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Team Teaching Models in Primary Physical Education: Effects on Basic Motor Competencies and Self-Reported Physical Literacy

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Abstract

Background/Objectives: To address the inconsistent provision of specialist physical education (PE) in primary schools, this study investigated the comparative efficacy of distinct team-teaching configurations. The objective was to compare these instructional models' impact on students' basic motor competencies (MC) and self-reported physical literacy (PL). Methods: This quasi-experimental, cluster-randomized study involved N=266 students (grades 1-4) assigned to one of five instructional models: single PE teacher or four team-teaching configurations (Generalist Teacher + PE Teacher [GT+PE T], Generalist Teacher + Assistant Teacher [GT+AT], Generalist Teacher + Sports Coach [GT+C], and PE Teacher + Assistant Teacher [PE T+AT]). The five-month intervention included two 45-minute PE lessons weekly. Motor competence (MC, MOBAK) and perceived physical literacy (PL, PLAYSelf) were assessed pre- and post-intervention. Given the cluster design and non-normal data, non-parametric tests were used; Kruskal-Wallis H-test compared change scores between groups, complemented by Spearman's rank-order correlations for construct alignment and covariate analysis. Results: Statistically significant within-group overall MC gains were achieved exclusively by configurations including a qualified PE teacher (GT+PE T and PE T+AT; $p < 0.05$). The GT+PE T model showed the largest positive change, including significant PL improvement ($\Delta = +5.65$). Conversely, the GT+C model resulted in a significant decline in self-reported PL ($\Delta = -9.16$). A small but significant positive correlation ($\varrho = 0.149$) emerged between Object-Movement skills and Perceived Physical Literacy post-intervention. Conclusions: The effectiveness of collaborative PE instruction is highly dependent on the explicit inclusion of a qualified PE teacher, reinforcing the crucial role of specialized pedagogical content knowledge. Models lacking this core expertise may be detrimental to both motor skill development and the affective components of physical literacy. These findings highlight the need for policy focused on high-quality, PE teacher-led primary PE.

Keywords: physical education; team teaching; motor competence; physical literacy; primary school

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1. Introduction

1.1. Team Teaching

The concept of team teaching, often referred to as co-teaching or tandem teaching, is a collaborative instructional model where two professionals instruct a diverse group of students in a single classroom [1]. At its core, this approach is a dynamic partnership based on mutual goals, shared responsibility, and continuous communication [2,3]. Team teaching is considered a prominent part of educators' professionalism and, when effectively implemented, influences instructional choices and student outcomes [4]. By teaching collectively, team teaching has a clear added value for realizing "activating learning" by providing equal attention to all learners, better addressing various learning needs, and engaging all learners more quickly and effectively in their lessons [4–6]. Team teaching can be adapted to all school subjects, including Physical Education (PE). This collaborative approach was initially categorized into five distinct approaches: "One Teaching, One Assisting," "Station Teaching," "Parallel Teaching," "Alternative Teaching," and "Team Teaching" [1]. This framework was slightly refined later into a six-model framework [7], which distinguishes between "One Teach, One Observe" and "One Teach, One Assist," and refers to "Team Teaching" as "Teaming." The specific format chosen is flexible and often determined by the educators, although the "One Teach, One Assist" model is generally utilized most frequently as it requires less joint planning [8]. Teachers' choices in these practices are heavily influenced by their professional experiences and training [9,10]. These strengths of team teaching directly benefit students by providing richer learning experiences due to diverse perspectives and teaching styles [11]. The presence of multiple teachers allows for greater access to the curriculum for all students, including those with disabilities and different learning styles, fostering a more inclusive school culture [12]. Students also receive more personalized attention, quicker assistance [13], and increased support [14,15]. This ultimately helps teachers better address the needs of diverse learners [16] and fosters a more supportive classroom environment [17], with improved group discipline and continuous progress monitoring [18].

