THE IMPACT OF PHYSICAL EDUCATION ON INTERPERSONAL RELATIONSHIPS: A SYSTEMATIC REVIEW

EL IMPACTO DE LA EDUCACIÓN FÍSICA EN LAS RELACIONES INTERPERSONALES: UNA REVISIÓN SISTEMÁTICA

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Short title:
Physical Education and Interpersonal Relationships

How to cite this article:
Mallén-Lacambra, C., Menezes-Fagundes, F., Ben-Chaabâne, Z., & Lavega-Burgués, P. (2025). The impact of physical education on interpersonal relationships: a systematic review. *Cultura, Ciencia y Deporte, 20*(64), 2232. https://doi.org/10.12800/ccd.v20i64.2232

Received: 06 June 2024 / **Accepted:** 27 March 2025

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Abstract

Promoting gender equity and fostering peaceful, inclusive coexistence are critical educational goals that physical education can address. By offering a context rich in motor interactions and promoting well-being, physical education provides an optimal environment to enhance interpersonal relationships. This study conducted a systematic review following Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to examine the impact of motor interactions during physical education sessions on interpersonal relationships. A total of 9,904 studies were collected from four databases (Web of Science, Scopus, SPORTDiscus, and PsycInfo), with 10 papers meeting the inclusion criteria. Findings revealed that motor interactions have significant potential to improve relationships at group, subgroup, individual, and gender levels, with evidence-based pedagogical models further amplifying these benefits. However, the methodological inconsistency across the reviewed studies limited the ability to draw concrete conclusions. The review also discussed key methodological considerations to guide teachers and researchers in effectively applying sociometric and social network analysis, emphasizing their utility for evaluating group dynamics. This research provides practical evidence and actionable insights for educators and researchers seeking to enhance interpersonal relationships, demonstrating the potential of physical education on promoting peaceful, inclusive, and equitable coexistence.

Keywords: Physical activity, sport, school, friendship, popularity.

Resumen

Promover la equidad de género y fomentar una convivencia pacífica e inclusiva son objetivos educativos fundamentales que la educación física puede abordar. Al ofrecer un contexto rico en interacciones motrices y propiciar el bienestar, la educación física proporciona un entorno óptimo para mejorar las relaciones interpersonales. Este estudio realizó una revisión sistemática siguiendo las directrices PRISMA para examinar el impacto de las interacciones motrices durante las sesiones de educación física en las relaciones interpersonales. Se analizaron un total de 9,904 artículos recopilados de cuatro bases de datos (Web of Science, Scopus, SPORTDiscus y PsycInfo), de los cuales 10 cumplieron los criterios de inclusión. Los resultados revelaron que las interacciones motrices tienen un gran potencial para mejorar las relaciones a nivel grupal, de subgrupo, individual y de género, y que los modelos pedagógicos basados en evidencia amplifican estos beneficios. Sin embargo, la falta de coherencia metodológica entre los estudios revisados limitó la posibilidad de extraer conclusiones definitivas. La revisión también discutió consideraciones metodológicas clave para guiar a docentes e investigadores en la aplicación efectiva de la sociometría y el análisis de redes sociales, destacando su utilidad para evaluar las dinámicas grupales. Esta investigación ofrece evidencia práctica y orientaciones útiles para docentes e investigadores interesados en mejorar las relaciones interpersonales, demostrando el potencial de la educación física para promover una convivencia pacífica, inclusiva y equitativa.

Palabras clave: Actividad física, deporte, escuela, amistad, popularidad.

Introduction

Promoting gender equality and a peaceful inclusive coexistence becomes a pivotal educational imperative in the 21st century (UNESCO, 2021). Ethics of care applied into educational field represents a shift into educational paradigm that address such relational contemporaneous challenges (Noddings, 1984). Ethics of care reconceptualizes individuals as inherently relational beings whose lives are fundamentally intertwined with material, structural, and living-being relationships (Beetz, 2016; Noddings, 1984). From this perspective, enhancing relationships is seen as a means to promote a peaceful coexistence and gender equity by promoting personal well-being (Busquets, 2019) and positive freedom, which is understood as the ability to act autonomously within the context of these diverse relational dimensions (Christman, 1991).

The ethics of care places a strong emphasis on the development of socio-affective relationships, which are defined as outcomes of emotional expressions exchanged during interactions (Borgatti et al., 2009; Moreno, 1941). Socio-affectivity becomes essential for nurturing caring behaviors: reciprocal and interdependent interactions that sustain and repair our bodies, identities and environments (Tronto, 1998). Educational strategies grounded in the ethics of care seek to cultivate such caring behaviors to facilitate recognizing and addressing human needs. Therefore, enhance socio-affective relationships becomes crucial because humans tend to care for and about those with whom they share stronger positive bonds (Noddings, 1984). Additionally, cultivating positive bonds improves learning, academic success, and serves as a preventive measure against social issues such as bullying (Mamas et al., 2023).

Within this educational framework, physical education assumes a distinctive role, serving as an unparalleled environment for educating in interpersonal relationships for peaceful coexistence and gender equity (Mallén-Lacambra et al., 2022). Motor practice teaches players to interact with other persons with same or different characteristics and objectives, following specific rules, social pacts and roles (Parlebas, 2020).

According to motor praxeology, the internal logic of motor practices profoundly shapes motor interactions, dictating the rules and norms that influences the motor conduct: temporal considerations, material utilization, spatial dynamics and interactions with other participants (Parlebas, 2020). Within each motor practice lies an educational setting replete with unique relational challenges (Luchoro-Parrilla et al., 2024; Minuzzi Lanes et al., 2017; Pic & Navarro, 2017), endowing physical education with a boundless spectrum of learning opportunities in the realm of human interaction.

This framework envisions physical education as the education of motor conducts, wherein students, engaged in motor practice, concurrently trigger all their human dimensions: cognitive, organic, emotional, and relational in a unique way, according each person's personality (Lavega-Burgués, 2018). This multidimensional perspective facilitates an educational focus on developing these dimensions, including the relational dimension.

