of intervention hours	Teaching strategies	Outcomes
14	Gorucu (2016)	Quantitative	48	No	20	Combined	Cognitive: Effect on students' problem-solving skills
15	Darnis and Lafont (2015)	Quantitative	82	No	10	Combined	Physical: Development of motor and tactical skills
16	Benkhaled et al. (2015)	Quantitative	72	No	80	Combined	Physical: Implementation of the Competency-Based Approach in physical and sports education class
17	Bensikaddour et al. (2015)	Qualitative	48	No	24	LT	Physical: Improved physical performance Social: Improved relationships
18	Lee (2014)	Mixed methods	60	No	10	Combined	Physical: Improved physical fitness
19	Callado et al. (2014)	Qualitative	7	No	24	CLM	**
20	Goodyear et al. (2014)	Qualitative	60	No	8	CLM	Affective: Improved engagement among girls
21	O'Leary et al. (2014)	Qualitative	3	No	8	JIG	**
22	Luo and Sun (2013)	Quantitative	20	No	8	CLM	Physical: Improved motor skills
23	André et al. (2013)	Qualitative	168	No	72	CLM	Social: Improved helping behavior and acceptance of pupils with learning disabilities
24	Cohen and Zach (2013)	Qualitative	49	No	4	CLM	Affective: Less teaching efficacy Cognitive: More cooperation principles in teachers' planning
25	Wang (2012)	Quantitative	67	No	24	Combined	Affective: Improved motivation for enhancing achievements
26	Callado (2012)	Qualitative	30	Yes	>24*	LT	Physical: Positive effects on students' motor performance Social: Greater autonomy in the learning process, increased pro-social behaviors and inclusion
27	Geok and Malaysia (2011)	Quantitative	60	No	36	STAD	Social: Improved social skills
28	André et al. (2011)	Quantitative	217	No	6	LT	Social: Impact on acceptance among mainstream students
29	Shoval and Shulruf (2011)	Quantitative	158	No	24	CI	Cognitive: Improved academic achievements

(Continued)

TABLE 1 (Continued)

ID	References	Research method	No. of participants	Previous CL experience	No. of intervention hours	Teaching strategies	Outcomes
30	Shoval (2011)	Quantitative	216	No	24	CI	Cognitive: Improved academic achievements
31	Bayraktar (2011)	Quantitative	50	No	18	LT	Cognitive: Academic success Affective: Improved attitudes toward PE lessons and practicing skills
32	Dyson et al. (2010)	Qualitative	48	No	24	Combine	**
33	O'Leary and Griggs (2010)	Qualitative	61	No	>24*	JIG	Affective: Found ways to give affective feedback Social: Improved responsibility taking
34	Casey and Dyson (2009)	Qualitative	67	No	14	Combined	**
35	Goudas and Magotsiou (2009)	Quantitative	114	No	13	Combined	Social: Gained social skills Affective: Preferences for group work
36	Casey et al. (2009)	Quantitative	67	Yes	28	CLM	**
37	Chen et al. (2007)	Qualitative	35	No	8	Combined	**
38	Lafont et al. (2007)	Quantitative	30	No	10	Combine	Physical: Positive effect on games' skills Social: No effect was found on inter-personal relationships
39	Barrett (2005)	Qualitative	23	No	18	PACER	Physical: Low-skilled students performed as well as others
40	Dyson and Strachan (2004)	Qualitative	54	Yes	72	Combined	**
41	Dyson (2002)	Quantitative	49	Yes	24	Combined	**
42	Dyson (2001)	Qualitative	47	Yes	16	Combined	**
43	Dyson and Strachan (2000)	Qualitative	9	Yes	10	Combined	Affective: Students believed that CL encouraged learning motor skills, participating, communicating, having fun and cooperating
44	Polvi and Telama (2000)	Quantitative	95	No	80	Combined	Social: Development of social helping behavior

* Data were not explicitly presented.
** Qualitative articles that only examined processes, not outcomes.

were associated with positive outcomes in the *social* and *physical* domains. Meaningful results were those that yielded a medium or larger effect size.

When the *JIG strategy* was implemented, positive outcomes were reported in the *affective* domain, and to a lesser degree in the *cognitive* and *social* domains (standardized coefficients = 0.734, 0.404, and −0.403, respectively). When the *LT* teaching strategy was implemented, positive outcomes were reported in the *physical* and *affective* domains, yet with a low-medium effect size (standardized coefficients = 0.377 and 0.360, respectively). When the *CI* teaching strategy was reported, positive outcomes were seen in the *cognitive* domain (standardized coefficient = 0.586). When *CLM* was reportedly implemented, positive outcomes were reported in the *affective* domain, and to a lesser degree in the *cognitive* domain

TABLE 2 Discriminant function coefficients: predictors of reported positive outcomes.