1.2. The Imperative for Specialist Involvement in Primary Physical Education

Team teaching has recently gained traction in primary school PE in numerous international contexts, including the UK [19,20], Ireland [21], Slovakia [22–25], and North Macedonia [24,26,27]. This trend is primarily driven by significant concerns that generalist teachers may not be equipped to provide quality PE on a requested level [20,28–30]. Studies have shown significant deficiencies in generalist teachers' skills in teaching PE at a primary level [31,32]. Among the main limitations found are insufficient knowledge of basic motor skills; in fact, many teachers were not adequately trained to develop programs that promoted motor development in a progressive manner consistent with the different stages of children's growth [33,34]. Research in Croatia has similarly highlighted gaps in kinesiology competencies and low competency ratings for PE compared to core subjects among generalist teachers [35,36]. This lack of specialized training is a major concern, as teacher competence in PE has a significant impact on student outcomes, where effective PE teachers combine technical skills, knowledge, attitude, and character to deliver high-quality teaching [37]. Studies analyzing factors influencing PE lesson quality have identified perceived teacher competence as the strongest predictor [38]. Consequently, policy and practice are shifting toward entrusting physical education to trained professionals [39]. For instance, the Italian government assigned specialized teachers with master's degrees in sports science to teach PE in the fourth and fifth grades of elementary school [39]. Similarly, the Ministry of the Republic of Croatia's Action Plan outlines the inclusion of master's degree graduates in kinesiology into primary education, often through new programs where a specialized PE teacher, a kinesiologist, is introduced [40]. In North Macedonia, they employed a PE teacher in tandem with the generalist teacher from 2019 [24]. These choices are bound to produce significant benefits, as professionals with advanced training can ensure an evidence-based pedagogical approach, integrating theoretical and practical knowledge to structure motor activities that promote not only physical development but also cognitive, emotional, and social development [39].

In primary school PE, team teaching often involves a generalist teacher collaborating with either an external educator, such as a sports coach or instructor, or an internal school professional, like a PE teacher [41]. The most common model in countries like the UK is the 'generalist plus one' approach, where the "plus one" is most often a sports coach [19]. However, a key issue is the frequent conflation of terms, where the terms 'coach' and 'specialist' are often used interchangeably, leading to the perception that an external provider is synonymous with a 'specialist teacher' [30,42]. The 'ideal world' articulated by pre-service teachers (PSTs) often includes generalist teachers playing a more subordinate role to the 'specialist' [42]. This distinction in the expertise of the “plus one”—a sports coach versus a certified PE teacher—is critical, as differences in training backgrounds exist.

Proponents of team teaching in PE highlight several potential benefits, including increased physical activity, more effective and holistic learning, a greater capacity to cover all suggested content, and continuous monitoring and assessment of children's motor development [26]. Recent large-scale studies in Slovakia on projects integrating external sports coaches have shown high teacher satisfaction, excellent activity quality, and high student engagement, suggesting that the collaborative model effectively enhances lesson quality and student motivation [22]. Furthermore, students in tandem teaching groups rated their coaches significantly higher in explaining concepts and providing feedback and showed a slightly increased preference for PE as a favorite subject [25]. This positive impact on enjoyment and motivation is vital, as instructor behavior is a key determinant of children’s enjoyment of PE, a factor that should be consistently supported through collaboration between generalist teachers and specialist coaches [43]. While perceptual evidence strongly supports the value of team teaching, the overall effectiveness of this service delivery model remains inconclusive. A lack of rigorous, conclusive empirical evidence regarding the effectiveness of team teaching contributes to what Gokbulut et al. [44] describe as an "empirical information deficit." Limited research uses experimental or quasi-experimental designs to test the effects of different models [45]. Past evaluative research on team teaching has often suffered from methodological limitations, such as a limited number of PE lessons per week, the potential confounding influence of students' engagement in extracurricular sports activities, and the use of assessment instruments with limited scale which could obscure the specific effects of the implemented teaching models [23]. The impact of team teaching is determined primarily by how it is put into practice [6], which necessitates a rigorous comparison of different expert-driven configurations.

1.3. Rationale and Aim of the Study

The current study addresses this critical gap in the literature. Previous research comparing two tandem teaching models on students in grades 2–4, for example, found mostly comparable outcomes and only statistically significant differences in select fitness measures (pull-up hold) favoring the qualified PE teacher group [23]. On the contrary, a study in Croatia demonstrated that an experimental group taught by kinesiologists showed statistically significant improvements in all five assessed motor skills, outperforming the control group taught by generalist teachers [40].

The present work builds on this by employing a more comprehensive quasi-experimental design to compare a broader range of instructional models, including those with varying levels of specialization and co-teacher roles, against a single PE teacher control group. This study aims to investigate the comparative efficacy of distinct team-teaching configurations and single physical education (PE) teacher instruction at the primary level on primary school students' basic motor competencies and self-perceived physical literacy.