Motor interactions among persons possess the inherent capacity to trigger interpersonal relationships, for interaction constitutes the prelude to relationship (Borgatti et al., 2009). Moreover, relationships are perceived as emotional projections that people emanate and receive through our interactions with others (Moreno, 1941). Studies such as those by Alcaraz-Muñoz et al. (2023), Lavega-Burgués et al. (2023) and Lorente-Sanz et al. (2023) underscore that motor interactions frequently occur in an emotionally positive environment. Consequently, it follows that motor interactions hold the potential to enhance and fortify interpersonal relationships.

In essence, physical education not only presents unique relational challenges to promote gender equity and a peaceful coexistence education, but also holds the potential to enhance interpersonal relationships. In order to understand the relational challenges that students address, it is necessary to identify the great categories of motor interactions that physical education could provide according to the internal logic of the activity (Parlebas, 2020). Motor praxeology establishes four categories of motor interactions: psychomotor (players do not engage in motor interaction), sociomotor cooperation (two or more players interact to achieve a common goal), sociomotor opposition (one player opposes one or more rivals to achieve the game's objective) and sociomotor cooperation-opposition domain (often corresponding to the confrontation between teams).

Although its importance is crucial, the relational dimension of physical education deserves to be further explored and more deeply analyzed to discover its full educational potential. Sociometric questionnaires stands as the optimal approach for measuring interpersonal relationships (Avramidis et al., 2017). Concurrently, social network analysis, rooted in graph theory and designed to scrutinize the relational dynamic of groups and their constituents, emerges as the preeminent method for evaluating interpersonal relationships (Borgatti et al., 2009).

This review aimed to assess the impact of motor interactions within physical education sessions on the interpersonal relationships of young individuals, employing sociometric techniques for measurement. To achieve this objective, this study represents the first systematic review in this domain. This study encompasses the synthesis of scientific evidence and a critical assessment of the quality of the methodologies employed in prior research. This investigation defines the principles for future relational research and educational practices.

Materials and Methods

Research Design

The systematic review followed the guideline of PRISMA (Page at al., 2021). The primary goal of systematic reviews is to methodically gather and structure scientific evidence from extant literature. This aim was achieved through the formulation of inclusion criteria specifically tailored to address the research questions. A PICOS strategy was adopted to define the search and inclusion criteria: Population – young pupils in physical education sessions; Intervention – motor activities;

Comparison – sociometric questionnaire; Outcomes – interpersonal relationships; and Study design – experimental or quasi-experimental studies.

Search Method to Identify Studies

The search equation was based on four blocks: population, physical education, interpersonal relationships and gender (Table 1).

Table 1
Search Strategy

Searched on November 3, 2022. No filter per date. Searched on titles, abstract & keywords	
Search #	**Search terms**
S1 Concept: Population	"child*" OR "student*" OR "pupil*" OR "school*" OR "classmate*" OR "youth*" OR "adolescent*" OR "teen*" OR "universit*" OR "college*" OR "undergraduate*"
S2 Concept: Physical Education	"physical activit*" OR "physical exercise*" OR "physical educat*" OR "traditional sport* game*" OR "sport*" OR "movement educat*" OR "motor behavi*" OR "motor conduct*" OR "motor learning*" OR "playground game*"
S3 Concept: Interpersonal Relationships	"social acceptance*" OR "peer acceptance*" OR "social reject*" OR "peer reject*" OR "popularity" OR "peer status" OR "peer network*" OR "social relation*" OR "social network*" OR "rapport*" OR "peer relation*" OR "sociogram*" OR "friendship*" OR "sociometry" OR "sociometric*" OR "peer nomination*" OR "peer rating*" OR "social cognitive mapping" OR "interpersonal relation*" OR "social Interaction*" OR "group* cohesion" OR "socio-affectiv*" OR "socio affect*" or "socioaffect*"
S4 Concept: Gender	"gender*" OR "coeducation*" OR "feminin*" OR "masculin*" OR "intersex*" OR "queer*" OR "transgender*" OR "cisgender*" OR "lgb*" OR "sex*" OR "non-binar*" OR "nonbinar*" OR "non conform*" OR "non-conform*" OR "nonconform*" OR "lgtb*" OR "agender*" OR "ftm*" OR "mtf*" OR "transboy*" OR "transgirl*" OR "transexual*" OR "androgyne*" OR "neutrois*" OR "glb*" OR "male*" OR "female*" OR "women" OR "woman" OR "man" OR "men" OR "boy*" OR "girl*"
S5	S1 AND S2 AND S3 AND S4

To construct the gender block, researchers used the glossaries provided by Gender Spectrum (https://www.genderspectrum.org) and Gender Minorities (https://www.genderminorities.com). This approach guaranteed consistency, inclusivity and relevance in the language (Graham & MacFarlane, 2021), and to avoid some ethical quandaries about referring to non-hegemonic genders from the privileged position of people identified with binary and hegemonic genders.

This search equation was applied regarding the metadata: title, abstract and keywords, and was adapted to four databases: Web of Science, Scopus, Sportdiscuss and PsychInfo. The search was conducted on the 3rd of November of 2022 with the aim of reviewing all studies published to date.

Inclusion Criteria

The identified records were loaded into Rayyan, an automated citation classification to reduce the workload of the systematic review (Ouzzani et al., 2016). Rayyan software detected duplicated articles and a researcher discarded most of them after a review following the strategy of Camacho-Sánchez et al. (2023).