Discriminant function coefficients									
Outcome	Social		Physical			Affective		Cognitive	
	Un-Stand	Stand	Un-Stand	Stand		Un-Stand	Stand	Un-Stand	Stand
Qualitative	2.007	**1.025**	−1.318	**−0.672**		1.587	**0.809**	−1.707	**−0.822**
Quantitative	2.427	**1.240**	−1.192	**−0.603**		1.662	**0.849**	−0.543	−0.267
Student data individual level	−1.445	**−0.592**	1.362	**0.560**		0.199	0.082	1.773	**0.691**
Teacher data individual level	0.544	0.339	0.680	**0.413**		−0.499	−0.317	0.324	0.204
Class data level	1.207	**0.443**	−0.022	−0.008		1.252	**0.463**	−0.016	−0.006
Teaching strategy TL	0.404	0.129	−1.238	**−0.377**		1.109	**0.360**	0.788	0.254
Teaching strategy IC	3.466	**0.729**	1.569	0.333		−0.130	−0.028	2.940	**0.586**
CLM	1.015	**0.434**	1.612	**0.665**		2.738	**1.160**	0.983	**0.421**
Teaching strategy JIG	−1.261	**−0.403**	2.293	**0.732**		2.271	**0.734**	1.247	**0.404**
Combined strategies	0.795	**0.402**	0.132	0.067		1.566	**0.797**	0.009	0.004
Duration (≥24 h) of Intervention	−0.785	**−0.367**	0.204	0.095		−0.007	−0.003	0.136	0.063
Student.Prev. Experience.CL Other.Subj	1.588	**0.454**	0.558	0.162		−1.769	**−0.511**	−1.527	**−0.441**
(Constant)	−2.086		−0.914			−3.381		−1.001	
Positive outcome not reported	0.512		0.374		Positive outcome reported	−0.256		−0.459	
Classification cut-point	−0.192		−0.541		**Classification cut-point**	0.2125		0.382	
Positive outcome reported	−0.896		−1.456		Positive outcome not reported	0.681		1.223	
Function's classification correct	79.5%		81.8%			68.2%		81.8%	
Effect size criteria									
Small	<0.35								
Medium	**0.35–0.65**								
Large	**>0.65**								

Effect size criteria is the Key/Legend, it shows the meanings of the bold and gray values.

(standardized coefficients = 1.160 and 0.421, respectively). Finally, when *Combined* teaching strategies were reported, positive outcomes were seen in the *affective* domain (standardized coefficient = 0.797).

When the duration of the intervention was examined as being ≥24 h in terms of academic lessons, a negligible impact was seen on the positive outcomes, with the exception of positive outcomes being reported in the *social* domain (standardized coefficient = −0.367, i.e., low-medium effect).

When examining the students' previous experience in CL that was reported in the reviewed articles, no significant associations were found with any positive outcomes, thereby suggesting that this variable has no impact on the positive outcomes reviewed in this study. However, student data that was reported on the individual level was associated with positive outcomes in the *cognitive* and *social* domains (standardized coefficients = 0.691 and −0.592, respectively).

It is important to note that the DFA for the *affective* domain only yielded 68.2% correct classification. Such levels are estimated to be equivalent to a medium effect in comparison to the DFA of the other three domains (i.e., social, physical, and cognitive) that yielded 79.5–81.8% correct classification, which is estimated to be equivalent to a high effect (Coe, 2002).

Discussion

The motivation for conducting this article review stemmed from the importance of understanding how PE teachers can benefit from implementing CL in their classes, based on the corpus of articles that

have been published in academic journals. Based on our systematic review, diversified studies have been conducted across a wide range of classrooms and durations, and have resulted in a range of outcomes regarding social, physical, affective, and cognitive domains. While such a large pool of data is important and beneficial, in this case it makes it harder for PE teachers to make an educated decision regarding the type of CL that they should apply in their classroom in order to achieve optimal outcomes.

The outcomes of CL in PE

Further to our findings, some associations were seen between certain teaching strategies and outcomes. The social domain was found to be weakly associated with the JIG model, while the physical domain was found to be weakly associated with the LT strategy. The affective domain was found to be associated with JIG, CLM, and Combined strategies, and to a lesser effect with LT. Finally, the cognitive domain was found to be associated with the CI strategy, and to a lesser degree with JIG and CLM. As such, we cannot fully recommend a certain teaching strategy for teachers who wish to achieve social and physical goals through CL in their PE classes.

