Impact of peer-based cooperative learning in Physical Education on physical fitness and learning motivation among secondary school students

Impacto de la enseñanza cooperativa entre iguales en Educación Física en condición física y motivación del aprendizaje

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Abstract

Introduction: secondary school physical education often relies on teacher-directed instruction, which may limit student engagement and comprehensive physical development. cooperative learning has been proposed as a student-centered alternative to address these limitations.
Objective: to examine the effectiveness of peer-based cooperative teaching on physical fitness and learning motivation among Palestinian secondary school students.
Methodology: a quasi-experimental pre-test/post-test design was conducted with 400 students assigned to experimental and control groups. the experimental group followed an eight-week peer-led cooperative learning program, while the control group received traditional Instruction. aerobic capacity, muscular endurance, flexibility, and learning motivation were assessed using standardized tests and questionnaires. data were analyzed using multivariate and covariance-based procedures.
Results: students in the experimental group showed significantly greater improvements in all physical fitness components and learning motivation compared with the control group. multivariate analyses confirmed a significant overall intervention effect.
Discussion: the findings support evidence that cooperative learning enhances physical engagement and motivation through structured peer interaction.
conclusions: peer-based cooperative teaching is more effective than traditional instruction and should be incorporated into secondary school physical education programs.

Keywords

Cooperative learning; motivation; Physical Education; physical fitness; secondary school.

Resumen

Introducción: la educación física en la educación secundaria suele basarse en la instrucción dirigida por el docente, lo que puede limitar la participación del alumnado y el desarrollo físico integral. el aprendizaje cooperativo se ha propuesto como una alternativa centrada en el alumnado para superar estas limitaciones.
Objetivo: analizar la eficacia de la enseñanza cooperativa basada en pares sobre la condición física y la motivación hacia el aprendizaje en estudiantes palestinos de educación secundaria.
Metodología: se aplicó un diseño cuasiexperimental con preprueba y posprueba a 400 estudiantes distribuidos en grupos experimental y de control. el grupo experimental participó en un programa cooperativo dirigido por pares durante ocho semanas, mientras que el grupo de control recibió enseñanza tradicional. se evaluaron la capacidad aeróbica, la resistencia muscular, la flexibilidad y la motivación mediante pruebas estandarizadas y cuestionarios. los datos se analizaron mediante procedimientos multivariados y de covarianza.
Resultados: el grupo experimental presentó mejoras significativamente mayores en todos los componentes de la condición física y en la motivación en comparación con el grupo de control. el análisis multivariado confirmó un efecto global significativo de la intervención.
Discusión: los resultados respaldan la evidencia de que el aprendizaje cooperativo mejora la implicación física y la motivación a través de la interacción estructurada entre iguales.
Conclusiones: la enseñanza cooperativa basada en pares resulta más eficaz que la instrucción tradicional y debería incorporarse en los programas de educación física de secundaria.

Palabras clave

Aprendizaje cooperativo; motivación; Educación Física; condición física; educación secundaria.

Introduction

Cooperative learning (CL) is a student-centered, structured instructional method that involves students working in small, interdependent groups toward common educational goals. Whereas collaborative learning tends to be a loose structure, cl has clearly defined roles, positive interdependence, individual accountability, and guided group processing. This type of instructional design contributes to increasing student participation in learning by establishing social bonds that promote greater success in school and increase attainment of affective and cognitive skills (Zach et al., 2023). Many have referred to cooperative learning as a teaching method that stimulates interaction, participation, and responsibility in the classroom.

While physical education (PE) provided a structured and systematic means of improving students' health through intentional physical activity (Zhang et al., 2019), secondary school pe instruction has traditionally relied on teacher-directed approaches. The result is often limited opportunity for sustained peer interaction, student autonomy and motivational engagement. Yet, traditional pe continues to have important neurological and physical benefits that support cognitive development and academic performance among school-aged students (Latino & Tafuri, 2023).

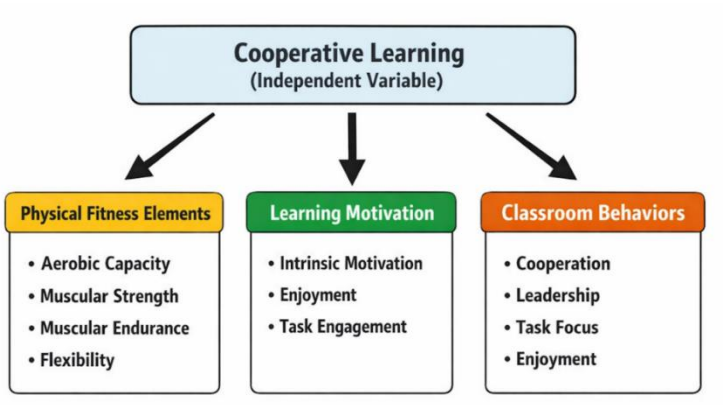
Because of these limitations, peer-based cooperative learning has increasingly received increased empirical support in the context of physical education (Aparicio Espejo et al., 2025). Recent studies have shown that cl improves strategic awareness, decision-making skills and psychomotor performance by actively engaging students in structured learning tasks (Boke et al., 2025). Additionally, cooperative learning has been shown to improve overall classroom atmosphere by stimulating enjoyment, confidence, and satisfaction also by decreasing negative emotions such as boredom and anxiety. These affective effects are closely associated with improved persistence and engagement in learning because positive emotional experiences directly enhance achievement by improving confidence, enjoyment, and reducing disengagement (León et al., 2023).