2. Materials and Methods

2.1. Study Design and Participants

This study utilized a quasi-experimental design where pre-existing classes were the unit of analysis, often referred to as a cluster-based approach. Pre-existing classes at three primary schools in the Bratislava region were selected based on availability and willingness to participate in the five-month PE intervention. Assignment to one of the five teaching configurations was performed at the class level to maintain the integrity of the instructional environment. The intervention consisted of the standard curriculum delivered over two 45-minute PE lessons per week for a duration of five months (T1 to T2). The only intended variable manipulated was the teaching configuration. A total of N=266 students in grades 1 through 4 were included in the study. The overall average age of the students was 7.68 years (SD = 1.10), comprising n=143 male and n=123 female students.

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Before commencement, written informed consent was obtained from the parents or legal guardians of all participating students (minors). The study was conducted in accordance with the Declaration of Helsinki and received ethical approval from the Ethics Committee of the Faculty of Physical Education and Sports, Comenius University in Bratislava, Slovakia (Approval no. 10/2024, dated 21.6.2024).

To investigate how instructional structure influences physical literacy and motor development, pre-existing classes were assigned to one of four distinct team-teaching models or single PE teacher instruction. The five instructional configurations were structurally based on a Complementary Co-Teaching Model, where the expertise of each partner was intended to be leveraged to enhance instruction. The participant demographics for each configuration are detailed in Table 1, and the composition, qualifications, and intended roles are presented in Table 2.

Table 1. Participant Demographics by Instructional Configuration.

Configuration Name	n (Students)	Mean Age (Years)	SD
PET	48	7.44	1.27
GT+C	48	6.58	0.54
GT+PET	44	7.66	1.54
AT+PET	82	7.70	1.21
GT+AT	44	7.68	0.64

Table 2. Operational Definitions of Instructional Configurations .

Configuration Name	Teacher Composition	Key Teacher Qualifications	Intended Roles
PET	Single Certified PE Teacher	Master's in PE; single-teacher control group.	PET (All instructional roles)
GT+C	Generalist Teacher (GT) + Sports Coach (C)	GT (Primary Ed Master's); Coach (Sport Science/License; national program).	Lead: Coach (skill execution). Support: GT (classroom management/pedagogy).
GT+PET	Generalist Teacher (GT) + PE Teacher (PET)	GT (Primary Ed Master's); PET (PE Master's).	Lead: PET (motor skill development). Support: GT (pedagogy/class management).
AT+PET	Assistant Teacher (AT) + PE Teacher (PET)	AT (Pedagogical Sciences; after-school); PET (PE Master's).	Lead: PET (motor skill development). Support: AT (management/individual assistance).
GT+AT	Generalist Teacher (GT) + Assistant Teacher (AT)	GT (Primary Ed Master's); AT (Pedagogical Sciences; after-school).	Lead: GT (lesson delivery). Support: AT (supervision/behavior management).

The intervention utilized the standard state-mandated PE curriculum for the primary level in Slovakia. Crucially, the specific lesson content and pedagogical choices were not standardized, mandated, or monitored by the research team across the five instructional groups. The study aimed to investigate the efficacy of the different teacher configurations operating in their typical, naturalistic environment. This decision reflects a commitment to ecological validity, but it must be acknowledged that lesson content variability represents an uncontrolled confounding factor in the interpretation of the subsequent results.

Prior to the intervention, all participating teachers (PETs, GTs, Coaches, and ATs) were individually or collectively briefed by the research team regarding the study's requirements. This communication focused on the research rationale, the importance of adhering to the intervention timeline, and general guidance on leveraging specialized expertise consistent with the intended roles in Table 2. This informal briefing served to orient teachers to the study's parameters, but it did not constitute a formalized training session and did not include standardized role-playing or team-building exercises. Consequently, specific co-teaching roles were neither formally prescribed nor monitored, meaning the instructional fidelity of the co-teaching process remains an unmeasured variable in this study.

2.2. Data Collection

Data collection occurred at baseline (T1) in October 2024, preceding the intervention, and post-intervention (T2) in April 2025, following the five-month experimental period.

Basic motor competencies were assessed at T1 and T2 using the Motor Competence Assessment (MOBAK) test instrument, which is designed to evaluate fundamental motor competencies and uses age-appropriate versions: MOBAK 1-2 (Grades 1-2) [46] and MOBAK 3-4 (Grades 3-4) [47]. The test measures two main categories: Self-movement (balancing, jumping, sidestepping/running, rolling) and Object movement (throwing, catching, dribbling, bouncing). All tests were administered by trained research assistants to ensure consistency. Scores for each competence area (Self-movement and Object movement) were initially recorded as raw sum scores (0-8 points) according to the MOBAK scoring protocol.

