

## Effects of cooperative learning on gender equality education in university students Efectos del aprendizaje cooperativo en la educación en igualdad de género en estudiantes universitarios

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**Resumen.** Antecedentes: La coeducación en entornos universitarios es esencial para fomentar un ambiente de aprendizaje inclusivo, equitativo y diverso. En este sentido, el aprendizaje cooperativo podría desempeñar un papel crucial en la promoción de la coeducación al fomentar la colaboración, comunicación y comprensión mutua entre estudiantes de género masculino y femenino. Por lo tanto, el objetivo de este estudio fue evaluar los efectos del aprendizaje cooperativo en la igualdad de género y habilidades cooperativas en estudiantes. Métodos: El diseño del estudio fue cuasiexperimental con medidas cuantitativas pre y post-test. La muestra estuvo compuesta por 60 estudiantes (30 mujeres, 30 hombres, edad:  $19,97 \pm 1,21$  años) matriculados en el segundo curso de Ciencias del Deporte, distribuidos en dos grupos (control y experimental). La Escala de Competencias para Educar en Igualdad de Género (CEIG) y el Cuestionario para el Análisis del Trabajo Cooperativo en Educación Superior (ACOES) se implementaron antes y después de la intervención en ambos grupos. El grupo experimental participó en 7 lecciones de voleibol ejecutadas siguiendo una metodología fundamentada en el Aprendizaje Cooperativo, utilizando específicamente el método de Jigsaw, lo que garantizó la formación de equipos de trabajo mixtos. Se realizó una prueba U de Mann-Whitney para verificar el efecto intergrupalo de la intervención. Resultados: El grupo experimental mejoró significativamente en 2 de las 3 dimensiones del CEIG y en 5 de las 7 dimensiones del ACOES. Conclusiones: Enseñar deportes colectivos como el voleibol a través de un modelo cooperativo, específicamente con el método de Jigsaw e incluyendo equipos mixtos, contribuye significativamente a mejorar no solo las habilidades cooperativas de trabajo en equipo, sino también la igualdad de género en la educación.

**Palabras clave:** didáctica, voleibol, trabajo en equipo, coeducación, método Jigsaw, género

**Abstract.** Background: Coeducation in university settings is essential for fostering an inclusive, equitable, and diverse learning environment. In this regard, cooperative learning could play a crucial role in promoting coeducation by fostering collaboration, communication, and mutual understanding between male and female students. Thus, the aim of this study was to assess the effects of cooperative learning on gender equality and cooperative skills in students. Methods: The design of the study was quasi-experimental with quantitative pre- and post-test measures. The sample was comprised of 60 students (female = 30, male = 30, age:  $19,97 \pm 1,21$  years) enrolled in the 2nd grade of Sport Sciences, distributed into two groups (control and experimental). The Competencies Scale for Gender Equality Education (CEIG) and the Questionnaire for the Analysis of Cooperative Learning in Higher Education (ACOES) were implemented before and after the intervention in both groups. The experimental group participated in 7 volleyball lessons that followed a methodology grounded in Cooperative Learning, specifically using the Jigsaw method, which ensured the formation of mixed-gender teams. A Mann-Whitney U test was carried out to verify the intergroup effect of the intervention. Results: The experimental group significantly improved in 2 out of 3 dimensions of the CEIG and in 5 out of the 7 dimensions of the ACOES. Conclusions: Teaching collective sports like volleyball through a cooperative model, specifically with the Jigsaw method and including mixed teams, significantly contributes to improving not only cooperative teamwork skills but also gender equality in education.

**Key Words:** didactics, volleyball, teamwork, coeducation, Jigsaw method, gender

Fecha recepción: 20-12-23. Fecha de aceptación: 21-02-24

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### Introduction

Current challenges such as climate change, resource scarcity, and social disparity have generated a renewed interest in science, education, technology, and innovation (Economic Commission for Latin America and the Caribbean, 2017). For this reason, research on any of these topics is fundamental to trigger profound systemic changes necessary to resolve these problems. This mission for transformation is composed of complex systems, as many issues are a reflection of working with traditional models, which did not include the development of sustainable and equitable solutions (UNESCO, 2017). This change implies taking advantage of current advances in knowledge, foresight, socio-technical impacts, and the particularities of each territory, as suggested by Nelson (2008) and Miller (2017).