Motivation is a key predictor of students' success and long-term participation in physical education. Self-determination theory asserts that learning environments that encourage autonomy, competence, and relatedness, the key concepts of cooperative learning, assist in stimulating intrinsic motivation (Sotos-Martínez et al., 2024). Evidence from empirical supports cooperative learning as an increase in student participation and persistence in pe classes leading to increased intrinsic motivation (Fernández-Espínola et al., 2020; Mchale et al., 2022; Miao et al., 2024). In addition, structured cooperative roles and shared responsibility were demonstrated to help change classroom behaviors such as cooperation, leadership, and completion of tasks (Liao et al., 2023; Miao et al., 2024).

In Arab and regional settings, several studies have investigated cooperative learning's effects on motor skills, physical fitness, and social behavior. While many of these studies have used either primary or university-level populations, the results are a major indicator of the usefulness of cooperative learning strategies. For example, cooperative learning has shown to improve social skills such as cooperation and responsibility among secondary school students as well as leadership and task performance (García-González et al., 2023). Mahmmod and Odat (2007) found that cooperative learning students in Jordan demonstrated significant improvements in their basic motor skills over traditional instruction. As for technical performance in discus throw, Khataybeh et al. (2024) reported that visual exercise activities combined with a cooperative learning program enhanced technical performance by 20 percent. Further, results from university of Jordan have shown that cooperative mastery learning and guided inquiry strategies perform better than traditional methods in developing technical performance at track and field events (Hammouri et al., 2016). Another body of data from colleges of physical education supports the role of cooperative learning in the development of physical fitness training components and skill development, demonstrating the value of peer-based instructional strategies (Berdai et al., 2024). Despite strong international evidence and supporting findings from Arab and regional studies, existing research has a number of limitations (Álvarez-Sánchez et al., 2025). Most studies focus on primary school or university populations, examine individual motor skills rather than all aspects of physical fitness, or examine motivation and physical outcomes separately. Therefore, there is clearly limited research dealing with secondary school students through interventions that target physical fitness, motivation, and classroom behavior. This gap is especially critical given the special developmental, social, and motivational challenges of adolescence.

In response to such gaps, a physical education program based on peer-based cooperative learning was used to assess the effectiveness of improving core physical fitness components, including aerobic capability, muscular endurance, muscular strength, and flexibility among secondary school students. Additionally, the study looks at the influence of this approach to instruction on student motivation for physical education classes and similar classroom skills such as cooperation, effort, and leadership. This study aims to build upon existing knowledge and provide evidence-based guidance for improving the quality and efficacy of secondary school physical education programs in the context of Palestinian education by integrating physical, motivational, and behavioral outcomes in one intervention. Figure 1 shows that peer-based cooperative learning includes physical, motivational, and behavioral outcomes.

Figure 1. Conceptual layout of the peer-based cooperative learning model and its outcome domains.



Method

Study Design

The pre- and post-test design was a quasi-experimental, non-equivalent control group of subjects with experimental control and a control group. In contrast, the control group received traditional (PE) instruction via teacher-directed instructional approach, while the experimental group received structured peer-based collaborative learning (CL). Both groups were assessed during the pre-test and post-test, just prior to and following the eight-week intervention, for the three primary dependent variables: physical fitness, learning motivation, and classroom behavior.

Due to the practical and logistical constraints of a school setting, whole classes rather than individual students were placed in experimental conditions. To circumvent possible threats to internal validity with this design, strict statistical controls were implemented. Pre-test scores were also included as covariates in all ANCOVA analyses to account for baseline differences, and demographic differences between groups was scrutinized and confirmed prior to inferential analysis.

Participants

Participants were tenth graders, eleventh graders and twelfth graders in public and private secondary schools during the 2024-2025 school year. There was an inclusion requirement that all participating schools have Physical Education units, a class size of 25-35 students on average and approval for curriculum-based research.

A multi-stage sampling strategy was used. First, four schools with inclusion criteria were deliberately selected to ensure geographical and administrative diversity. To preserve ecological validity and maintain regular school hours, intact Physical Education classes were placed in either the experimental or control condition. Each of the schools brought in two grades: grades 10 to 12, one of which was involved with Cooperative Learning with a peer and group was received as classroom instruction for the second semester.

The final total number of students was 400 representing a total of the experimental (n = 205) and control (n = 195). This sample included Palestinian secondary school students of all genders, 15-18

years of age, and categorized by school type (62.5% public, 37.5% private) (62.5% public, 37.5% private). At baseline, there were no statistically significant differences between populations.

Procedure

The Cooperative Learning (CL) Intervention

Intervention Design and Framework

The program consisted of an eight-week Physical Education course using peer-based Cooperative Learning, with two 45-minute sessions per week. This instruction was based on the Learning Together Cooperative Learning model developed by Johnson and Johnson (1999), with a focus on positive interdependence, accountability, promotion, interpersonal skills, and group processing (Martínez Benito et al., 2025).

The shift to a student-centered cooperative model of instruction that focused on student participation to achieve common goals regarding physical education and learning was intentionally designed to shift instruction away from teacher-centered instruction. This study did not use the term collaborative learning as the instruction followed a model of structured cooperative learning.