In more than half the studies, the intervention duration was relatively short. However, we did not find a relationship between the length of the intervention program and its outcomes. This differs from previous findings, whereby researcher suggest that teachers must invest time and effort in order to conduct effective CL in small groups (Baloche and Brody, 2017). Moreover, Bjørke and Mordal Moen (2020) argued that children who embark on CL, approach it with skepticism at first, only gradually developing a positive attitude toward the process, understanding its benefits, and actually beginning to learn through it. In our research, no association was found between the reported duration of the intervention programs and outcomes on physical, affective, and cognitive domains, yet a small impact was seen, however, on social outcomes.

Only four of the reviewed research studies in this paper addressed students' previous CL experience and this aspect was not associated with any positive outcomes. Previous studies (e.g., Ghaith, 2018) mention that students who have learned to listen to each other in small group lessons, in classes such as math or language, may apply this CL skill in PE classes as well. In other words, when experiencing CL in one field, students could be expected to transfer this capability to other fields, thereby achieving more meaningful learning. It is therefore recommended that future research examine this aspect of previous CL experience among children.

Strategies employed in CL in PE

A range of CL strategies are analyzed in the literature and applied in various teaching professions (e.g., Felder, 2001). Yet in our review, only the following three strategies—JIG, LT, and CLM—were found to have been used as intervention programs in more than one article. The question is therefore, what makes each of these strategies special and what is their contribution to the intervention outcomes in the various dimensions? To answer this, we will now present the main concept of these three teaching strategies and their unique association with PE classes.

The JIG strategy

This strategy is based on the recognition that it is of the utmost importance to maximize the learning potential of each and every student in the classroom, which can be achieved by creating motivation to learn among the students. To do so, the teacher must conduct meticulous and structured planning that encourages children's involvement in the learning through social processes (Aronson et al., 1978).

The principles that enable this relate to the cultivating and nurturing of students' self-esteem while decreasing their anxiety that could prevent them from participating in class. Self-esteem improves as those involved become more experienced and enthusiastic, and achieve mastery of the learned topic. As such, students must have mutual goals and agree to share their ideas and solutions with their classmates. It is also important to create in children a sense that they are needed and that they can teach and contribute to the class (Marhamah and Mulyadi, 2013). The teacher must serve as a mediator or facilitator, helping the children to take responsibility for their own learning and for that of their peers (Lee and Kim, 2015).

Applying this strategy entails four steps: (1) dividing the class into small heterogeneous home groups of students and assigning a different sub-topic to each member of the group; (2) the students then study their allocated sub-topics; (3) in turn, each student teaches the other group members about the specific sub-topic; (4) the group and the teacher summarize and evaluate the learning process. Specifically in PE classes, JIG has the potential to improve the affective domain, i.e., the students' attitude toward PE (Casey and Fernandez-Rio, 2019; Walad et al., 2019), and facilitate social communications, as the stronger students cannot take over and prevent the quieter ones from participating. Instead, it provides an opportunity for all students to participate and be partners to the lesson. Indeed, our literature review confirms that the JIG strategy has a positive impact on the affective domain, and to some extent on the social domain.

The LT strategy

This strategy is based on the assumption that there is inequality in education—due to the discrimination of children with disabilities, from different racial or ethnic backgrounds, and from different socio-economic statuses (Johnson and Johnson, 1999)—which in turn leads to inequality in their integration and achievements in the future.

The principles that enhance equality in learning require the enhancing of students' positive interdependence, individual accountability, and ability to conduct face-to-face interactions. In addition, they require the appropriate use of group skills and processing that are necessary for achieving the best group results by means of mutual assistance among the group members. All group members know that they must work together on the task and are aware of their individual contribution to the success or failure of the group as a whole (Rimmerman, 2004). In order to realize these principles, teachers need to teach interpersonal skills and impart self-regulating behavior capabilities, while conducting the classroom in a structured framework that enables cooperation (Hobri and Hossain, 2018).

Applying this strategy entails four steps: (1) prior to embarking on group learning, the teacher must build up the students' ability to work in collaboration; (2) Students are divided into small heterogeneous groups and must work together to define the purpose of the group; (3) while performing activities in the group setting, discussions are held

within the group as well as, ongoing self-assessment of the cooperation in the group; (4) Each member of the group has to perform tasks in pairs (one performs while the other assists), and the tasks constantly change (Bayraktar, 2011). In this strategy, the teacher fills the role of environment organizer, supporter, and assistant.