Continuing from the previous discussion on the necessity of systemic change through science, education, technology, and innovation, the role of Education for

Sustainability, particularly in university settings, has emerged as a key element in addressing global challenges (Blasco et al., 2021; Jickling & Wals, 2008). The significance of integrating sustainability into higher education aligns with the Sustainable Development Goals (SDGs) established in the 2030 Agenda, championed by UNESCO, a specialized educational agency of the United Nations (UNESCO, 2022b). UNESCO, tasked with leading and coordinating the Education 2030 Agenda, is part of a global movement aimed at eradicating poverty through the achievement of the 17 SDGs and their 169 corresponding targets by 2030 (United Nations, 2015; UNESCO, 2017). In this context, education is recognized as a fundamental pillar in attaining each of these goals. This is particularly evident in the specific aim of SDG 4, which focuses on "ensuring inclusive, equitable, and quality education and promoting lifelong learning opportunities for all" (UNESCO, 2020). Building on the importance of education in achieving the SDGs, the Education 2030 Framework for Action

provides a comprehensive plan to reach this ambitious target. It outlines specific commitments to promote truly inclusive, equitable, and quality education for all, ensuring lifelong learning opportunities (UNESCO, 2016). In this vein, it is crucial to understand that sustainability encompasses more than just the environmental aspect; it also includes two additional dimensions: a social and an economic one (Lozano, 2008). In this context, the university not only stands as a bastion of knowledge but also as an active agent committed to achieving sustainable objectives, ranging from poverty eradication to promoting health and well-being (Blasco et al., 2021). Its contribution on a global scale is seen as a significant push towards progress and comprehensive development (United Nations, 2015). Consequently, the university positions itself as a key pillar in social, economic, and environmental transformation, playing a central role in shaping a more sustainable and equitable future for all (UNESCO, 2022a).

### *The SDGs in universities*

The academic institution of the 21st century is not limited to generating knowledge and scientific advancements (Gibbons, 1998; Karaca-Atik et al., 2023), and this includes the field of Physical Education (PE). Its mission extends further, aiming for a positive social impact not only in its immediate surroundings but also in society as a whole; this purpose is reflected in its commitment to social transfer, as highlighted by the Universia Foundation (2017). University education seeks not only to impart technical knowledge but also to cultivate social awareness, empathy, and responsible citizenship. This social function, explored in the concepts of University Social Responsibility by Vallaes (2014) and Andrades and Larrán (2015), closely aligns with the concept of Human Development outlined in the 2030 Agenda. In many territories, universities assume a fundamental role as primary engines in the production of knowledge, generating positive impacts both technologically and socially (Touriñán López, 2020). Recognized as key drivers of innovation, these institutions are distinguished by their ability to foster advances in both social and technological fields (González Gaudiano et al., 2015). Their central function lies in integrating diverse areas of knowledge and establishing active links with a wide range of social groups and activities (Cortese, 2003; Trencher et al., 2014). While emphasis has been placed on the co-creation of scientific knowledge to drive transformative changes (Trencher et al., 2014), there is also progress in the systematization of experiences that go beyond. These efforts are oriented towards the co-creation of practical solutions for sustainability, encapsulated in the conceptual framework of 'co-creation for sustainability' (Trencher et al., 2014). This approach seeks to go beyond mere generation of ideas and knowledge, aiming at the implementation of concrete and significant transformations to address current socio-environmental challenges (UNESCO, 2022b). The models previously mentioned highlight the essential role of universities as drivers of new narratives, perspectives, and shared

visions. These visions focus on driving structural changes that encompass fundamental aspects such as sustainability, social justice, recognition, and inclusion (Sanchez-Carrillo et al., 2021). In this context, the SDGs function as an integral framework that invites reflection on the participation of universities in strategic alliances aimed at promoting significant transformations (SDSN Australia/Pacific, 2017). Universities thus become authentic spaces of exchange, debate, and action, where new ways of thinking and acting emerge in the face of contemporary challenges (Ministry of Foreign Affairs, 2019; UNESCO, 2022b). Therefore, the integration of concepts such as sustainability, social justice, and inclusion into the very core of these educational institutions paves the way for the joint creation of innovative and sustainable solutions. The SDGs serve as a reference framework that urges universities to consider comprehensively their role in partnerships and collaborations directed towards achieving global socio-environmental goals (Sanchez-Carrillo et al., 2021). Therefore, it is crucial to recognize how these SDGs can be linked with the mission and vision of universities, not only as educational centers, but also as active drivers of change and advancement (UNESCO, 2017). Integrating these objectives into the academic realm promotes a stronger connection between higher education and society as a whole, generating specific actions and strategic collaborations that contribute to building a more equitable, sustainable, and just future for all (SDSN Australia/Pacific, 2017; UNESCO et al., 2023).