Session Structure

Each 45-minute session followed the usual sequence of group warm-up and task explanation, primary activity phase at cooperative stations that aimed to address specific fitness components, and cool-down phase with group reflection and feedback. Station activities were aimed at promoting fitness, including aerobic performance, muscle endurance and flexibility, and were gradually reviewed over weeks to ensure safety and appropriate physical load.

Table 1. Structure of a 45-Minute Cooperative Learning PE Session

Phase	Duration	Experimental Group (CL) Activity	Control Group (Traditional) Activity
Warm-up & Explanation	10 min	Teacher explains group goals and station tasks. Dynamic warm-up in groups.	Teacher-led calisthenics and skill demonstration.
Main Activity	25 min	Rotating Stations (5 min/station): 1. Aerobic: [Your Specific Activity]. 2. Strength/Endurance: [Your Specific Activity]. 3. Flexibility: [Your Specific Activity]. 4. Tactical/Game: [Your Specific Activity].	Whole-class drill practice: teacher-directed [List Activities].
Cool-down & Processing	10 min	Group stretching followed by a guided group discussion.	Teacher-led stretching.

Note. The specific activities at each station were aligned with the target fitness components (aerobic capacity, muscular endurance, etc.) and were adapted weekly to maintain engagement and progressive overload.

The control group followed a more traditional model of instruction by the teacher, with demonstrations, feedback and practice being provided directly by the PE teacher. These two groups reported similar curricula and fitness goals, having only differences in instructional design (Cooperative Learning versus traditional instruction) and no structured peer roles or cooperative task organization. The lead researcher designed the intervention and supervised participation during the intervention by monitoring the alignment of the Cooperative Learning framework with the participating PE teachers.

Study tools

Physical Fitness Tests

At the same time, standardized physical fitness tests were administered prior to and after intervention to assess cardiorespiratory fitness, muscular endurance, and flexibility. This cardiorespiratory fitness test, a field-tested measure of aerobic capability, was administered as the Cooper running test, administered in 12 minutes (Cooper, 1968). Durability was measured by push-ups, and maximal plank hold (seconds). Flexibility was measured via the sit-and-reach test (Wells & Dillon, 1952). BMI was not a primary intervention outcome and was a descriptive variable.

Motivation Questionnaire

The completed questionnaire was drawn from the educational literature and results of previous studies. The questionnaire consisted of five measures of motivation, five measures of perceived effectiveness of

Cooperative Learning, and five measures of attitudes toward Physical Education, all with 5-point Likert scales. Experts in Physical Education evaluated content validity (Alfonzo Marin et al., 2025). Confirmatory Factor Analysis (CFA) assessed construct validity and obtained acceptable fit indices (χ^2/df < 3; RMSEA = .05; CFI = .95) using Cronbach's alpha coefficients, motivation =.82, cooperative learning =.80, attitudes =.84, and overall reliability coefficient =.88.

Classroom Observation Checklist

Following classroom observations, a pre-assessment checklist was used to take notes on four areas of practice identified as on-task, peer collaboration, leadership, and attentiveness. The checklist was created for the purposes of this study and is descriptive rather than quantitative. Observers were undergraduate research assistants with no training in coding. Behaviors were recorded using time-sampling during regular PE sessions.

Procedure

Participants in the experimental and control groups were assessed for physical fitness, motivational questionnaires, and observation checklists prior to intervention. The intervention then lasted eight weeks with two 45-minute sessions per week.

The control group continued to have primarily teacher-led PE lessons while the experimental group participated in Cooperative Learning where peer leaders rotate activity stations. These sessions focused on peer feedback and sharing and shared responsibility toward common performance goals.

The directness of the instruction prevented blinding participants. However, data analysis was conducted by a researcher who was blind to group selection, analytical bias was minimized. Post-test measures were conducted using the same procedures and instruments used at pre-test.

Data analysis

Data were analyzed using the SPSS version 28 and AMOS version 27 in sequential fashion to ensure statistical validity, reliability, and robustness of results. Means, standard deviations, frequencies, and percentages were used to represent demographic characteristics, gender, grade level, and school type among the participants, and mean values for all dependent variables (aerobic capacity, muscular endurance, flexibility and learning motivation).

Inferential testing assumptions were tested before inferences. The normal distribution was checked by the Shapiro-Wilk test and the homogeneity of variance was checked by Levene's test. The results indicated that all variables were suitable for parametric analysis assumptions ($p > .05$). These preliminary checks validated the suitability of future ANCOVA, MANOVA and Structural Equation Modeling procedures.

Because participants were assigned to conditions with intact classes, the data structure could exhibit a non-independence (clustering) effect. This problem was explicitly addressed in the analysis strategy. In previous studies, the violation of independence assumptions in group educational design was found to be lessened with moderate to large classes and low intraclass correlation coefficients (Scariano & Davenport, 1987). While the majority of students in the present study came from intact classes with between 25 and 35 students, and the consistency between instruction and similar content at the class level was maintained to minimize student variation, individual ANCOVA was considered a conservative and appropriate assessment technique (Murray, 1998). This approach mirrors practices in school quasi-experimental research.