Specifically in PE, this strategy enables students to apply the social skills that are needed in face-to-face interactions (Hannon and Ratliffe, 2004). Moreover, this strategy makes solving problems and giving feedback much easier, as the students' movements are visible, demonstrating and enabling trial and error (Huang et al., 2017). However, evidence regarding outcomes of applying this strategy in PE classes on the physical and affective domains is weak, and no evidence can be seen for positive outcomes on students' social and cognitive domains.

The CI strategy

The goal of the CI strategy is to provide students with equal accessibility to the teacher and to the learning (Cohen and Lotan, 1997). To break the cycle of discrimination whereby students from a lower socio-economy status have less access to education, the teacher must ensure that optimal student-teacher contact conditions exist. This strategy entails four contact conditions: (1) institutional support provided by the school principal and the teachers to encourage social rapprochement between different groups; (2) equal status and equal division of roles between the group members when performing the tasks; (3) cooperation and mutual assistance between group members for achieving the common goals; and (4) an intimate, pleasant, and rewarding environment when working as a group.

Applying this strategy encompasses six basic requirements: (1) maintaining equal access to each interaction; (2) addressing each group as an independent entity; (3) implementing cooperative behavior as the norm; (4) treating children as multidimensional; (5) setting norms and maintaining a consistent framework; and (6) ensuring an intimate and pleasant environment. Each of these six principles includes a methodical breakdown of the learning structure, the teacher and students' behavioral norms. Every little detail is specific and accurate, pieces of a puzzle that together provide a comprehensive picture.

Specifically in terms of PE lessons, the CI strategy could serve as a special aid that allows the teacher to implement the contact conditions in the classroom (Ben Ari, 2002; Shoval, 2011), thereby enhancing both learning and social relationships between students. Indeed, our literature review confirms the impact of the CI strategy on the cognitive domain, whereby adherence to the rules of communication and equality between children has an impact on their learning. However, evidence is lacking about the impact of CI on other dimensions.

Table 3 is a summary of missing and existing evidences to serve physical education teachers who are interested in applying CL as was reported in the existing body of research.

TABLE 3 Summary of existing and missing evidences to serve physical education teachers who are interested in applying CL.

The subject	The existing evidence	The missing evidence
Teaching strategies and outcomes	JIG implementation is associated with outcomes in the affective domain and to a lesser effect in cognitive and social domains LT implementation is associated with outcomes in the physical and affective domain but with low-medium effect size only CI implementation is associated with outcomes in the cognitive domain	Not yet have evidence on the ability of JIG to improve the outcomes of the physical domains Not yet have evidence on the ability of LT to improve the outcomes of social and cognitive domains Not yet have evidence on the ability of CL to improve physical, affective and social domains
Experience of learners and outcomes		Not enough evidence yet regarding the desired duration of learning activation in CL No evidence yet on association between students' previous experience in CL and outcomes

Non-specific strategy intervention programs

Of the 44 research studies reviewed in this article, 10 were not based on a detailed or structured teaching strategy, but rather implemented the more general CLM that is based on five principles (positive interdependence; individual accountability; group processing; face-to-face interaction; and small groups and interpersonal skills). When examining the outcomes of this more general model, our results indicate positive outcomes in the affective domain and a positive yet weaker outcome on the cognitive domain. Yet to maintain fidelity and enable other researchers to replicate research findings, the methodology must be more detailed than it is in these 10 articles (Casey et al., 2015). As such, PE teachers who wish to implement CLM may find it difficult to do so. Future research could therefore benefit from specifying the CLM methodology and comparing studies that employ the same techniques.

Moreover, 20 studies combined principles from different strategies. These studies, which we referred to as Combined, presented outcomes in the affective domain. However, here too, PE teachers may find it difficult to replicate these studies, due to the inability to replicate the methodologies employed. Many studies with identical combination and comparison between different combinations and between different well-defined CL's teaching strategies may change the picture.

Conclusion

Our literature review of 44 articles that address CL strategies employed in PE classes indicates a lack of data regarding the specific strategy and methodology employed and their outcomes on four domains: Social, physical, cognitive, and affective. It is therefore important to further explore CL so as to provide PE teachers with applicable methodologies for achieving desired outcomes. Researchers and teachers could benefit from applying specific existing strategies based on known principles and pedagogical theories that are specially

interwoven as a means for achieving defined outcomes. In turn, such research could serve as scaffolding for providing teachers with solid grounds for teaching. Research should consider the time children acquire the ability to act in collaborative groups, and the time they use CL to achieve meaningful outcomes as two separate procedures.