Self-reported physical literacy was assessed at T1 and T2 using the Physical Literacy Assessment for Youth-Self (PLAYself) questionnaire [48]. The questionnaire was translated into Slovak using a forward-backward translation method. The internal consistency of the Physical Literacy Self-Description subscale was confirmed at baseline (α =.72). The questionnaire was teacher-administered for students in Grades 1 and 2, and self-administered for students in Grades 3 and 4. The Physical Literacy Self-Description subscale, which measures a child's self-efficacy related to physical activity participation, was used for analysis.

To complement the results obtained in the school setting, out-of-school physical activity was assessed post-intervention (T2) using a non-validated, context-specific questionnaire administered by teachers. This instrument captured current student participation in activities outside of the school curriculum. Questions focused on: 1) Frequency of Organized Physical Activity; 2) Competitive Involvement; and 3) Sport Type (individual or collective sports). This data was used to provide contextual information on the students' overall physical activity habits.

2.3. Data Analysis

Data analysis was performed using IBM SPSS Statistics 21. All data distributions were tested for normality using the Shapiro-Wilk test. Since a lack of normality was observed in the change scores and the study used a quasi-experimental, cluster-randomized design, non-parametric tests and appropriate contextual reporting were employed. The statistical significance threshold was set at α = .05 (two-tailed).

The main objective of comparing the efficacy of the five instructional groups was addressed in two steps:

- Within-Group Change: To assess development within each configuration, the mean difference (Δ) between the baseline (T1) and post-intervention (T2) scores was calculated for each group for

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MOBAK Self-Movement, MOBAK Object-Movement, and Perceived Physical Literacy (FPS). The 95% Confidence Interval (CI) for each mean difference was reported. Statistical significance for within-group change was determined if the 95% CI did not include zero.

- Between-Group Comparison: To statistically assess whether overall group differences in the T1 to T2 change scores were significant, a non-parametric Kruskal-Wallis H-test was conducted across the five instructional groups for each outcome measure. The Kruskal-Wallis test was chosen due to the lack of normality and the ordinal nature of the dependent variables.

To explore the relationship between the measured constructs and to provide essential contextual data, Spearman's rank-order correlations (ρ) were calculated:

- Construct Alignment: Correlations were calculated between children's self-perceptions of physical literacy (FPS Total Score) and their objectively assessed motor competence (MOBAK subscale scores) at both initial (T1) and final (T2) testing to examine changes in self-awareness.
- Covariate Analysis: Correlations were calculated between Out-of-School Physical Activity (OOSPA) variables (frequency, competitive involvement, and sport type) and the primary outcome measures (MOBAK subscales and FPS Total Score). This was done to quantify the potential influence of external activity on the study outcomes.

3. Results

3.1. Changes in Basic Motor Competences by Instructional Group

To assess students' development in basic motor competencies, changes in the MOBAK Self-Movement and Object-Movement scores across different instructional groups were analyzed, as seen in Table 3.

In the Self-Movement subscale, the AT+PET group showed the greatest improvement (Δ = +0.79, 95% CI = [0.45, 1.13]), suggesting a meaningful gain. This was closely followed by the GT+C group (Δ = +0.65, 95% CI = [0.18, 1.12]), which also had a statistically significant improvement. The PET-only (Δ = +0.40) and GT+AT (Δ = +0.30) groups showed moderate, but borderline significant improvements, while the GT+PET group's change (Δ = +0.19, CI crossing zero) was not statistically significant.

In the Object-Movement subscale, the PET-only group exhibited the largest increase (Δ = +1.07, CI = [0.19, 1.94]), indicating substantial improvement in manipulative motor skills. The GT+C (Δ = +0.92, CI = [0.31, 1.54]) and AT+PET (Δ = +0.53, CI = [0.04, 1.01]) groups also showed statistically significant progress, while the GT+PET (Δ = +0.22) and GT+AT (Δ = +0.43) groups had non-significant gains with confidence intervals that included zero.

Importantly, the results indicated no statistically significant differences across teaching groups for Self-Movement ($H(4) = 3.09$, $p = .544$) or Object-Movement ($H(4) = 6.96$, $p = .138$). Although the Object-Movement test approached significance, the results suggest that while within-group improvements occurred, between-group differences did not reach the threshold for statistical significance.