To study the intervention effects under normalization of baseline effects, Analysis of Covariance (ANCOVA) was performed with post-test scores as dependent variable and the pre-test scores as covariates. Different ANCOVA models were used for aerobic capability, muscular endurance, flexibility, and learning motivation. This improved statistical accuracy and decreased the error variance of existing groups.

Multivariate Analysis of Variance (MANOVA) was used to evaluate the combined effect of the Cooperative Learning intervention on multiple dependent variables. MANOVA lowered the Risk of Type I error by being used for multiple univariate tests and allowed for the analysis of the aggregate

multivariate effects of the intervention on physical and motivational outcomes at the same time. Following univariate tests, in which multivariate significance was found, were conducted afterwards.

The effects sizes were calculated to supplement the significance testing and to check the relevance of findings in practice. ANCOVA and MANOVA results were taken as Partial eta squared (η^2_p) and Cohen's d was used to estimate standardized mean differences between the groups. Effect sizes were calculated using Cohen's (1988) guidelines. Mean score was set to $p < .05$ and Bonferroni corrections were made as needed to account for familywise error rates.

Grade level (Grades 10-12) was considered a demographic control variable and not an experimental variable so there were no independent t-tests or factorial analyses across grade levels. This was done in order to maintain analytical parsimony and to avoid unnecessary inflation of Type I error.

Finally, Structural Equation Modeling (SEM) with AMOS were used for Self-Determination Theory mediation model testing, to explore learning motivation as a mediator between the Cooperative Learning intervention and physical performance outcomes. Estimation of models was performed using the maximum likelihood procedures. Model fit was assessed using multiple indicators including the chi-square to degrees of freedom ratio (χ^2/df), the CFI, the TLI, and the RMSEA, the Root Mean Square Error of Approximation. The model was constructed on established cutoff criteria such as (χ^2/df < 3; CFI ≥ .95; TLI ≥ .90; RMSEA ≤ .05).

Ethical Considerations

An ethical support for this study was obtained from the relevant institution's research ethics committee and Ministry of Education before data collection. The boards of participating schools also granted permission to conduct the research. All procedures were conducted according to accepted international ethical standards for human participant research. All participants and their parents or legal guardians were given written informed consent before participating. Students knew what to study, how to conduct it, and what should be done when they withdraw at any moment without penalty or punishment. The participants were voluntary and no incentive was offered. While research was conducted, confidentiality and anonymity were maintained. No personal information was collected and data was coded and stored securely in the password-protected files that only the research team was accessing. This aggregate data made results available, so that no individual participants and schools were identified. All physical activities in this study were age appropriate, non-invasive, and coordinated by qualified Physical Education teachers. The participants were encouraged to work within their limits to minimize the risk of injury. The collected data was used for academic purposes only.

Results

Physical education is central to adolescent development at secondary school, at a crossroads between physical, social, and cognitive development. This section describes descriptive and econometric data on the performance of peer-based Cooperative Learning (CL) over traditional teacher-centered instruction. Differences in physical fitness components and learning motivation were assessed by means of descriptive statistics and inferential analysis (ANCOVA and MANOVA) between experimental and control groups.

Before inference was made, descriptive statistics were calculated based on demographic characteristics and baseline measures. Table 2 analyses the demographic characteristics of the participants, showing a split of females and males; median age was 16.6 years (SD = 0.9), and ages ranged from 15 to 18 years. Most participants were in public schools (62.5%) and 37.5% in private schools. This distribution reflects the national trend of Palestinian secondary education.

Table 2. Demographic Characteristics of Participants (N = 400)

Characteristic	n	%	Descriptive Statistic
Gender			
Male	200	50.0	
Female	200	50.0	
Age (Years)			M = 16.6, SD = 0.9
Range			15–18

15–16 Years	180	45.0
17–18 Years	220	55.0
School Type		
Public	250	62.5
Private	150	37.5

200 males and 200 females were enrolled in the sample. The majority of respondents aged 17-18 years, and 45% aged 15-16 years. These demographic characteristics illustrate a balanced and representative sample.

Table 3 lists the sample size by grade level and experimental conditions of the 400 participants (n = 205 in experiment group; n = 195 in control group). A chi-square test found no statistically significant difference between the experimental and control group for grade level variation, $\chi^2(2) = 0.08$, $p = .991$. for the pair of data for the pair of data. This data supports demographic similarity between groups prior to intervention.

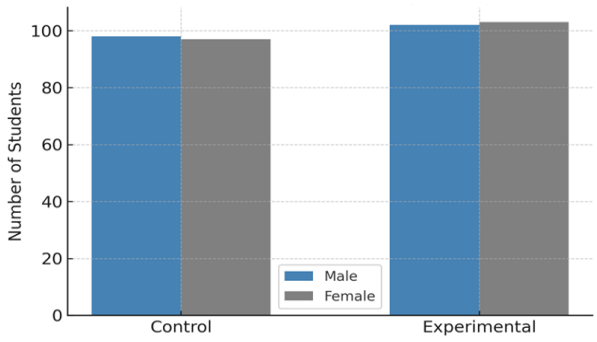
Table 3. Distribution of Participants by Grade Level and Group (N = 400)

Grade Level	Control Group (n = 195)		Experimental Group (n = 205)		Total (N = 400)		χ^2 (p-value)
	n	%	n	%	n	%	
Grade 10	62	31.8%	68	33.2%	130	32.5%	
Grade 11	68	34.9%	72	35.1%	140	35.0%	$\chi^2(2) = 0.08$, $p = .991$
Grade 12	65	33.3%	65	31.7%	130	32.5%	
Total	195	100%	205	100%	400	100%	

Note: Percentages in Control and Experimental columns represent within-group proportions (e.g., 31.8% of the Control group were Grade 10 students).