Limitations

As the articles reviewed in this study were only written in English, articles in other languages such as Spanish and Portuguese were excluded. Therefore, the review may be culture biased. Moreover, throughout this reviewed, we classified each article according to type of teaching strategy employed and outcomes on four domains. With regards to outcomes, our classification differentiated positive outcomes and all other outcomes (negative, unclear, or not reported)—based on the assumption that negative outcomes are less likely to be reported (Torgerson, 2006). That being said, this limitation does not compromise the quality of this literature review, and may even strengthen it, as we acknowledge the possible (or likely) bias that some of the literature may be subject to.

Author contributions

SZ: Investigation, Methodology, Project administration, Visualization, Writing – original draft, Writing – review & editing. ES: Visualization, Writing – original draft, Writing – review & editing, Conceptualization, Investigation, Project administration, Supervision. BS: Data curation, Formal analysis, Methodology, Software, Validation, Writing – original draft, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

Altınkök, M. (2017). The effect of movement education based on cooperative learning method on the development of basic motor skills of primary school 1st grade learners. *J. Balt. Sci. Educ.* 16, 241–249. doi: 10.33225/jbse/17.16.241

André, A., Deneuve, P., and Louvet, B. (2011). Cooperative learning in physical education and acceptance of students with learning disabilities. *J. Appl. Sport Psychol.* 23, 474–485. doi: 10.1080/10413200.2011.580826

André, A., Louvet, B., and Deneuve, P. (2013). Cooperative group, risk-taking and inclusion of pupils with learning disabilities in physical education. *Br. Educ. Res. J.* 39, 677–693. doi: 10.1080/01411926.2012.674102

Aronson, E., Blaney, N., Stephan, C., Sikes, J., and Snapp, M. (1978). *The jigsaw classroom*. Beverly Hill: Sage.

Baena-Morales, S., Jerez-Mayorga, D., Fernández-González, F. T., and López-Morales, J. (2020). The use of a cooperative-learning activity with university students: A gender experience. *Sustainability* 12:9292. doi: 10.3390/su12219292

Baloche, L., and Brody, C. M. (2017). Cooperative learning: exploring challenges, crafting innovations. *J. Educ. Teach.* 43, 274–283. doi: 10.1080/02607476.2017.1319513

Barrett, T. (2005). Effects of cooperative learning on the performance of sixth-grade physical education students. *J. Teach. Phys. Educ.* 24, 88–102. doi: 10.1123/jtpe.24.1.88

Bayraktar, G. (2011). The effect of cooperative learning on students' approach to general gymnastics course and academic achievements. *Educ. Res. Rev.* 6, 62–71. doi: 10.5897/ERR2023.4367

Ben Ari, R. (2002). Mindful movement: towards enhanced intergroup relations in heterogeneous classrooms. *Curricul. Teach.* 17, 19–36. doi: 10.1093/elt/56.2.128

Benkhaled, H., Atallah, A., and Touati, H. (2015). Effects of cooperative and self-learning strategies on physical education and sport class. *Int. J. Cross Discip. Subj. Educ.* 6, 2340–2347. doi: 10.20533/ijcdse.2042.6364.2015.0321

Bensikaddour, H., Mokrani, D., Benklaouz Touati, A., Benzidane, H., and Sebbane, M. (2015). The importance of the practice of competitive games kid's athletics in physical education for college students (11-12 years) using the cooperative learning strategy. *Eur. Sci. J.* 11, 280–297.

Bjørke, L., and Mordal Moen, K. (2020). Cooperative learning in physical education: a study of students' learning journey over 24 lessons. *Phys. Educ. Sport Pedagog.* 25, 600–612. doi: 10.1080/17408989.2020.1761955

Bodsworth, H., and Goodyear, V. A. (2017). Barriers and facilitators to using digital technologies in the cooperative learning model in physical education. *Phys. Educ. Sport Pedagog.* 22, 563–579. doi: 10.1080/17408989.2017.1294672

Bores-García, D., Hortigüela-Alcalá, D., Fernandez-Rio, F. J., González-Calvo, G., and Barba-Martín, R. (2021). Research on cooperative learning in physical education: systematic review of the last five years. *Res. Q. Exerc. Sport* 92, 146–155. doi: 10.1080/02701367.2020.1719276

Buchs, C., Filippou, D., Pulfrey, C., and Volpé, Y. (2017). Challenges for cooperative learning implementation: reports from elementary school teachers. *J. Educ. Teach.* 43, 296–306. doi: 10.1080/02607476.2017.1321673

Callado, C. V. (2012). Analysis of the effects of the implementation of cooperative learning in physical education. *Qualitat. Res. Educ.* 1, 80–105. doi: 10.4471/qre.2012.04

Callado, V. C., Fraile, A. A., and Lopez Pastor, V. M. (2014). Cooperative learning in physical education. *Movimento* 20, 239–259. doi: 10.22456/1982-8918.40518