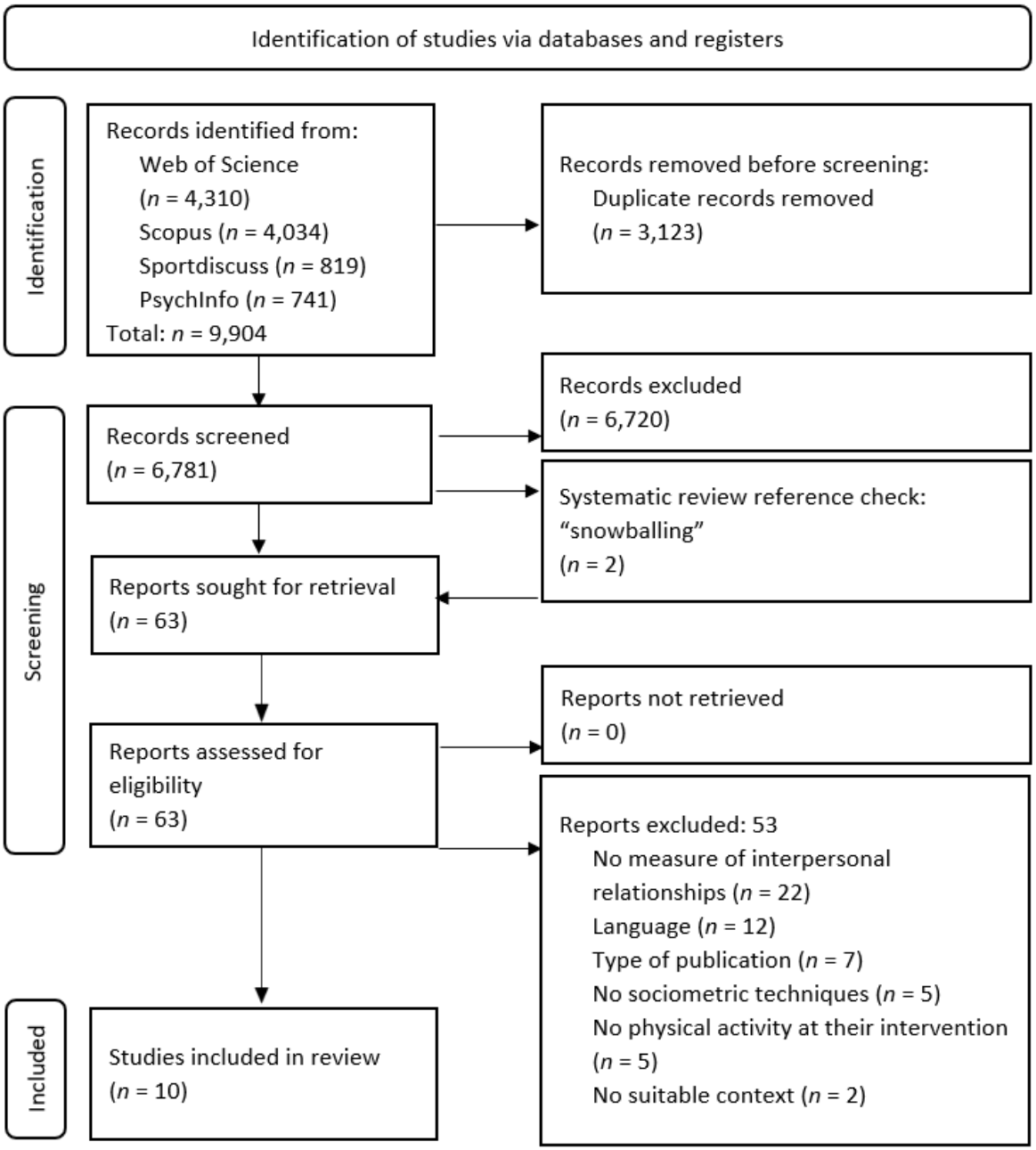
Two researchers, one expert and one non-expert on interpersonal relationships, independently reviewed all the studies using the following inclusion criteria: (1) published in a peer reviewed journal to ensure high quality standards; (2) full access articles; (3) articles written in English, Spanish, French or Portuguese; (4) use of a sociometric or Social Network Analysis methodology to measure interpersonal relationships; (5) studies developed in a physical activity context at physical education lessons; (6) studies indicating gender of participants; (7) studies with participants in childhood and youth (up to 24 years old) according to the World Health Organization (WHO) (Dyussenbayev, 2017); and (8) studies discovered through bibliographic references in studies meeting selection criteria and conforming through snowballing.

Articles with titles, abstracts, and keywords aligning with the inclusion criteria passed the screening. The match between investigators was 97.83%, 147 articles generated a division of opinion, and an agreement was reached on their inclusion or exclusion.

In the subsequent eligibility assessment, comprehensive scrutiny was applied to full articles, resulting in a concordance rate of 90.16% between investigators. While six articles initially prompted dissent, consensus was ultimately achieved regarding their inclusion or exclusion.

Furthermore, an exhaustive examination of the bibliographies associated with the included articles led to the addition of two more articles to the eligibility process, with only one successfully incorporated after a deliberation. In total, ten articles emerged as the definitive inclusions within the systematic review (Figure 1).

Figure 1
Scheme for Searching and Selecting the Sources to be Analysed



Results

Table 2 shows the characteristics of the studies encompassed within this review. Two investigators, meticulously categorized the primary findings of these studies, employing a framework based on Avramidis et al. (2017). Table 3 indicates the questions employed for the sociometric questionnaire of each study.