The gender distribution by group is shown in Figure 2, which confirms the balance of baseline across the experimental and control conditions.

Figure 2. Gender Distribution by Group



Fuente: Author

Table 4 indicates the similarity in their pre-test scores among both groups in all variables examined, suggesting similarity prior to intervention. The experimental group showed the greatest average improvements for all outcome variables at post-test, while the control group had the lowest average improvements that were not statistically significant. In particular, the experimental group had an increase in aerobic capacity of 11.6 units compared with the control group. The experimental group increased their muscle endurance by 7.6 units and the control group by 1.9 units. Flexibility was higher in the experimental group with a larger mean gain in the experimental condition. The experimental group increased learning motivation by 1.16 points compared with the control group by 0.11 points.

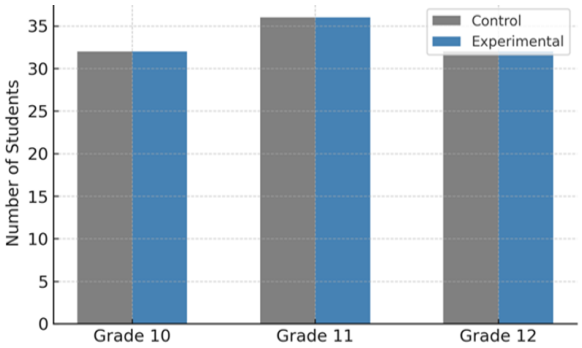
Table 4. Pre-test and Post-test Means and Standard Deviations for Experimental and Control Groups (N = 400)

Variable	Group	Pre-test Mean (SD)	Post-test Mean (SD)	Mean Difference	p-value (within-group)
Aerobic Capacity	Experimental	54.2 (8.6)	65.8 (7.4)	+11.6	<.001
	Control	53.7 (9.1)	55.2 (8.9)	+1.5	>.05
Muscular Endurance	Experimental	42.9 (7.3)	50.5 (6.8)	+7.6	<.01
	Control	43.1 (7.1)	45.0 (6.7)	+1.9	>.05
Flexibility	Experimental	28.5 (5.2)	32.6 (5.9)	+4.1	<.05
	Control	28.8 (5.5)	29.3 (6.1)	+0.5	>.05
Motivation	Experimental	3.12 (0.41)	4.28 (0.39)	+1.16	<.001
	Control	3.10 (0.42)	3.21 (0.40)	+0.11	>.05

$p < .05$

Figure 2 illustrated that participant distribution across grade levels was nearly identical between the control and experimental groups, confirming grade-level balance and supporting internal validity.

Figure 2. Distribution of Participants by Grade Level and Group



Fuente: Author

Both groups started with similar pre-test scores across all measured variables, which indicated they were statistically equivalent prior to intervention. However, the experimental group made much greater gains in all domains at the post-test stage compared with the control group showing only small but not significant gains.

More specifically, the experimental group significantly increased aerobic capacity and muscular endurance by +11.6 and +7.6 points while the control group gained only modestly (+1.5 and +1.9). Similarly, students' motivation scores in the experimental group increased by more than one full point (from 3.12 to 4.28, $p < 0.001$), indicating strong and meaningful motivational effects of the peer-based cooperative learning approach.

This study was the first to link cooperative learning with performance-relevant increases in physical performance as well as psychological engagement, these results became the first to address this issue.

Prior to performing inferential analysis, formal assumption testing was conducted to ensure that the data met parametric test requirements ($p > .05$) of all study variables was not associated with significant deviations from the normal distribution using the Shapiro–Wilk test. Levene's test also confirmed homoscedasticity after post-hoc testing by showing homogeneous variances among experimental and control groups ($p > .05$). Thus, the data met all the assumptions for ANCOVA and MANOVA, and therefore enables inferential analyses to be performed in parallel.

To test all hypotheses, the ANCOVA results are presented as means-by-post and as covariates for pre-test scores. This analysis was used to adjust for any residual baseline variance and further enhance statistical precision. It was evident in Table 5 that the experimental group was better at all physical and motivation measures. These differences indicate that peer-based cooperative learning improved performance and motivation relative to conventional instruction, which is a direct statistical support for the study hypotheses.

Table 5. Adjusted Post-test Means and Standard Deviations for Experimental and Control Groups (ANCOVA Results, N = 400)

Variable	Group	Mean	SD	p-value
Aerobic Capacity	Experimental	62.4	8.3	< .001
	Control	54.8	9.1	
Muscular Endurance	Experimental	48.7	7.2	< .01
	Control	42.1	6.8	
Flexibility	Experimental	32.6	5.9	< .05
	Control	29.3	6.1	
Motivation	Experimental	4.32	0.58	< .001
	Control	3.74	0.66	

$p < .05$ considered statistically significant. Values represent post-test means adjusted for pre-test scores using ANCOVA.