Capar, G., and Tarim, K. (2015). Efficacy of the cooperative learning method on mathematics achievement and attitude: A Meta-analysis research. *Educ. Sci. Theory Pract.* 15, 553–559. doi: 10.12738/estp.2015.2.2098

Casey, A., and Dyson, B. (2009). The implementation of models-based practice in physical education through action research. *Eur. Phys. Educ. Rev.* 15, 175–199. doi: 10.1177/1356336X09345222

Casey, A., Dyson, B., and Campbell, A. (2009). Action research in physical education: focusing beyond myself through cooperative learning. *Educ. Action Res.* 17, 407–423. doi: 10.1080/09650790903093508

Casey, A., and Fernandez-Rio, J. (2019). Cooperative learning and the affective domain. *J. Phys. Educ. Recreat. Dance* 90, 12–17. doi: 10.1080/07303084.2019.1559671

Casey, A., Goodyear, V. A., and Dyson, B. P. (2015). Model fidelity and students' responses to an authenticated unit of cooperative learning. *J. Teach. Phys. Educ.* 34, 642–660. doi: 10.1123/jtpe.2013-0227

Casey, A., and Goodyear, V. A. (2015). Can cooperative learning achieve the four learning outcomes of physical education? *Rev. Liter. Quest.* 67, 56–72.

Casey, A., and Quennerstedt, M. (2020). Cooperative learning in physical education encountering Dewey's educational theory. *Eur. Phys. Educ. Rev.* 26, 1023–1037. doi: 10.1177/1356336X20904075

Chen, W., Cone, T. P., and Cone, S. L. (2007). A collaborative approach to developing an interdisciplinary unit. *J. Teach. Phys. Educ.* 26, 103–124. doi: 10.1123/jtpe.26.2.103

Chiu, Y. C., Hsin, L. H., and Huang, F. H. (2014). Orientating cooperative learning model on social responsibility in physical education. *Int. J. Res. Stud. Educ.* 3, 3–13. doi: 10.5861/ijrse.2014.728

Coe, R. (2002). It's the effect size, stupid: what effect size is and why it is important. British Educational Research Association annual conference, Exeter.

Cohen, E. G., and Lotan, R. A. (1997). *Working for equity in heterogeneous classrooms: Sociological theory in practice*. New York, NY: Teachers College Press.

Cohen, R., and Zach, S. (2013). Building pre-service teaching efficacy: A comparison of instructional models. *Phys. Educ. Sport Pedagog.* 18, 376–388. doi: 10.1080/17408989.2012.690374

Darnis, F., and Lafont, L. (2015). Cooperative learning and dyadic interactions: two modes of knowledge construction in socio-constructivist settings for team-sport teaching. *Phys. Educ. Sport Pedagog.* 20, 459–473. doi: 10.1080/17408989.2013.803528

Dyson, B. (2001). Cooperative learning in an elementary physical education program. *J. Teach. Phys. Educ.* 20, 264–281. doi: 10.1123/jtpe.20.3.264

Dyson, B. (2002). The implementation of cooperative learning in an elementary physical education program. *J. Teach. Phys. Educ.* 22, 69–85. doi: 10.1123/jtpe.22.1.69

Dyson, B., and Casey, A. (2016). *Cooperative learning in physical education and physical activity: A practical introduction*. London: Routledge.

Dyson, B. P., Colby, R., and Barratt, M. (2016). The co-construction of cooperative learning in physical education with elementary classroom teachers. *J. Teach. Phys. Educ.* 35, 370–380. doi: 10.1123/jtpe.2016-0119

Dyson, B. P., Linehan, N. R., and Hastie, P. A. (2010). The ecology of cooperative learning in elementary physical education classes. *J. Teach. Phys. Educ.* 29, 113–130. doi: 10.1123/jtpe.29.2.113

Dyson, B., and Strachan, K. (2000). Co-operative learning in a high school physical education programme. Waikato. *J. Educ.* 6, 19–37.

Dyson, B., and Strachan, K. (2004). The ecology of cooperative learning in a high school physical education programme. Waikato. *J. Educ.* 10, 117–140. doi: 10.15663/wje.v10i1.335

Dzemidzic Kristiansen, S., Burner, T., and Johnsen, B. H. (2019). Face-to-face promotive interaction leading to successful cooperative learning: A review study. *Cogent Educ.* 6:1674067. doi: 10.1080/2331186X.2019.1674067

Felder, R. (2001). Effective strategies for cooperative learning. *Cooperat. Collab. Coll. Teach.* 10, 69–75.