### *Cooperative learning at university*

Under this specific focus, cooperative learning (CL) becomes a valuable tool in promoting collaboration, communication, and problem-solving in teams. Despite doubts about its application in university teaching, Johnson et al. (1997) noted that there was a misconception that CL was effective at primary and secondary educational levels, but not suitable for university teaching. This notion was expressed through statements like: "While the benefits of CL in younger school environments are recognized, these benefits do not translate in the same way to the post-secondary educational context." However, higher education has a solid and extensive history in the practical use of CL, as evidenced by Johnson et al. (1997). It dates back thousands of years and can be observed in various educational figures and movements. For example, Socrates, known for his "art of discourse," taught his students in small groups, fostering participatory dialogues. Seneca, the Roman philosopher, endorsed CL with his famous phrase "Qui Docet Discet" ("He who teaches, learns twice"). Even in colonial Boston, a young Benjamin Franklin, facing poverty, organized study groups to obtain education. During the Mass School Movement in the United States in the 19th century, CL received a significant boost. John Dewey, known for his project-based educational method, actively promoted the use of CL groups as an essential part of his educational approach. This rich and diverse history demonstrates how CL has been a rooted practice in higher

education over time. CL is not a novelty in the educational field; rather, it has been the subject of extensive research due to its impact on students' academic achievements and their emotional, cognitive, and social development (Trujillo Saez & Ariza Pérez, 2006). Numerous studies worldwide support its application as an alternative method to traditional teaching, demonstrating its effectiveness (Slavin, 2011). In fact, the contributions of CL are considered so relevant that it is recognized as a crucial methodological tool for addressing the varied needs of people in the 21st century (Johnson & Johnson, 2015). Considering these arguments, a direct connection can be established between the application of CL in university education and the SDGs, specifically with SDG 4 on Quality Education and its target 4.7, which seeks to ensure all students acquire the knowledge and skills needed to promote sustainable development, including gender equality. It also relates to SDG 16 titled Peace, Justice, and Strong Institutions, particularly its target 16.7, which seeks to ensure inclusive, participatory, and representative decision-making at all levels, responding to needs equitably. However, there are critical voices that do not fully support the use of this model. These critics raise doubts about the expectations placed on CL as a universal solution to educational challenges (Cobas, 2016). Their skepticism is based on the reality of our education system, where collaboration is scarce and competition, hierarchy, and exclusion of the less capable prevail (Lorente, 2006). This leads to questioning how a population educated in competition can develop cooperative skills. Countering these premises, Moriña (2011) argues that cooperation is not only practiced to learn but that it is necessary to learn to cooperate in the first place. Additionally, Riera (2011) highlights CL as a resource to address diversity, being a crucial component in an inclusive educational model that takes into account individual differences and personal realities. In practice, it has been observed that the majority of group work strategies rely more on collaboration than on cooperation (Kagan & Stenlev, 2009). This distinction is significant: collaboration involves working together on a common project, whereas cooperation implies a deeper interaction and an active commitment from all group members towards a shared goal. In this scenario, it is essential to reconsider the teaching of CL from the early stages up to university education, integrating it as an essential component in the curriculum. This integration could contribute to the formation of critical and responsible citizens, aligned with a renewed pedagogical approach that every plural and democratic society should aspire to achieve. Moreover, using a CL strategy in the university registered positive engagement and performance in graduating students, by carefully designing the task, providing follow-up and motivation to students, offering constructive and timely feedback, and ensuring greater student engagement in the task (Agonafir, 2023). However, in order for this methodology to result in positive effects on students, it is necessary to engage students in discussing and clarifying the mechanisms of cooperative learning, and structure

teaching to involve them in discussions aimed at collectively self-regulating their activities (Bächtold et al., 2023). An example of CL is the Jigsaw method, which recently showed to enhance collaboration, communication, cooperation, and critical thinking among university students (Jeppu et al., 2023).

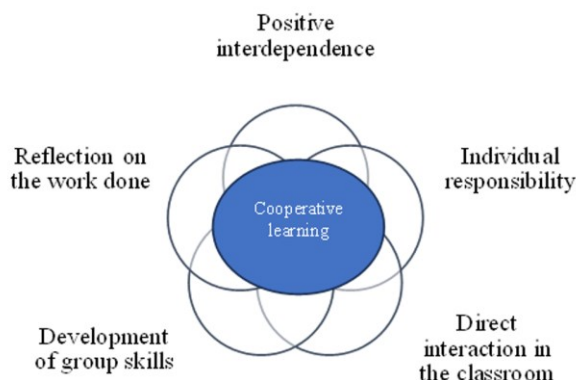


Figure 1. Key elements of cooperative learning.