Table 2
Summary Table of Included Sources of Evidence

Author & Year	Research Design	Sample	Intervention	Sociometric Questionnaires and Social Network Analysis Variables	Relational Results
Whilden (1956)	Quasi-experimental No control group Natural groups Mixed methods: Observation	*n* = 75; 12-13 yo 100% F; 0% M	Teaching beginning basketball IG1: pupil-dominated IG2: teacher-dominated 2x/week 16 sessions	Peer nomination method; five nominations allowed; unweighted and directed network. Indices: Individual Status Index and Group Cohesion Score	Improvement and decline
Petracovschi et al. (2011)	Quasi-experimental No control group Natural groups No mixed methods	*n* = 18 8th grade students 50% F; 50% M	Gender-mixed pairs motor games First semester of scholastic year	Peer nomination method; three nominations allowed; weighted and directed network. Gender analysis applied. Weighted and Unweighted In-degree Centrality*[1]. Indices: social preference*[2] and density of positive nominations*[3].	Improvement and decline
García-López, et al. (2012)	Quasi-experimental No control group Natural groups No mixed methods	*n* = 21; M_{yo} = 10.7 52% F; 48% M Avg. SEL	Handball (Sports Education Model) 2x/week 18 sessions	Peer nomination method; unlimited nominations allowed; unweighted and directed network. Gender analysis applied. Average In-degree Centrality*[4] (Gender, Team, Role and Group).	Significant improvement
Zander et al. (2014)	Quasi-experimental Control-group Natural groups Mixed methods: Focus group	*n* = 421; M_{yo} = 10.99 *SD* = 1.11 52% F; 48% M 52% MB	Collaborative dance: Choreography 90 min 1x/week IG1: 21 h in 4-5 months IG2: 42 h in 10-11 months	Peer nomination method; unlimited nominations allowed; unweighted and directed network. Gender analysis applied. Normalized Average Reciprocal Ties*[5]; In-degree Centrality; Out-degree Centrality; Cross-gender density.	Significant improvement
Andueza & Lavega (2017)	Quasi-experimental No control group Natural groups Action research methodology No mixed methods	*n* = 78; 8-9 yo 51.3% F; 48.7% M 25% MB 25% Low SEL	Cooperative activities without competition and alternation of material and groups size (Motor Conduct Education) 60 min 2x/week 8 h in 4 weeks	Peer nomination method; three nominations allowed; unweighted and directed network. Gender analysis applied. Number of Reciprocal Ties*[6] (group, intergroup, intragroup, gender, isolated, subgroups and classes). Vulnerability, compaction, number of ties and proprieties of subgroups. Dyads: complete; incomplete and simple. Indices: group cohesion; group dissociation; integrated and isolated students.	Predominantly improvement but also decline
Shin et al. (2019)	Quasi-experimental Repeat measures No control group Natural groups No mixed methods	*n* = 157; 12 yo 48% F; 52 % M	Physical Education 12 weeks	Peer rating method; unlimited ratings allowed; weighted and directed network. Gender analysis applied. Average Weighted In-degree Centrality*[7] (Group and gender).	Significant decline

Grimminger-Seidensticker & Möhwald (2020)	Quasi-experimental Repeat measures No control group Natural groups Mix methods: Observation	*n* = 227 IG = 69; M_{yo} = 11.6 *SD* = 0.60 47.8% F; 52.2% M 60.9% MB ICG = 63 M_{yo} = 11.8 *SD* = 0.62 31.7% F 68.3% M 46.0% MB ECG = 95; M_{yo} = 10.8 *SD* = 0.69 47.1% F 52.1% M 23.2% MB	Cooperative games and sports games (Intercultural Movement Education) 90 min 5x/sessions and 45 min 4x/ sessions 10.5 h in 6 weeks	Peer rating method; unlimited ratings allowed; weighted and directed network. No gender analysis applied. Average Weighted In-degree Centrality*[8] Indices: Very popular; Rather popular; Contradictory; Indifferent; Rather unpopular and Very unpopular.	Significant improvement
Molina et al. (2020)	Quasi-experimental No control group Natural groups Mix methods: Focus group	*n* = 24 ; M_{yo} = 10.12 *SD* = 1.29 75% F; 25% M IG1: 8-10 yo IG2: 10-12 yo	Basketball (Sports Education Model) 45 min 3x/week. 13.5 h in 6 weeks.	Peer nomination method unlimited nominations allowed Weighted and directed network. No gender analysis applied. Average Weighted In-degree Centrality*[9] (Group and Subgroup).	Significant improvement
Salvador-García et al. (2020)	Quasi-experimental No control group Natural groups No mixed methods	*n* = 49; M_{yo} = 13,8 *SD* = 0,18 65% F; 35% M IG = 23 57% F; 43% M	Athletics (Content and Language Integrated Learning) 50 min 2x/week 5 h in 3 weeks	Peer nomination method; unlimited nominations allowed; unweighted and directed network. Gender analysis applied. Normalized Average In-degree Centrality*[10] (Group and Gender).	No changes
Casado-Robles et al. (2022)	Experimental Cluster-randomized controlled trial No mixed methods	*n* = 165; M_{yo} = 14.0 *SD* = 1.1 46.7% F; 53.3% M IG = 108 CG = 57	IG: Basketball (Sports Education Model) CG: Basketball (Direct instruction and small-sided games model) 60 min 2x/week 12 h in 6 weeks	Peer nomination method; three nominations allowed; unweighted and directed network. No gender analysis applied. Average In-degree Centrality*[11] (Group and Teams); Average Reciprocal Ties*[12] (Group and Teams). Visual analysis of teams sociogram. Indices: Social impact; Social preference; Preferred; Rejected; Neglected; Controversial; and Average.	Significant improvement

Note. IG = intervention group; CG = control group; M_{yo} = years old mean; yo = years old; M = male; F = female; *n* = participants; *SD* = standard deviation; MB = migration background; SEL = socioeconomic level; Q = question; *[1] total preferences/rejections; *[2] preferential status index; *[3] social status index; *[4] positive/negative friend; *[5] degree centrality; *[6] dyad of perceived/real choice/rejection; *[7] peer acceptance score; *[8] peer acceptance score; *[9] positive/negative friend; *[10] frequency of nominations; *[11] positive/negative nominations received; *[12] reciprocal positive/negative nomination received.

This review classified studies that improved interpersonal relationships as "improvement". Conversely, studies indicating a deterioration in relational data received the designation of "decline". The cases without noticeable changes were labelled as "no changes." In instances where a study presented simultaneous improvement and decline in interpersonal relationships, both labels were employed: "improvement and decline". Should one label substantially outweigh the other, the finding was categorized as "Predominantly improvement/decline but also decline/improvement". When the results were statistically significant the word "significant" was incorporated to these labels.