Fernandez-Rio, J., Sanz, N., Fernandez-Cando, J., and Santos, L. (2017). Impact of a sustained cooperative learning intervention on student motivation. *Phys. Educ. Sport Pedagog.* 22, 89–105. doi: 10.1080/17408989.2015.1123238

Garson, D. (2012). *Discriminant function analysis*. Asheboro, NC: Statistical Associates Publishers.

Geok, B., and Malaysia, P. (2011). Issue of the social dilemmas after wars: A cooperative learning intervention through physical education and its effect on social skills development among middle school students in Baghdad, Iraq. *Aust. J. Basic Appl. Sci.* 5, 980–989.

Ghaith, G. M. (2018). Teacher perceptions of the challenges of implementing concrete and conceptual cooperative learning. *Issues Educ. Res.* 28, 385–404. doi: 10.13140/RG.2.2.32014.66888

Ghanbari, N., and Abdolrezapour, P. (2020). Group composition and learner ability in cooperative learning: A mixed-methods study. *TESL-EJ* 24, 1–18.

Goodyear, V. A., Casey, A., and Kirk, D. (2014). Hiding behind the camera: social learning within the cooperative learning model to engage girls in physical education. *Sport Educ. Soc.* 19, 712–734. doi: 10.1080/13573322.2012.707124

Gorucu, A. (2016). The investigation of the effects of physical education lessons planned in accordance with cooperative learning approach on secondary school students' problem solving sills. *Educ. Res. Rev.* 11, 998–1007. doi: 10.5897/ERR2016.2756

Goudas, M., and Magotsiou, E. (2009). The effects of a cooperative physical education program on students' social skills. *J. Appl. Sport Psychol.* 21, 356–364. doi: 10.1080/10413200903026058

Haas, R. E., Nugent, K. E., and Rule, R. A. (2004). The use of discriminant function analysis to predict student success on the NCLEX-RN. *J. Nurs. Educ.* 43, 440–446. doi: 10.3928/01484834-20041001-03

Hannon, J. C., and Ratliffe, T. (2004). Cooperative learning in physical education. *Strategies* 17, 29–32. doi: 10.1080/08924562.2004.11000362

Hastie, P. A., and Casey, A. (2014). Fidelity in models-based practice research in sport pedagogy: A guide for future investigations. *J. Teach. Phys. Educ.* 33, 422–431. doi: 10.1123/jtpe.2013-0141

Hobri, D., and Hossain, A. (2018). The implementation of learning together in improving students' mathematical performance. *Int. J. Instr.* 11, 483–496. doi: 10.12973/iji.2018.11233a

Hortigüela Alcalá, D., Hernando Garijo, A., Perez-Pueyo, A., and Fernandez-Rio, J. (2019). Cooperative learning and students' motivation, social interactions and attitudes: perspectives from two different educational stage. *Sustainability* 11:7005. doi: 10.3390/su11247005

Huang, M. Y., Tu, H. Y., Wang, W. Y., Chen, J. F., Yu, Y. T., and Chou, C. C. (2017). Effects of cooperative learning and concept mapping intervention on critical thinking and basketball skills in elementary school. *Think. Skills Creat.* 23, 207–216. doi: 10.1016/j.tsc.2017.01.002

Johnson, D. W., and Johnson, R. T. (1999). Making cooperative learning work. *Theory Pract.* 38, 67–73. doi: 10.1080/00405849909543834

Johnson, D. W., Johnson, R. T., and Stanne, M. B. (2000). Cooperative learning methods: A meta-analysis. (online). Available at: http://www.co-operation.org/pages/cl-methods.html.

Joyce, B. R., Weil, M., and Calhoun, E. (2015). *Models of teaching. 9th* Edn. Boston, USA: Prentice-Hall.

Lafont, L., Proeres, M., and Vallet, C. (2007). Cooperative group learning in a team game: role of verbal exchanges among peers. *Soc. Psychol. Educ.* 10, 93–113. doi: 10.1007/s11218-006-9006-7

Lee, T. E. (2014). Effects of a cooperative learning strategy on the effectiveness of physical fitness teaching and constraining factors. *Math. Probl. Eng.* 2014, 1–6. doi: 10.1155/2014/519291

Lee, Y. S., and Kim, S. S. (2015). The effects of the self-directed learning ability and task commitment through the jigsaw cooperative learning. *J. Kor. Soc. Earth Sci. Educ.* 8, 87–97. doi: 10.15523/JKSESE.2015.8.1.87

Luo, Y., and Sun, Y. (2013). The effects of collectivism-individualism on the cooperative learning of motor skill. *J. Int. Stud.* 3, 41–51. doi: 10.32674/jis.v3i1.517