### *Cooperative learning and the Jigsaw method*

According to Johnson et al. (2000), the diversity of the eight CL methods examined in their meta-analysis further confirms the effectiveness of this strategy. These methods range from specific approaches like Jigsaw and Cooperative Integrated Reading and Composition, to conceptual frameworks that educators use to develop their cooperative lessons, such as Learning Together and Group Investigation. They also encompass curricular packages where CL is central, like Team-Assisted Individualization and Student Teams-Achievement Divisions, in addition to more complex procedures requiring specific skills for their application, like Constructive Controversy. The fact that all these methods are effective in enhancing academic performance is a testament to the inherent power of cooperation. In our approach, we will focus on the technique known as jigsaw or more commonly referred to as the Aronson's Puzzle. This methodology was devised by Aronson and his colleagues in 1975, and its analysis and development were expanded through subsequent research by the same author. This strategy reinforces CL as it is based on a constructivist and interactionist approach to the teaching and learning process (Mayorga & Madrid, 2012). The Aronson's Puzzle methodology provides students with the opportunity to engage in deepening activities, which involve the search and evaluation of information. Furthermore, they must follow a specific procedure that includes an active reading of the material, resolving doubts through interaction with the expert group, creating concept maps, and conducting activities that they will later present to the main group. They are also asked to be accountable for their own learning process by contributing to the community, as their results ultimately depend on the other group members. For students to be fully engaged, both intrinsic motivation, driven by the

desire to pass the subject and interest in the topic, and extrinsic motivation, related to the need to demonstrate and share their learning with peers, are required (Mayorga & Madrid, 2012). This work strategy mainly complies with five fundamental elements of CL (Domingo, 2008) (Figure 1).

### *Cooperative learning and gender equality*

The orientation of the subject matter and the role of teachers in the classroom with students are crucial aspects to foster positive behaviors and values in students (Bozkurt & Tel, 2016). Therefore, establishing a direct and effective connection between what is taught in school PE and the principles imparted in Initial Teacher Training becomes a relevant aspect. This leads to the need to reformulate teaching, orienting it towards a deeper integration of emotional and gender aspects (Chick, 2014). In the context of gender equality and its relationship with the SDGs, it is observed that goal 5 focuses on achieving gender equality and empowering all women and girls; goal 10 seeks to reduce inequalities within and among countries; while goal 11 aims to make cities more inclusive, safe, resilient, and sustainable (UNESCO, 2017). This relationship between education, gender equality, and the SDGs highlights the importance of integrating these concepts into teacher training and educational content to promote a more equitable and sustainable environment. SDGs, centered on gender equality, presents in its articles the goal of eliminating all forms of gender discrimination (5.1), eradicating violence against women and girls (5.2), and ensuring full and equal participation of women, as well as their equal access to leadership at all levels of decision-making (5.5) (UNESCO, 2017). Moreover, SDG 4 addresses the promotion of gender-equal education (4.1), the reduction of gender inequalities (4.5), and the previously mentioned target 4.7 (UNESCO, 2017). Therefore, gender stereotypes are positioned as one of the main obstacles to achieving gender equality in SDGs (Seguino, 2007). Inclusive educational models must be based on parameters of equality, and CL emerges as an approach that could foster opportunities equitably and stimulate equality in achieving success. This egalitarian context could be key to driving a significant improvement in student learning. Inclusive educational approaches should be based on standards of equality, and CL emerges as a methodology that could promote opportunities equitably and encourage equality in achieving success (Johnson et al., 1999). This egalitarian environment could be fundamental in driving significant improvements in student learning (Fernández-Río, 2017). To effectively implement CL, the importance of having heterogeneous groups is emphasized, adapting both success standards and task expectations to the individual needs of each student within the team (Baena-Morales et al., 2020). Additionally, Kagan and Stenlev (2009) underline the importance of employing techniques that organize activities in a way that ensures equitable participation of the entire group, as this does not usually happen spontaneously among students. If these guidelines are followed, CL can promote a high degree of

equality by equitably distributing roles among participants in group activities (Baena-Morales et al., 2020).