In Table 2, researchers standardized the nomenclature of the Social Network Analysis variables to facilitate the comparison between the studies. Due to the widespread diversity in nomenclature across the studies included, where identical variables might be assigned different names or different variables could be given the same name, researchers applied a unified nomenclature grounded in principles originating from Social Network Analysis. The standardized variables are marked with the symbol "*", while the original variable names from the source articles are included at the bottom of Table 2 for reference.

Table 3
Questions Used in Sociometric Questionnaires

Author & Year	Sociometric Questions	Network Inquired
Whilden (1956)	(Q1) Name five girls in this class whom you would most like to have on your team	Instrumental
	(Q2) Name five girls in this class whom you would least like to have on your basketball team	
	(Q3) Name five girls in this class whom you would most like to have as friends, whom you would invite to your home	Expressive
	(Q4) Name five girls in this class whom you would least like to have as friends	
Petracovschi et al. (2011)	(Q5) Whom would you choose as your pair in "The Statues" game?	Instrumental
	(Q6) Whom would you not choose as your pair in "The Statues" game?	
	(Q7) Who do you think would make a pair with you in "The Statues" game?	
	(Q8) Who do you think would not make a pair with you in "The Statues" game?	
García-López, et al. (2012)	(Q9) With whom do you have a better friendship?	Expressive
	(Q10) With whom do you have a worse friendship?	
Zander et al. (2014)	(Q11) Those students whom you like	Expressive
	(Q12) Those students with whom you enjoy collaborating	Instrumental
Andueza & Lavega (2017)	(Q13) Which three classmates do you prefer to play with?	Instrumental
	(Q14) Which three classmates would you prefer not to play with?	
	(Q15) Which three classmates do you think they would prefer to play with you?	
	(Q16) Which three classmates do you think they prefer not to play with you?	
Shin et al. (2019)	(Q17) How much do you enjoy living and engaging with the friends below?	Expressive
Grimminger-Seidensticker & Möhwald (2020)	(Q18) talking about problems and concerns	Instrumental
	(Q19) selecting for a relay race	
	(Q20) preparing a presentation	
Molina et al. (2020)	(Q21) With whom do you have a greater degree of friendship?	Expressive
	(Q22) With whom do you have a lower degree of friendship?	
Salvador-García et al. (2020)	(Q23) Which classmates do you most like being with in Physical Education lessons?	Instrumental
	(Q24) Which classmates do you least like being with in Physical Education lessons?	
	(Q25) Which classmates can help you to learn more in Physical Education lessons?	
	(Q26) Which classmates can't help you to learn in Physical Education lessons?	
Casado-Robles et al. (2022)	(Q27) Who are the three classmates you like the most?	Expressive
	(Q28) Who are the three classmates you like the least?	

Relational Results

Eight studies reported improvement on interpersonal relationships. Four studies indicated a decline on relationships, however, only one of these investigations showed a predominance of negative outcomes. Solely one article showed no changes after the intervention.

The variables demonstrating statistically significant improvement include: an increase in the intra-team positive friend variable and a decrease in the negative friend variable among girls (García-López et al., 2012); an enhancement in reciprocal collaborative relationships among boys (Zander et al., 2014); an improvement in social cohesion (Grimminger-Seidensticker & Möhwald, 2020); a decrease in the negative friend variable (Molina et al., 2020); and an increase in positive nominations and a decrease in negative nominations at the intra-team level (Casado-Robles et al., 2022).

Three studies revealed non-significant improvements. Whilden (1956) reported improvements in the Group Cohesion Score and all items of the Individual Status Index within the pupil-dominated group (IG1). Additionally, a reduction was observed in the rejected item of the Individual Status Index in the teacher-dominated group (IG2). The study of Andueza and Lavega (2017) evidenced an increase in cross-gender choices made by girls, intragroup selections, group cohesion, the number of complete choice dyads, compactness, the number of subgroups within the less cohesive groups, and the number of members and elongation of subgroups within the less cohesive groups. Reductions in isolated rejections, group disassociation within the less cohesive groups, the number of complete rejection dyads, and the count of subgroups within the more cohesive groups. An integration of isolated individuals into subgroups, particularly notable in boys and the less cohesive groups. Petracovschi et al. (2011), revealed a reduction in girls' cross-gender rejections and a decrease in boys' expectations of rejections. The only variable that showed a significant decline of relationships is peer acceptance among girls (Shin et al., 2019).

Three studies yielded non-significant decline outcomes. These included an increase of near-isolated item and a decrease of well-liked and liked items of the Individual Status Index in the teacher-dominated group (IG2) (Whilden, 1956). An increase of expectations of rejection among girls, an increase in cross-gender rejections among boys, and a decrease in boys' expectations of choices (Petracovschi et al., 2011). Additionally, there were increases in rejections, cross-gender rejections, intergroup rejections, and perceived rejections, alongside a decrease in perceived choices (Andueza & Lavega, 2017).

Sociometric Questionnaires

The peer nomination method, where group members identify and nominate their peers based on specific questions and preferences, stands as the prevailing sociometric methodology. In contrast, the peer rating method, which involves group members rating their peers using questions and a rating scale, is less common.

In three studies, students were constrained to making only three nominations, in one study pupils were limited to five nominations, while six studies allowed unlimited nominations (n-1). All the examined networks were directed, signifying that connections exhibit a specific direction, indicating the flow of nominations from one individual to another. Four of these networks were weighted, implying that connections between individuals are assigned numerical values (weights), thus signifying the strength, intensity, or a quantitative measure of nominations. This weighted nomination serves to highlight the importance of each nomination within the network. There is a wide variety of sociometric questions asked: 10 questions had a socio-affective orientation and 18 were task-oriented.

Social Network Variables

A considerable diversity is evident in the measured variables, encompassing variables such as reciprocity, gender relations... Nonetheless, a common thread across all these measures is the utilization of the variable in-degree centrality, which measures the number of incoming nominations an individual receives within a group. This metric serves as an indicator of their prominence and influence as recipients of nominations.

It is worth noting that Zander et al. (2014) stands as the sole study in assessing out-degree centrality, which quantifies the number of nominations a person emits upon others within a group. This metric highlights an individual's prominence and ability to disseminate information or interactions to their peers. Finally, six studies encompassed a gender analysis component.