ANCOVA analyses found that the experimental condition exceeded the control condition in terms of aerobic ability, muscular endurance, and motivation, with adjusted post-test means favoring the experimental group. This phrase should be integrated into the previous or following sentences. The same statistically significant increase in flexibility was found in the experimental group ($p < .05$), suggesting the program had a positive effect on performance in a variety of fitness domains. These differences were statistically significant, and even practically meaningful, with large effect sizes (η^2 = .23 to .30).

These findings indicate that peer-to-peer collaborative interaction promotes physical competence and intrinsic motivation, two of the primary emphases in Self-Determination Theory (SDT).

Table 6 displays the ANCOVA results with F values, mean squares, sums of squares, and degrees of freedom for each dependent variable. ANCOVA tests found statistically significant differences between the control and experimental groups for all measures of outcome after the intervention, excluding pre-test scores. In particular, aerobic capacity showed an $F(1,398) = 22.38$, $p > .001$ improvement in the experimental group after the cooperative learning intervention. Similarly, muscle endurance benefited significantly, $F(1,398) = 19.19$, $p < .01$, and motivation, $F(1,398) = 26.57$, $p < .001$.

Table 6. ANCOVA Summary for Post-Test Outcomes (Covariate: Pre-test Scores)

Dependent Variable	SS	df	MS	F	p
Aerobic Capacity	870.52	1	870.52	22.38	<.001
Muscular Endurance	611.74	1	611.74	17.41	<.01
Motivation	4.32	1	4.32	26.57	<.001

SS =sum of Squares; MS = Mean Square; $p < .05$ considered statistically significant.

These results supported the conclusion that while there were no statistically significant differences at pre-test, there were large differences at post-test that confirmed the effectiveness of the peer-based Cooperative Learning intervention. The impact was also quantifiable in terms of physical performance and motivation among students taught using a non-traditional model of teaching based on Cooperative Learning.

Table 7 plots the adjusted post-test results for each dependent variable as well as effect sizes (η^2). Flexibility had a medium effect size (η^2 = .09), and aerobic capacity had a large effect size (η^2 = .27), muscular endurance (η^2 = .23) and motivation (η^2 = .30). These values are consistent with Cohen's (1988) guidelines and represent strong practical effects of the intervention on students' physical and motivational outcomes.

Table 7. Adjusted ANCOVA Results with Effect Sizes for Study Variables (N = 400)

Variable	F(1,398)	p-value	η^2 (Effect Size)	Interpretation
Aerobic Capacity	22.38	< .001	.27	Large effect
Muscular Endurance	17.41	< .01	.23	Large effect
Flexibility	6.88	< .05	.09	Medium effect
Motivation	26.57	< .001	.30	Large effect

η^2 = Partial Eta Squared; interpreted according to Cohen (1988).

This partial eta squared values suggest that Cooperative Learning promoted teamwork, peer accountability, and intrinsic motivation, which are the five essential constructs of Self-Determination Theory that are believed to support sustained behavioral and performance change.

Summary results of MANOVA for N = 400 are presented in Table 8. Among the combined dependent variables, Wilks' Λ = .86, F (3,396) = 21.22, p < .001, η^2 = .24, the MANOVA revealed a statistically significant overall difference between the experimental and control groups. This suggests that the cooperative learning intervention produced substantial multivariate effects in both physical and motivational outcomes. The large partial eta squared value (η^2 = .24) suggests that an estimated 24% of variance of the combined dependent variables was explained by the intervention, which supports the robustness of the cooperative learning model.

Table 8. MANOVA Summary (N = 400)

Wilks' Λ	F(3,396)	p-value	η^2	Interpretation
.86	21.22	< .001	.24	Significant multivariate difference favoring the experimental group

These data set are consistent with the strong parallel effect of the cooperative learning model on aerobic strength, muscular endurance, and motivation, and support the expectation that peer-directed group interaction enhances Physical Education performance. Table 9 displays the estimated effect sizes of each outcome variable. Based on Cohen's (1988) parameters, all outcomes showed moderate to large effects, with a d of 0.70 and 0.95, and partial $\eta^2$of .23 and .30 respectively. Motivation was the strongest effect (d = 0.95, η^2_p =.30) followed by aerobic ability (d = 0.82, η^2_p =.27) and muscular endurance (d = 0.70, η^2_p =.23). Such results provide strong evidence of the Cooperative Learning intervention as both an educationally and statistically significant.

Table 9. Effect Size Estimates for Main Outcomes

Variable	Cohen's d	Partial η^2	Effect Magnitude
Aerobic Capacity	0.82	0.27	Large
Muscular Endurance	0.70	0.23	Moderate
Motivation	0.95	0.30	Large

This significant motivational effect is consistent with Self-Determination Theory's emphasis on autonomy, competence, and relatedness as psychological drivers of the continuation of participation and performance in education.

As Table 10 demonstrates, the SEM for the relationship between cooperative learning, motivation and physical performance compared with the other models in the same sample was well-adjusted to the data. All the model fit indices were in the range of χ^2/df = 2.41 (< 3.00), CFI = .96 (≥ .90), TLI = .94 (≥ .90), and RMSEA = .05 (≤ .05). These values indicate the parsimonious nature of the proposed mediation model, as well as its theoretical validity, supporting the motivation pathway that was hypothesized.