For these reasons, it is essential that teachers are familiar with the necessary information to effectively implement CL techniques (Johnson et al., 2000). In broad terms, we could assert that CL not only facilitates the acquisition of specific knowledge by students but also cultivates an environment of collaboration and mutual aid. In this context, each member of the group not only learns but also teaches and benefits from collective learning (Johnson et al., 2000). Consequently, this proposal explores the role of higher education in promoting sustainability from a social perspective, highlighting how CL could facilitate coeducation thanks to its collaborative and mutual support characteristics. This study addresses a significant research gap in the field of higher education in Sports Sciences. Despite the growing importance of gender equality and collaborative skills in today's society, there is a lack of comprehensive studies and interventions in the context of sports education at the university level. The primary objective of this study is to propose and implement a CL-based approach to enhance coeducation within the Sports Sciences degree program. The secondary objective is to examine the effect of CL on fostering cooperation among students. Hypothesis 1 (H1) posits that the implementation of CL will significantly improve coeducation. Hypothesis 2 (H2) suggests that CL will positively impact cooperation among students. These objectives and hypotheses aim to create an inclusive and collaborative learning environment that aligns with the principles of gender equality and teamwork skills development in Sports Sciences education.

## **Material & methods**

### *Design & participants*

A quasi-experimental pre-post study with three groups is presented, using non-probabilistic convenience sampling. The sample consisted of 60 students (female = 30, male = 30, age:  $22,21 \pm 1,62$  years) attending 2<sup>nd</sup> grade (see table 1). The inclusion criteria for the experimental group were to be enrolled in the lecture Fundamentals of Team Sports and their Didactics, of the 2<sup>nd</sup> grade of the degree in Physical Activity and Sport Sciences (PASS). The inclusion criteria for the control group were to be enrolled in 2<sup>nd</sup> grade of PASS.

The participants were distributed in two groups (control & experimental). The study was conducted in accordance with applicable national law and the declaration of Helsinki from 1975 (current and revised version). All study participants signed a declaration of consent on the anonymous utilization of the collected data prior to the study.

Table 1.  
Description of the participants integrating each of the studied groups.

	All		Male		Female	
	N	Age	N	Age	N	Age
Experimental	29	$20,03 \pm 0,90$	21	$20,09 \pm 0,94$	8	$19,87 \pm 0,83$
Control	31	$19,90 \pm 1,45$	9	$19,78 \pm 1,64$	22	$19,95 \pm 1,40$

### *Instruments*

For the evaluation of the impact of this educational

initiative, two questionnaires were implemented: the Competencies for Gender Equality Education (CEIG) Scale (Miralles-Cardona et al., 2018) and the Questionnaire for the Analysis of Cooperation in Higher Education (ACOES) (García-Cabrera et al., 2012). The CEIG questionnaire aims to measure the teaching competence for gender equality education. It has the potential to identify students' training needs in three areas: cognitive, behavioral, and affective. Additionally, it can be used to guide interventions aimed at integrating gender perspective in university teaching and assess changes after implementing these interventions.

It consists of 31 items divided into three subscales: Knowledge, Skills, and Attitudes, which, together, explain 54% of the variance and provide an overview of teaching competence for gender equality; thus, the CEIG can be considered a valid and highly reliable instrument ( $\alpha = .93$ ). The ACOES scale aims to investigate the value that university students attribute to cooperative work in their preparation as future teachers, while also seeking to understand their perception of the optimal structure and functioning of teams in this educational methodology. It follows a numerical Likert scale ranging from 1 to 5, where 1 means total disagreement and 5 means totally agree. It consists of 49 items distributed as follows: Group work conception; Utility of group work for their training; Planning of group work by the faculty; Criteria for organizing groups; Group norms; Internal functioning of groups; and Efficacy of group work. This instrument showed a high internal consistency ( $\alpha > .884$ ) and reliability ( $\alpha > .890$ ).

### Procedure

The experimental intervention was implemented as a part of the subject Fundamentals of Team Sports and its Didactics, specifically during the teaching of Volleyball. The intervention consisted of seven sessions, distributed in a weekly session of two hours. The intervention took place from February 2023 to March 2023. The pretest evaluation was conducted in the class prior to the intervention, and the posttest evaluation in the class after the intervention. The sessions were planned and executed following a methodology grounded in CL, specifically using the Jigsaw method.

This methodology allows for an effective structuring of sessions, fostering collaboration and collective learning, developing social and educational skills among university students. This method comprises the following four phases (Cochon et al., 2022). In stage one (introduction) the class is split into 'home' groups of between five or six students. In this case, the teacher distributed these groups, ensuring that they were homogeneous in terms of the presence of female students in order to encourage cooperation between male and female. The topic and how the students will be evaluated are also explained. Specifically, the students would have to prepare, explain, design, and teach tasks related to the technical-tactical elements of volleyball. In step two, students are divided and assigned to complete diverse tasks and become part of a group of experts (i.e. experts in teaching volleyball serving technique). Each student is then made responsible

for learning and executing a certain task and thus becoming an "expert" at that task, that is, to develop as much competence at a specific task as possible. In step three, each student returns to his or her home group and is assigned responsibility for teaching and explaining the skills he or she has learned to his or her home group peers with the aim of making them competent at those skills. Finally, in step four, home group students work together to produce the final joint work. This step represents the moment at which the specific learning from each of the partners is integrated and evaluated.