Intervention

The interventions exhibited a striking diversity, often aligning with specific pedagogical models. The most prevalent pedagogical model employed is the Sports Education model, two studies based in basketball and one on handball. The majority of interventions revolved around socio-motor scenarios, involving activities with motor interactions among players. These interventions were distributed between three cooperative and four cooperative-oppositional settings.

However, it is important to note that the remaining studies did not explicitly specify the domain of motor action prevalent within their respective interventions, not indicating if the intervention used psychomotor, cooperation, opposition, and cooperation-opposition motor games. Notably, all studies employed a quasi-experimental methodology, with the exception of one study, which adopted an experimental approach. Finally, no study examined the impact of socio-affective relationships on motor conducts, evaluating how group dynamics or students' relational positions within the group influence the motor conducts they perform.

Sample

Among the selected studies, four had a sample size of fewer than 50 individuals, while two studies encompassed a sample size ranging from 50 to 100 participants. Additionally, four studies comprised a sample size exceeding 150 individuals. The age range of the study population spanned from 8 to 14 years.

Regarding gender distribution, eight studies maintained a roughly equal representation of females and males, except for one study where females predominated and one female exclusive investigation. None of the studies include non-binary or non-gender-identifying individuals in their sample. Furthermore, two of the studies incorporated measurements related to the participants' migration background, while two others assessed the socio-economic status of the participants.

Methodological Quality

PRISMA recommends methodological quality control of the assessed studies (Page et al., 2021). To check the quality of the studies, two researchers independently used the tools: JBI Critical Appraisal Checklist for Quasi-experimental studies and JBI Critical Appraisal Checklist for Randomised Controlled Trials (Tufanaru et al., 2020). An agreement rate of 83.53% and consensus was reached for the 14 items where initial disagreement arose.

The criteria labelled as "unknown" pertained to the participants' exposure to external stimuli that might influence interpersonal relationships (criterion 3 in Table 4 and criterion 7 in Table 5) and the utilization of a reliable measurement method (criterion 8 in Table 4 and criterion 11 in Table 5). The most commonly overlooked criteria included the absence of a control group (criterion 4 in Table 4) and the omission of follow-up measurements (criterion 5 in Table 4). Additionally, the criteria related to the blinding of treatment (criteria 5 and 6 in Table 5) was breached in the experimental study.

Table 4
Methodological Quality of the Included Quasi-Experimental Studies, Measured by the JBI Critical Appraisal Checklist for Quasi-Experimental Studies

Study	1	2	3	4	5	6	7	8	9
Whilden (1956)	Y	Y	U	N	N	Y	Y	U	Y
Petracovschi et al. (2011)	Y	Y	U	N	N	Y	Y	U	N
García-López (2012)	Y	Y	U	N	N	Y	Y	U	Y
Zander et al. (2014)	Y	Y	U	Y	N	N	N	U	Y
Andueza and Lavega (2017)	Y	Y	U	N	N	Y	Y	U	Y
Shin et al. (2019)	Y	Y	U	N	Y	U	Y	U	Y
Grimminger-Seidensticker and Möhwald, (2020)	Y	Y	U	Y	N	Y	Y	U	Y
Molina et al. (2020)	Y	Y	U	N	N	Y	Y	U	Y
Salvador-García et al., (2020)	Y	Y	U	N	N	Y	Y	U	Y

Note. Y = yes; N = no; U = unknow.

Table 5
Methodological Quality of the Included Experimental Studies, Measured by the JBI Critical Appraisal Checklist for Randomized Controlled Trials

Study	1	2	3	4	5	6	7	8	9	10	11	12	13
Casado-Robles et al. (2022)	Y	Y	Y	Y	N	N	U	Y	Y	Y	U	Y	N

Note. Y = yes; N = no; U = unknow.

Discussion

This systematic review aimed to explore the influence of motor interactions during physical education sessions on interpersonal relationships of young individuals, utilizing sociometric techniques for measurement. The results demonstrate mainly an improvement on relationships, suggesting that motor interactions enhance interpersonal relationships. This research underscores the significant potential of physical education as an avenue for educating in the realm of interpersonal dynamics, gender equity and peaceful coexistence (Lavega-Burgués et al., 2023).

This review highlights the potential of sociometry and social network analysis in the evaluation of interpersonal relationships. However, it also acknowledges certain limitations and puts forward proposals for further enhancements.

Effects of Motor Interactions on Relationships

The reviewed articles reported enhancements in interpersonal relationships and just one study revealed a slight deterioration, suggesting that motor interactions have the potential to foster relationships (Borgatti et al., 2009). This trend can be explained by the prevalence of positive emotions within motor interaction contexts (Alcaraz-Muñoz et al., 2023).

Infrequently situations of emotional discomfort (Lavega-Burgués et al., 2022; Rillo-Albert et al., 2021) may explain the slight deterioration of some relational metrics). Non-sociometric studies in physical education have also shown positive effects on relational well-being and social skills (Fernández-Río et al., 2017). While not directly focused on interpersonal relationships, these findings emphasize the potential of physical education to educate relationships.

Regarding studies that yielded inconclusive, mixed or showed a decline on relationships, Whilden (1956) reported an improvement on pupils-directed group and a decline on teacher-directed group, although in teacher-directed group the number of rejected people decreased. These findings suggest that the methodology employed might have a discernible impact on sociometric outcomes. Petracovschi et al. (2011) identified both improvement and decline on relationships and suggested that these findings may be attributed to gender-related tendencies, with females displaying a propensity to reject competition and males showing reluctance towards cooperation. Salvador-García et al. (2020) revealed no significant relational changes and lacked a definitive conclusion, although they maintained the belief that Content and Language Integrated Learning (CLIL) method could potentially enhance interpersonal relationships. In contrast, Shin et al. (2019) was the sole study to report only a decline on relationships, attributing them to female shyness and positing that engagement in sports activities may heighten aggressive, violent, and insulting behaviours. Additional evidence is required to substantiate these conclusions.