Marhamah, M., and Mulyadi, M. (2013). Jigsaw cooperative learning: A viable teaching-learning strategy? *J. Educ. Soc. Res.* 3:710. doi: 10.5901/jesr.2013.v3n7p710

Marks-Anglin, A., and Chen, Y. (2020). A historical review of publication bias. *Res. Synth. Methods* 11, 725–742. doi: 10.1002/jrsm.1452

Montoya, A., Simonton, K., and Gaudreault, K. L. (2020). Enhance student motivation and social skills: adopting the sport education and cooperative learning models. *J. Phys. Educ. Recreat. Dance* 91, 15–20. doi: 10.1080/07303084.2020.1798307

Nopembri, S., Sugiyama, Y., and Rithaudin, A. (2019). Improving stress coping and problem-solving skills of children in disaster-prone area through cooperative physical education and sports lesson. *J. Hum. Sport Exerc.* 14, 185–194. doi: 10.14198/jhse.2019.141.15

O'Leary, N., Barber, A., and Keane, H. (2019). Physical education undergraduate students' perceptions of their learning using the jigsaw learning method. *Eur. Phys. Educ. Rev.* 25, 713–730. doi: 10.1177/1356336X18767302

O'Leary, N., and Griggs, G. (2010). Researching the pieces of a puzzle: the use of a jigsaw learning approach in the delivery of undergraduate gymnastics. *J. Furth. High. Educ.* 34, 73–81. doi: 10.1080/03098770903477110

O'Leary, N., Wattison, N., Edwards, T., and Bryan, K. (2014). Closing the theory–practice gap: physical education students' use of jigsaw learning in a secondary school. *Eur. Phys. Educ. Rev.* 21, 176–194. doi: 10.1177/1356336X14555300

Page, A. (2017). Implementing cooperative learning: A consideration of barriers and enablers. *J. Initial Teach. Inquiry* 3, 49–52. doi: 10.26021/820

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., et al. (2020). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 372:n71. doi: 10.1136/bmj.n71

Page, M., Sterne, J., Higgins, J., and Egger, M. (2020). Investigating and dealing with publication bias and other reporting biases in meta-analyses of health research: A review. *Res. Synth. Methods* 12, 248–259. doi: 10.1002/jrsm.1468

Polvi, S., and Telama, R. (2000). The use of cooperative learning as a social enhancer in physical education. *Scand. J. Educ. Res.* 44, 105–115. doi: 10.1080/713696660

Pulgar, J., Candia, C., and Leonardi, P. (2019). Cooperation is not enough: the role of instructional strategies in cooperative learning in higher education. *arXiv:1912.06923*

Rimmerman, H. (2004). *Resources in cooperative learning*. San Clemente, CA: Kagan Publishing.

Sánchez-Hernández, N., Martos-García, D., Soler, S., and Flintoff, A. (2018). Challenging gender relations in PE through cooperative learning and critical reflection. *Sport Educ. Soc.* 23, 812–823. doi: 10.1080/13573322.2018.1487836

Shoval, E. (2011). Using mindful movement in cooperative learning while learning about angles. *Instr. Sci.* 39, 453–466. doi: 10.1007/s11251-010-9137-2

Shoval, E., and Shulruf, B. (2011). Who benefits from cooperative learning with movement activity? *Sch. Psychol. Int.* 32, 58–72. doi: 10.1177/0143034310396806

Slavin, R. E. (2011). Instruction based on cooperative learning. *Handbook of research on learning and instruction* 4, 358–374.

Tiberi, S., Marti, I. F., and Laughlin, M. K. (2020). Cooperative learning in physical education and its effects on student Reading comprehension scores. *Phys. Educ.* 77, 294–312. doi: 10.18666/TPE-2020-V77-I2-9200

Torgerson, C. (2006). Publication bias: the Achilles' heel of systematic reviews? *Br. J. Educ. Stud.* 54, 89–102. doi: 10.1111/j.1467-8527.2006.00332.x

Walad, A. M., Razak, A., and Putri, D. H. (2019). Implementing jigsaw type of cooperative learning model to improve students' cognitive, affective and psychomotor domains in learning natural science at grade IX. 1 Smp Negeri 7 Sawahlunto. *Int. J. Prog. Sci. Technol.* 14, 329–337.

Wallhead, T., and Dyson, B. (2017). A didactic analysis of content development during cooperative learning in primary physical education. *Eur. Phys. Educ. Rev.* 23, 311–326. doi: 10.1177/1356336X16630221

Wang, M. (2012). Effects of cooperative learning on achievement motivation of female university students. *Asian Soc. Sci.* 8:108. doi: 10.5539/ass.v8n15p108