Table 10. Model Fit Indices for Structural Equation Model (SEM)

Index	Acceptable Range	Observed Value	Interpretation	Model Fit
χ^2/df	< 3.00	2.41	Excellent fit	Acceptable
CFI	≥ .90	.96	Good incremental fit	Good
TLI	≥ .90	.94	Good comparative fit	Good
RMSEA	≤ .05	.05	Close fit	Excellent

The SEM results also show the positive effects of the Cooperative Learning intervention on students' motivation and consequently improvements in physical performance. This indirect effect provides empirical evidence to support the motivational sequence proposed by Self-Determination Theory and serves as a foundation for the study.

Data on descriptive classroom observations indicated many qualitative differences between the classrooms. Observers blind to group allocation reported higher levels of peer support, group problem-solving, shared equipment uses, and verbal encouragement during Cooperative Learning sessions,

creating a more engaging and socially supportive classroom climate. Traditional teacher-led instruction, on the other hand, was characterized by individual practice, limited peer interaction, and teacher-centered communication.

These patterns are descriptive, but complement the quantitative results by emphasizing the importance of cooperative learning for engagement, collaboration, and shared responsibility and thus reinforce the gains in motivation and performance.

Table 11 summarizes the hypothesis testing results. All hypotheses were considered significant to $p < .05$ on the basis of the empirical results.

Table 11. Summary of Hypotheses Testing Result

Hypothesis	Description	Result	Decision
H1	Peer-based CL significantly improves students' physical fitness (aerobic capacity, muscular endurance, flexibility).	F (1,398) values significant at $p < .05$	Supported
H2	Peer-based CL significantly enhances students' motivation and engagement toward physical education.	$F(1,398) = 26.57$, $p < .001$, $\eta^2 = .30$	Supported
H3	The CL intervention has a combined multivariate effect on physical and motivational outcomes.	Wilks' $\Lambda = .86$, $F(3,396) = 21.22$, $p < .001$	Supported

All hypotheses were tested at a significance level of $p < .05$.

These results provide strong empirical evidence of the positive effects that the peer-based Cooperative Learning model has on physical fitness and motivation among secondary school students. This consistency across univariate, multivariate, and structural analyses is sufficient to validate the intervention effects.

Overall, the findings presented in this section indicate that peer-based Cooperative Learning is a powerful teaching tool that can produce real gains in physical performance, learning motivation, and classroom participation. These results provide solid empirical bases for the discussion that follows, considering findings in the literature and theoretical contexts.

Discussion

Using moderate to large effect sizes, significant differences between experimental and control groups in all major variables were found, further demonstrating the educational value of peer-led cooperative learning (CL) programs in supporting both physical and psychosocial development among Palestinian secondary school students in physical education (PE). This observation is consistent with recent research showing benefits of CL for physical performance and psychological outcomes such as motivation, teamwork, and leadership (Boke et al., 2025; Fernández-Espínola et al., 2020) and with local research showing the benefits of student-centered teaching in Jordan and other Arab regions (Hammouri et al., 2016; Khataybeh et al., 2024).

ANCOVA and MANOVA resulted in a positive predictive trend for post-intervention outcomes in the experimental population, and an inverse trend was observed at baseline. ANCOVA results demonstrated significant gains in aerobic capacity ($F (1, 398) = 22.38$, $p < .001$, $\eta^2 = .27$), muscular endurance ($F (1, 398) = 17.41$, $p < .01$, $\eta^2 = .23$), and motivation ($F (1, 398) = 26.57$, $p < .001$, $\eta^2 = .30$). These findings confirm the presence of enhancement in multiple developmental domains at the same time as noted in the significant multivariate MANOVA result (Wilks' $\Lambda = .86$, $F (3, 396) = 21.22$, $p < .001$).

The Cooper test showed that while aerobic capacity of both groups increased, the effects were small to moderate, consistent with previous evidence supporting the importance of aerobic adaptations to training volume and intensity (Boke et al., 2025). However, the greater increases in muscle strength and flexibility observed in the experimental cohort are consistent with the notion that peer accountability,

shared responsibility, and social facilitation provide strategies to support physical effort during PE training (León et al., 2023; Fernández-Espínola et al., 2020).

Regional data further supports these findings. Al-Defaye et al. (2023) found improvements in motor abilities and fitness among younger students, while Hammouri et al. (2016) found improvements in motor abilities and fitness among older students and found that cooperative and mastery-based instruction greatly improved student shot-put. Together, these findings validate the external validity of the present findings in Arab schools and suggest that CL has positive effects for students of all ages and levels of instruction. Consistent with Self-Determination Theory (SDT), which suggests that satisfaction of autonomy, competence, and relatedness increases intrinsic motivation (White et al., 2021), motivation was the outcome with the largest effect size ($\eta^2 = .30$). Similar motivational gains have been reported from previous PE studies that used peer-assisted and cooperative instructional strategies (Sotos-Martínez et al., 2024). Finally, as presented here, this research extends the evidence to show that motivation enhancement can occur as a function of gains in physical fitness rather than as a specific psychological outcome.