All the studies that used specific physical education pedagogical models improved interpersonal relationships (Andueza & Lavega, 2017; Casado-Robles et al., 2022; García-López et al., 2012; Grimminger-Seidensticker & Möhwald, 2020; Molina et al., 2020) CLIL, pupil-directed and teacher-directed models are not specific to physical education, underscoring the efficacy of the evidence based pedagogical models to enhance positive interpersonal relationships. No studies have specifically focused on Traditional Sporting Games, future research should assess their impact, as these games have shown positive outcomes in promoting inclusion and gender equity from an emotional perspective (Mallén-Lacambra et al., 2022; Luchoro-Parrilla et al., 2021).

From a motor conduct education perspective, the reviewed studies exhibited variations in the internal logic, which encompass different motor action domains (Parlebas, 2020). Specifically, three studies were grounded in cooperation (Andueza & Lavega, 2017; Grimminger-Seidensticker & Möhwald, 2020; Zander et al., 2014) and four were rooted in cooperation-opposition (Casado-Robles et al., 2022; García-López et al., 2012; Molina et al., 2020; Whilden, 1956). The remaining three studies do not provide detailed descriptions of the internal logic of the activities conducted.

Understanding the internal logic becomes essential for grasping the motor interactions during the intervention (Parlebas, 2020). Critical aspects like motor interaction domains, motor communication networks and interaction methods, must be considered. Without a detailed internal logic description, understanding motor interactions and their impact on relationships is limited. Addressing this gap would help explore how internal logic affects interpersonal relationships. Moreover, no study has examined the impact of socio-affective relationships on motor conducts, specifically assessing how group dynamics or students' relational positions within the group influence their motor actions. Research in other educational fields demonstrated the influence of interpersonal relationships on well-being and academic performance (Montecillo et al., 2024; Sinchigalo-Martínez et al., 2022). However, this review did not identify any study evaluating their impact in motor situations.

Notably, only Whilden (1956) provided an explicit explanation of the teacher's role within the intervention, and only seven studies offered a description of the pedagogical model employed (Andueza & Lavega, 2017; Casado-Robles et al., 2022; García-López et al., 2012; Grimminger-Seidensticker & Möhwald, 2020; Molina et al., 2020; Salvador-García et al., 2020; Whilden, 1956).

Future studies should provide a detailed description to understand how teacher's role, the internal logic of the games and pedagogical models, shape motor interactions and, subsequently, influence interpersonal relationships. Additionally, researchers should explore how interpersonal relationships affect motor conducts from a multidimensional perspective, emphasizing the activation of organic, cognitive, relational, and emotional dimensions (Lavega-Burgués, 2018).

Analysis of the Relationships

The potential of Social Network Analysis in the examination of data from sociometric studies is readily apparent (Mamas et al., 2023). In the studies reviewed, a wide range of variables were employed, with a particular emphasis on the in-degree centrality variable and its derived variables, such as density, reciprocity, various indices... Notably, only one study by Zander et al. (2014) measured out-degree centrality in addition to in-degree centrality.

Furthermore, six studies (Andueza & Lavega, 2017; García-López et al., 2012; Petracovschi et al., 2011; Salvador-García et al., 2020; Shin et al., 2019; Zander et al., 2014) incorporated gender as an attribute in their analyses to explore differences based on gender or gender relationships. Including demographic attributes becomes crucial for assessing the impact of homophily, which is the natural tendency to form connections with those who are similar to oneself (Borgatti et al., 2009).

Solely Whilden (1956) conducted her investigation in a gender exclusive setting (female). Although educating for coexistence implies to interact with similar and different people (UNESCO, 2021), investigations restricted to a single gender may reveal insightful distinctions to enhance our understanding of interpersonal relationships.

The variety of variables and attributes analyses furnishes a comprehensive perspective on the group's relational characteristics but introduce complexity in cross-study comparisons. Nevertheless, a more in-depth exploration of social network analysis variables, including metrics like closeness, betweenness, E-I Index, transitivity, ... and more rigorous statistical models like Exponential Random Graph Models (ERGM) and Separable Temporal Exponential Random Graph Model (STERGM) (Mamas et al., 2023), are recommended to unveil the subtleties within interpersonal relationships (Borgatti et al., 2009; Kezar, 2014). Software tools like R, Python, and UCINET facilitate these analyses. Employing a standardized nomenclature based on social network analysis, as seen in Table 2, is recommended to enhance comprehension and cross-study comparisons.

Sociometric Methodology

Out of the articles examined, eight employed the peer nomination methodology, with two of them focusing solely on reciprocal nominations, while two studies utilized the peer rating method. Moreover, three studies restricted the number of nominations to just three, one investigation limited nominations to five, while the rest allowed unlimited nominations. All the studies incorporated directed nominations, with four of them using weighted nominations and the remaining six utilizing unweighted nominations. Four studies incorporated a mixed methods methodology, including two that integrated focus groups and two that incorporated observation.

The adaptability of sociometric techniques allows for customization based on the specific context and objective of the study (Mamas et al., 2019). However, it introduces challenges when comparing results due to the variations in the object of study and methodology.

The systematic review conducted by Avramidis et al. (2017) advocates for a peer nomination methodology, unlimited nominations and weight-directed nominations. Furthermore, the systematic review of Froehlich et al. (2020) underscores the significance of adopting mixed methods to attain a comprehensive understanding of interpersonal relationships. Adhering to these recommendations will enhance the quality and comparability of future research.

Each of the studies reviewed employed a different set of questions within their sociometric questionnaires. Interpersonal relationships questions are inherently shaped by cultural, affective, and interest -efficient logics- factors (Parlebas, 1992). Therefore, it is imperative to align the orientation of the questions with the aim of the study. For instance, when investigating socio-affective relationships, it becomes crucial to avoid questions that pertain to performance-related tasks that tailor the instrumental network and instead concentrate on aspects related to socio-affectivity to obtain the expressive network (Mamas et al., 2023). This approach ensures that the questions are in harmony with the specific object of study and the desired research objectives.