### Statistical analysis

The SPSS 28.0 statistics software was used to carry out all the analyzes. Each factor's descriptive statistics (mean and standard deviation) were calculated. Shapiro-Wilk's normality test was performed, obtaining non-normal distributions in all cases ( $p < 0.05$ ). To analyse baseline and final differences between the experimental and the control group, a Mann-Whitney U test was carried out. If the p-value was less than or equal to 0.05, it was considered statistically significant.

### Results

The primary objective of this study is to propose and implement a CL-based approach to enhance coeducation within the Sports Sciences degree program. The secondary objective is to examine the effect of CL on fostering cooperation among students.

### Baseline differences

Baseline characteristics of both groups (control and experimental) are presented in Table 2 including baseline differences. The three first variables (knowledge, skills, attitudes) correspond to the CEIG Scale, an instrument to assess the influence of the CL intervention on coeducation, and the other seven variables (conception, utility, planning, organizing, norms, functioning, efficacy) to the ACOES Questionnaire, an instrument to assess the influence of CL on cooperation among students. At pre-test, both groups presented similar starting values in all research variables ( $p > .05$ ).

Table 2.  
Comparing variables between experimental (n=29) and control group (n=31) at baseline using Mann-Whitney test (Av $\pm$ SD).

Variables	Experimental	Control	Z	Sig.
Knowledge	4,48 $\pm$ 0,72	4,60 $\pm$ 0,90	0,859	,390
Skills	4,98 $\pm$ 0,89	4,95 $\pm$ 0,97	-0,007	,994
Attitudes	5,06 $\pm$ 0,97	5,08 $\pm$ 1,02	0,263	,793
Conception	4,11 $\pm$ 0,47	4,24 $\pm$ 0,80	1,428	,153
Utility	4,02 $\pm$ 0,53	4,12 $\pm$ 0,65	0,991	,322
Planning	3,94 $\pm$ 0,67	3,86 $\pm$ 0,72	-0,142	,887
Organizing	3,68 $\pm$ 0,79	3,69 $\pm$ 0,71	0,705	,481
Norms	3,66 $\pm$ 0,61	3,49 $\pm$ 0,65	-0,653	,514
Functioning	4,23 $\pm$ 0,53	4,13 $\pm$ 0,86	-0,082	,935
Efficacy	4,23 $\pm$ 0,52	3,92 $\pm$ 0,84	-1,394	,163

Av= Average; SD= Standard Deviation; Sig = P-Value

### Final differences

Final characteristics of both groups (control and experimental) are presented in Table 3 including final

differences. At post-test, the U Mann-Whitney test showed significant differences in seven of all variables, getting higher score on the experimental group on all variables. The experimental group significantly improved in 3 (knowledge and skills) out of 3 dimensions of the CEIG and in 5 out of the 7 dimensions of the ACOES (conception, utility, planning, organizing, efficacy). The variables that have registered the higher results for the experimental group in the post-test situation were skills and attitudes, being norms the variable that obtained the lowest values. The variables attitudes and norms obtain very similar values in both groups, control and experimental.

Table 3.

Comparing variables between experimental (n=29) and control group (n=31) at post-test using Mann-Whitney test (Av $\pm$ SD).

Variables	Experimental	Control	Z	Sig.
Knowledge	4,72 $\pm$ 0,76	4,28 $\pm$ 0,66	-2,483	,013
Skills	5,22 $\pm$ 0,76	4,87 $\pm$ 0,70	-2,123	,034
Attitudes	5,22 $\pm$ 0,79	5,12 $\pm$ 0,62	-1,025	,306
Conception	4,44 $\pm$ 0,48	3,95 $\pm$ 0,57	-3,18	,001
Utility	4,45 $\pm$ 0,50	3,97 $\pm$ 0,55	-3,202	,001
Planning	4,25 $\pm$ 0,41	3,78 $\pm$ 0,67	-2,988	,003
Organizing	4,07 $\pm$ 0,60	3,58 $\pm$ 0,79	-2,809	,005
Norms	3,68 $\pm$ 0,52	3,43 $\pm$ 0,64	-1,751	,080
Functioning	4,37 $\pm$ 0,50	4,20 $\pm$ 0,61	-1,192	,233
Efficacy	4,45 $\pm$ 0,41	4,07 $\pm$ 0,64	-2,392	,017