These quantitative data were supplemented by qualitative classroom observations indicating that CL promoted self-advocacy and relatedness-rich learning environments, including peer support, group discussion, shared problem-solving, and cooperative task execution (Hinojosa-Torres et al., 2025). The combination of observational and self-report measures reinforces the assumption that Cooperative Learning promotes a positive motivational environment. The CL model is a part of SDT, as well as need-supportive instructional components such as shared goal setting, structured peer feedback, and participatory decision making. Finally, a meta-analysis suggests that cooperative and autonomy-based teaching practices are associated with continued PE participation (Fernández-Espínola et al., 2020; White et al., 2021), along with motivational patterns reported in Arab schools (Frikha et al., 2022). Berdai et al. (2024) also suggest that mutual support may benefit cooperative systems based on collective values in the cultural context as a contextualization of strong motivational effects seen in the present Palestinian sample.

These self-reported outcomes were in addition to classroom observations of greater group coherence and active participation in CL sessions, consistent with research suggesting that cooperative instructional arrangements increase peer interaction and collective engagement (Nguyen & Oanh, 2025). Khataybeh et al. (2024) also reported similar results, with improved gymnastic performance as well as communication and cooperation skills. While regional research findings from Jordan, Saudi Arabia, and Egypt highlight strong differences in co-equivalent and inquiry-based instruction versus traditional instruction (Berdai et al., 2024; Hammouri et al., 2016) indicate that peer-based instructional practices also produce positive effects on physical, academic, and socio-emotional outcomes in school settings (McHale et al., 2022; Wade et al., 2022).

From a theoretical perspective, Self-Determination Theory is a coherent explanation of the findings. The Cooperative Learning intervention bolstered student autonomy through shared decision-making, skills through peer-reviewed instruction, and relatedness through ongoing group support (Fernández-Espínola et al., 2020). Satisfaction of these psychological needs could have mediated both motivational and physical performance gains, as discussed previously by White et al. (2021) and León et al. (2023), which emphasized the mediating role of motivation and positive affect in cooperative learning outcomes. Practically, and backed up by demands for quality PE programming (Dudley et al., 2022), they suggest a way to effectively integrate CL strategies such as role rotation, peer assessment, and shared goal setting into secondary school PE curricula. For this reason, the autonomy-supportive practices and quality of CL implementation are key to the success of cooperative learning because it requires consistent use of positive interdependence and individual accountability (Fernández-Espínola et al., 2020). Given these considerations, Cooperative Learning is a viable and culturally responsive model for improving the quality of Physical Education at Arab secondary schools.

The present study offers several strengths, including a triangulation of physical and psychological outcome measures, a large sample size (N = 400), a quasi-experimental design, and advanced statistical techniques (ANCOVA, MANOVA, SEM). However, there are a few limitations. The eight-week duration of the intervention may have limited the range of long-term physiological adaptations. In addition, the use of intact classes resulted in a clustered data structure that could not be fully modeled statistically, possibly affecting Type I error rates and effect size estimates. In addition, fidelity testing alone does not

reveal how well observed effects could be explained solely by the instructional strategy. Classroom observation data, although informative, were obtained from a checklist provided by the researcher and are not informally classified by inter-rater reliability indices, and thus should be considered descriptive rather than as confirmation.

Future research should incorporate some forms of systematic fidelity monitoring, such as teacher implementation logs or structured observation protocols, and use valid and reliable observation tools. Cluster identifiers would also be retained to allow multilevel modeling to be more precise. Qualitative research on student lived experiences of autonomy, cooperation, and motivation would enrich our understanding of CL processes and cross-national comparisons between Arab educational systems may reveal cultural moderators of the effectiveness of Cooperative Learning interventions.

Conclusions

These results show strong merit in the comparative value of peer-based cooperative learning over teacher-centered teaching in PE secondary schools. The experimental students participating in the structured CL intervention showed significant improvements in muscular endurance, flexibility, intrinsic motivation, and classroom participation compared to the control group. This study provides empirical support for the central assumption that physical and psychological outcomes are better when teachers are not required to teach, but that a facilitated, cooperative, and student-centered approach is used. These gains were supported by more active, collaborative, and well-managed classroom environments during CL sessions in terms of shared responsibility, peer support, and sustained engagement.

The results appear consistent with the local evidence from Arab schools (Berdai et al., 2024) and with other research demonstrating the utility of cooperative learning in physical education in other countries (Boke et al., 2025; Fernández-Espínola et al., 2020; León et al., 2023). One of the strengths of this study is that it has focused exclusively on secondary school students and examined physical fitness, motivation, and behavior related to exercise in one intervention framework, addressing a key lacuna in the literature. This research supports calls for a shift in secondary education as they apply physiological and motivational outcomes.

As described in the previous recommendations of focusing on quality Physical Education instruction (Dudley et al., 2022), these findings suggest that schools should have Cooperative Learning strategies integrated into their PE instruction. This integration should be supported by professional development initiatives targeted at group formation, peer-leadership rotation, cooperative task design, and fidelity of implementation (McHale et al., 2022). Policy-level educational authorities are encouraged to allocate resources and institutional support to support the continued adoption of Cooperative Learning approaches in secondary schools (Zach et al., 2023).

Lastly, although the present results are strong, further research should be undertaken to better understand the long-term effects of Cooperative Learning interventions, including larger and more diverse cross-cultural samples, and to use qualitative methods to capture students' subjective learning experiences. Given the evidence of the motivational benefits of Cooperative Learning for young adults, its development and contextual mechanisms need further investigation (Fernández-Espínola et al., 2020).

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