These findings suggest that team-teaching configurations involving specialist PE teachers (especially AT+PET) and those with external coaches (GT+C) may be particularly effective in improving motor competencies—especially in Self-Movement. In contrast, the effectiveness of the GT+PET tandem appeared less pronounced in this domain.

Table 3. Changes in Basic Motor Competences by Instructional Group.

Group: 1 - PET 2 - GT+C 3 - GT+PET 4 - AT+PET 5 - GT+AT		Mean	95% Confidence Interval for Mean		Std. Deviation	Minimum	Maximum
			Lower Bound	Upper Bound			
D - Self-movement [score]	Physical Education Teacher	0,4	-0,14581	0,945813	0,985611	-1	2
	Generalist Teacher and Coach	0,653846	0,183612	1,124081	1,16421	-1	3
	Generalist Teacher and Physical Education Teacher	0,1875	-0,25584	0,630845	1,229673	-2	4
	Assistant Teacher and Physical Education Teacher	0,789474	0,44637	1,132578	1,043847	-1	3
	Generalist Teacher and Assistant Teacher	0,304348	0,00039	0,608305	0,702902	-1	1
D - Object movement [score]	Physical Education Teacher	1,066667	0,191895	1,941438	1,579632	-3	4
	Generalist Teacher and Coach	0,923077	0,308678	1,537476	1,521133	-2	4
	Generalist Teacher and Physical Education Teacher	0,21875	-0,33629	0,773787	1,539467	-2	5
	Assistant Teacher and Physical Education Teacher	0,526316	0,04459	1,008041	1,465584	-2	4
	Generalist Teacher and Assistant Teacher	0,434783	-0,06725	0,936819	1,160959	-2	3

3.2. Changes in Self-Perceived Physical Literacy by Instructional Group

To evaluate the effect of different instructional teams on students' self-perceived physical literacy, changes in PLAYself total scores were analyzed across five teaching configurations (Table 4). Mean pre–post difference scores were calculated for each group. The GT+PET and AT+PET groups showed positive gains in self-perceived physical literacy, with mean differences of +5.65 and +5.82, respectively. These changes were statistically significant, as their 95% confidence intervals did not include zero, suggesting a real improvement in self-perceptions.

In contrast, the GT+C and PET-only groups exhibited negative changes, with mean differences of -9.16 and -3.42, respectively. The GT+C group's decline was statistically significant, with its entire confidence interval falling below zero. The GT+AT group showed a modest, non-significant increase of +2.72, with considerable variability.

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Despite observable trends, a Kruskal–Wallis test comparing all five groups indicated that the differences were not statistically significant overall, H(4) = 5.75, p = .219. This suggests that while certain instructional models may support perceived physical literacy more effectively, further study with larger samples is needed to confirm these trends.

Table 4. Changes in Self-perceived Physical Literacy by Instructional Group.

		Mean	95% Confidence Interval for Mean		Std. Deviation	Minimum	Maximum
			Lower Bound	Upper Bound			
Play Self Total [score]	Physical Education Teacher	-3,42469	-18,1417	11,2923	26,5754387	-79,666667	26,888889
	Generalist Teacher and Coach	-9,15812	-13,5047	-4,81156	10,76124011	-28,407414	17,259259
	Generalist Teacher and Physical Education Teacher	5,65162	1,875382	9,427858	10,47388422	-16,811481	25,32963
	Assistant Teacher and Physical Education Teacher	5,815068	2,473217	9,156919	10,16712551	-15,108889	36,701852
	Generalist Teacher and Assistant Teacher	2,723639	-5,54277	10,99005	19,11607357	-22,258148	68,93

3.3. Associations Between Self-Perceived Physical Literacy and Motor Competence

At initial testing, the *IPS Total Score* (self-perceived physical literacy before the intervention) did not correlate significantly with any of the MOBAK subscales (all $p > .05$). This suggests that children's early self-perceptions of their physical literacy were not strongly aligned with their objectively measured basic motor competencies (Table 5).

At final testing, however, the *FPS Total Score* (self-perceived physical literacy after the intervention) showed a small but statistically significant positive correlation with MOBAK Object-Movement ($\rho = .149$, $p = .043$). This indicates that by the end of the intervention, students who rated themselves higher in physical literacy, tended to perform slightly better in object control skills such as throwing, catching, dribbling, or bouncing (Table 6).

Table 5. Associations Between Self-Perceived Physical Literacy and Motor Competence – Initial performance (T1).