Av= Average; SD= Standard Deviation; Sig= P-Value

## Discussion

The specific objectives of this research were to propose and implement a CL-based approach to enhance coeducation and to examine the effect of CL on fostering cooperation among students within the Sports Science degree program. After participating in 7 sessions of volleyball instruction classes following a methodology grounded in CL (the Jigsaw method ensuring mixed groups), the experimental group significantly improved in 2 out of 3 dimensions of the CEIG and in 5 out of the 7 dimensions of the ACOES compared to control group. Therefore, the obtained results confirmed the two researched hypothesis: (H1) the implementation of CL significantly improves coeducation; (H2) CL positively impacts cooperation among students. Our findings agree with the study of Cochon et al. (2023), which aimed to clarify in the PE context the inconsistency regarding the effects of Jigsaw on students' learning in the educational field and the consequences of this method on student's engagement. They found that the Jigsaw intervention reduced the sex differences associated to the PE class, therefore it could be applied to reduce gender inequalities in education. Our results are also consistent with the conclusions of Prieto-Saborit et al. (2021), who found improvements in gender equality after implementing CL in the subject of Mathematics. They affirmed that CL in mathematics serves as a comprehensive methodology that, through its outcomes, enhances performance in equitable environments, significantly reducing the gender gap. Additionally, according to Esiobu (2011), the CL approach in science proved highly effective in altering students' perceptions toward the opposite gender. These findings could align with those

obtained in this study, as significant changes were observed in the "knowledge" ( $p = .013$ ) and "skills" ( $p = .034$ ) dimensions, which lay the groundwork for subsequently developing such practices in the educational sphere.

Some of the difficulties of coeducational PE implies the implementation of team sports, mostly because female students report being excluded and not getting the ball passed (Frühauf et al., 2022). In contrast, the positive results obtained in relation to the teaching of volleyball in mixed teams align with the study of Singh et al. (2022), that supported that mixed volleyball challenges conventional gender roles and stereotypes by fostering cohesion and contributed to a more equitable and inclusive sport. It encourages gender equality by offering an equitable platform for both male and female participants to engage and compete jointly. Moreover, taking into account that girls' participation rates in volleyball are higher than in other sports, especially when compared proportionally with boys, it allows girls to stand out and demonstrate their skills in this sport during PE classes. In fact, out of the 8 girls who participated in the experimental group, 2 were volleyball players. Therefore, the participation in volleyball, and particularly mixed volleyball could contribute to confront the "male-oriented" activities in PE (Kastrup & Kleindienst-Cachay, 2016). However, including modified game forms to teach team sports with simplified rules could contribute to enhance the participation of the female students in team sports for coeducational classes (Van, et al., 2010).

With respect to the potential of CL in improving the cooperation among students, in line with the results of El-Basiony (2015) and O'Leary et al., (2019), our study showed a significant change ( $p = .01$ ) in the "conception" dimension of CL, with focus in understanding how students perceive group work and how teamwork aids them in their cognitive, social, and academic growth. One possible explanation is that through CL, students display greater concern for their peers and take responsibility for their achievements. Conversely, Lozano et al. (2020) found significant differences in all dimensions except "conception"; this might be due to methodological differences between the studies, such as the mean age (28.6 years) and the percentage of female participants (73%). Nonetheless, their findings align with our positive results regarding "utility", "planning", "organizing" and "efficacy" dimensions, which aim to comprehend students' perceptions regarding the usefulness of group work in their development; examine teachers' planning of these tasks; explore the criteria used to form workgroups; and investigate the effectiveness of group work by examining both external and internal conditions that yield higher levels of performance and productivity, respectively. Regarding our improvements obtained in the dimension "utility", one probable reason is that, through explaining and receiving information between groups, they retain new skills in their memory for much longer (El-Basiony, 2015). Furthermore, according to Cochon et al. (2023), this may be because, on one hand, the employed method fosters interactions through significative learning,

and on the other hand, concerning “efficacy”, it seems that girls perceive themselves as more competent when the Jigsaw method is applied, as girls are more oriented towards mastery compared to boys who seek performance. This analysis was previously highlighted by Hoyenga and Hoyenga (1993), emphasizing that when boys and girls play the same game, boys tend to compete with those around them, whereas girls tend to form cooperative groups among themselves. However, in this study, the organization of activities forces heterogeneous group work, preventing this outcome. Regarding “organizing”, O’Leary et al. (2019) found that heterogeneous and friendship-based groupings have the potential to promote high-level social and cognitive learning, possibly due to the necessity of listening, constructing learning, and encouraging the learning of other group members. Finally, in the “planning” dimension, it appears that students perceive the teacher’s preparation for sessions as considerably more extensive than in a traditional session.