In this review, every study included at least one research objective related to socio-affective relationships. However, only six studies (Casado-Robles, 2022; García-López et al., 2012; Molina et al., 2020; Shin et al., 2019; Whilden, 1956; Zander et al., 2014), asked questions orientated to the expressive network, the proper orientation to measure socio-affective relationships (Mamas et al., 2023). Future research should strive for improved congruence in their questioning approaches.

None of the studies in the review provided in-depth details regarding the protocol used in the sociometric questionnaire. Parlebas (1992) recommends physically separating the subjects when they answer to minimize peer influence and to ensure confidentiality, and the establishment of a motivating context before administering the questionnaire to enhance motivation and to direct answers toward the appropriate network. Creating a context where students envision engaging in a fun, non-competitive leisure activity and asking them research questions related to that context such as "Who do you want to do the activity with?" can be a useful approach. These methodological considerations are crucial for enhancing the reliability of the sociometric questionnaire.

The methodological scores suggest that the reviewed articles demonstrate robust rigor (Tables 4 and Table 5) (Tufanaru et al., 2020). However, several limitations must be acknowledged, particularly the inherent complexity of studying interpersonal relationships in ecological educational contexts. Uncontrollable external factors, such as interactions outside the intervention, and ethical challenges, such as the potential for peer rating techniques to exacerbate social isolation among vulnerable children (Avramidis et al., 2017).

Only one investigation was experimental, while nine studies adopted a quasi-experimental approach, with just one incorporating a control group. None of the studies employed a follow-up methodology, and only one mentioned an intervention lasting more than 20 hours. To improve the quality of research, future studies should prioritize experimental designs, higher intervention frequencies, and longitudinal follow-ups to better capture sustained relational and social outcomes (Avramidis et al., 2017).

The age range of participants (8–14 years) limits generalizability, despite search criteria including individuals up to 24 years old. Expanding research to other age groups is necessary to understand how motor interactions influence interpersonal relationships across different developmental stages. Furthermore, the reliance on quantitative methods constrains a deeper exploration of relational dynamics.

For future empirical studies, randomized experimental designs with control groups are essential to strengthen causal inferences. Integrating multi-method approaches, such as combining quantitative methods with qualitative techniques like interviews and observations, would provide richer insights into relational dynamics. Moreover, systematically monitoring interactions beyond intervention settings is critical to account for the influence of external, uncontrolled factors on relational outcomes.

Finally, the search strategy and selection criteria used in this study may have inadvertently excluded relevant works. Future efforts should adopt other search strategies, expand the range of sources, and refine inclusion criteria to complement our findings and enhance the coverage of the literature.

Conclusions

This study represents the first systematic review to evaluate the impact of physical education on interpersonal relationships. Our findings revealed that motor interactions consistently improved relationships across group, subgroup, individual, and gender levels. These improvements underscored the transformative potential of physical education as an educational context where structured motor activities create opportunities for meaningful social engagement. However, no studies examined the impact of relationships on motor conducts, revealing a literature gap.

The integration of evidence-based physical education pedagogical models amplified these positive effects on relationships. Such models offer educators practical strategies to design activities that not only develop physical skills but also foster social bonding and inclusivity. Moreover, this study highlights sociometry and social network analysis as effective tools for evaluating social dynamics in educational settings. By explaining key methodological aspects for their application, this paper provides practical guidance to researchers and educators, helping them to evaluate relationships.

This systematic review reinforces the role of physical education as an optimal setting for addressing one of the most pressing educational challenges of the 21st century: fostering interpersonal relationships and promoting peaceful coexistence. By leveraging the unique potential of motor interactions, physical education can contribute to building more inclusive and socially connected communities.

Ethics Committee Statement

Not applicable due to the type of study: systematic review.

Conflict of Interest Statement

The authors — Carlos Mallén-Lacambra, Felipe Menezes-Fagundes, Pere Lavega-Burgués and Zhaira Ben-Chaâbane — declare that they have no conflicts of interest. No funding agency or institution played any role in the design of the study, data analysis, interpretation of the results, or in any other part of the research process.

Funding

This research was funded by the National Institute of Physical Education of Catalonia (INEFC), University of Lleida (UdL), (Resolution 21/03/2022; Order PRE/178/2021), through a grant linked to the project *Opportunity: Fostering Social Inclusion and Gender Equality in Formal and Non-Formal Educational Contexts through Applying Traditional Sports and Games*, co-funded by the Erasmus+ Programme of the European Union (project code: 622100-EPP-1-2020-1-ES-SPO-SCP). Funding details can be verified at: https://inefc.gencat.cat/es/inefc/beques/ajuts-contractacio-personal-investigador-predoctoral/ajuts-contractacio-personal-investigador/index.html.

Authors' Contribution

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Investigation: Mallén-Lacambra, C., Fagundes-Menezes, F., Ben-Chaâbane, Z., and Lavega-Burgués, P.; Resources: Mallén-Lacambra, C. and Fagundes-Menezes, F.; Writing – Original Draft: Mallén-Lacambra, C.; Writing – Review & Editing:

Fagundes-Menezes, F., Ben-Chaâbane, Z., and Lavega-Burgués, P.; Visualization: Mallén-Lacambra, C., Fagundes-Menezes, F., Ben-Chaâbane, Z., and Lavega-Burgués, P.; Supervision: Mallén-Lacambra, C., Fagundes-Menezes, F., Ben-Chaâbane, Z., and Lavega-Burgués, P.; Project Administration: Mallén-Lacambra, C., Fagundes-Menezes, F., Ben-Chaâbane, Z., and Lavega-Burgués, P.; Funding Acquisition: Mallén-Lacambra, C., Ben-Chaâbane, Z., and Lavega-Burgués, P.

All authors have read and agreed to the published version of the manuscript.

Data Availability Statement

Not applicable due to the nature of the study: systematic review.

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