The intervention based on the Jigsaw method implemented in the present study did not improve 2 of the dimensions of the ACOES questionnaire. The participants did not show significant differences in the dimension “functioning” ( $p = .233$ ), related to gathering to plan jointly, make consensual decisions, share their progress with others, evaluate it, and make improvement proposals. One possible explanation could be that students, when working in groups, limit themselves to dividing the tasks without a process of sharing, reflection, and joint decision-making. They might perceive it as more comfortable, quick, and efficient to limit themselves to dividing the work and then adding it up. The results neither indicated improvements in the dimension “norms” ( $p = .080$ ). This could be explained by the fact that in the implementation of the Jigsaw model, there was not a special emphasis on establishing, negotiating, or addressing the consequences of non-compliance with rules.

In line with our study, the research of Baena-Morales et al., (2020) also implemented the Jigsaw technique in order to analyse gender differences between university students regarding their perceptions and behaviors after having cooperated. They founded some differences with respect to gender, since female students preferred a different way to be organized, however both genders support this method for enhancing social competences. In the present study, considering the limited proportion of female participants with respect to male, it was not deemed relevant to carry out a gender-based comparison. The restricted representation of female students in relation to the number of male students reduces the possibility of creating homogeneous groups based on gender and prevents an analysis of the differences in perceptions between boys and girls in the studied variables. It would be interesting to replicate this study by increasing the number of participants, as a small sample size limits the ability to generalize the results to larger populations. Regarding the duration of the intervention, considering that previous studies indicated that students needed a few weeks to become accustomed to working collaboratively (Casey et al., 2020), the satisfactory results obtained

in the present study with only 7 sessions could be facilitated because certain groups of students were already used to working collaboratively. In fact, students in a previous work participated in 17 lessons before they were able to work as a team in PE (Bjørke & Kjersti, 2020). With respect to the instruments used, the students answered in two different moments 49 items from ACOES questionnaire plus 22 items from CEIG scales. They usually report that they perceive the instruments too extensive, so we might consider including shorter questionnaires in further research. Future studies could focus on validating instruments that are shorter and therefore quicker to implement, in order to not discourage students from participating in research in the educational context. It is important to remember that, unfortunately, gender stereotypes persist in the educational system. While the significance of women’s roles in sports is gaining recognition, there remains considerable work to be done to advance equality in various aspects, specifically in PE (Avraam & Anagnostou, 2022). This may difficult the transfer of these results to other educational areas. Therefore, it would be interesting to replicate this kind of studies in educational contexts different from PE and that could also include a greater number of representation of the female gender. Finally, it would be very interesting to replicate these types of studies with randomized designs, although the academic environment often makes it challenging to avoid convenience sampling. Thus, we must be cautious with the results obtained considering the limitations associated with quasi-experimental designs.

## Conclusions

In conclusion, the study results revealed that teaching collective sports like volleyball through the cooperative model, specifically Jigsaw using mixed teams, significantly contributes to improving not only cooperative teamwork skills but also significantly enhances gender equality education. The implementation of CL and the Jigsaw model emerges as a valuable tool in the field of PE to address co-education challenges. CL fosters collaboration among students, promoting an inclusive environment where individual skills are valued, and diversity is recognized. Likewise, the Jigsaw model, involving positive interdependence among group members to achieve a common goal, can contribute to challenging and dismantling gender stereotypes by fostering equal participation and recognition of skills without gender distinctions. Equality of women in sports in general and in PE in particular has experienced significant improvements in recent years; however, gender stereotypes persist, limiting their full participation. Despite the increasing significance of gender equality and collaborative skills in contemporary society, there remains a shortage of comprehensive studies and interventions within the realm of sports education at the university level. Thus, it is evident that there is still work to be done to achieve complete equity and this study fills a notable research gap within the field of higher education in Sports Sciences. In this context,

conducting more studies is essential to thoroughly understand existing gender barriers and develop effective strategies to overcome them.

### Conflicts of interest

The authors do not have conflicts of interest to declare.

### Funding

This research was funded by CESAG, affiliated to Comillas Pontifical University (Precompetitive Project: PRO-2022-002)

### Informed Consent Statement

Informed consent was obtained from the participants involved in this paper.

### Acknowledgments

The authors wish to acknowledge the support provided by CESAG, for the writing of this article (Precompetitive Project: PRO-2022-002). We also acknowledge the students that participated in this study.

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