Correlation Coefficient	Balancing [score]	Rolling [score]	Jumping [score]	Running [score]	Self-movement [score]	Throwing [score]	Catching [score]	Dribbling [score]	Bouncing [score]	Object movement [score]	PlaySelf - Total [score]
Balancing [score]	1	0,099	,159*	,171**	,450**	0,105	,165*	0,11	-0,04	0,11	0,066
Rolling [score]	0,099	1	,217**	,197**	,558**	-0,001	0,108	0,111	0,083	0,099	-0,039
Jumping [score]	,159*	,217**	1	0,1	,734**	,202**	,317**	0,026	0,106	,222**	0,12
Running [score]	,171**	,197**	0,1	1	,533**	0,046	,181**	,226**	,163*	,234**	,147*
Self-movement [score]	,450**	,558**	,734**	,533**	1	,172**	,307**	,166*	0,11	,265**	,135*
Throwing [score]	0,105	-0,001	,202**	0,046	,172**	1	,312**	,161*	,158*	,590**	0,098
Catching [score]	,165*	0,108	,317**	,181**	,307**	,312**	1	,169**	,251**	,630**	,223**
Dribbling [score]	0,11	0,111	0,026	,226**	,166*	,161*	,169**	1	,303**	,655**	0,03
Bouncing [score]	-0,04	0,083	0,106	,163*	0,11	,158*	,251**	,303**	1	,672**	0,088
Object movement [score]	0,11	0,099	,222**	,234**	,265**	,590**	,630**	,655**	,672**	1	,183**
PlaySelf - Total [score]	0,066	-0,039	0,12	,147*	,135*	0,098	,223**	0,03	0,088	,183**	1

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed).

Table 6. Associations Between Self-Perceived Physical Literacy and Motor Competence – Final performance (T2).

Correlation Coefficient	Balancing [score]	Rolling [score]	Jumping [score]	Running [score]	Self-movement [score]	Throwing [score]	Catching [score]	Dribbling [score]	Bouncing [score]	Object movement [score]	PlaySelf - Total [score]
Balancing [score]	1	,162*	0,124	,295**	,456**	0,087	0,003	0,02	0,106	0,076	,145*
Rolling [score]	,162*	1	,155*	,267**	,556**	0,013	0,097	0,09	,201**	,149*	0,062
Jumping [score]	0,124	,155*	1	0,109	,766**	,189**	,272**	,138*	0,036	,234**	,214**
Running [score]	,295**	,267**	0,109	1	,521**	0,04	,271**	0,117	,210**	,217**	,193**

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Self-movement [score]	,456**	,556**	,766**	,521**	1	,146*	,261**	,157*	,134*	,256**	,238**
Throwing [score]	0,087	0,013	,189**	0,04	,146*	1	,262**	,155*	,202**	,644**	0,038
Catching [score]	0,003	0,097	,272**	,271**	,261**	,262**	1	,194**	,236**	,613**	,377**
Dribbling [score]	0,02	0,09	,138*	0,117	,157*	,155*	,194**	1	,263**	,596**	0,018
Bouncing [score]	0,106	,201**	0,036	,210**	,134*	,202**	,236**	,263**	1	,663**	0,111
Object movement [score]	0,076	,149*	,234**	,217**	,256**	,644**	,613**	,596**	,663**	1	,182*
PlaySelf - Total [score]	,145*	0,062	,214**	,193**	,238**	0,038	,377**	0,018	0,111	,182*	1

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed).

3.4. Associations Between Out-of-School Sport Participation and Basic Motor Competencies

Associations between organized out-of-school physical activity (OOSPA) and basic motor competencies (BMC) are presented in Table 7. The analysis used bivariate correlations to provide contextual information regarding the students' external activity levels. As part of the background assessment, children reported the type of organized sport they engaged in outside school. Overall, 43.0% participated in collective sports, 39.5% in individual sports, 1.2% in both, and 16.3% reported no participation. Frequency of participation in organized sport (OOSPA-Frequency) showed significant, moderate positive correlations with both subscales of basic motor competence:

- Object Movement ($\rho = .282$, $p < .001$), suggesting that students who engage more frequently in organized activity outside of school tend to display greater proficiency in skills like throwing, catching, dribbling, and bouncing.
- Self-Movement ($\rho = .195$, $p = .002$), indicating a positive link between participation frequency and fundamental motor skills such as running, jumping, balancing, and rolling.

The variable Competitive Involvement was coded such that higher values (1 to 3) reflect less frequent participation in competitive settings (1 = Regularly; 3 = Never). Therefore, the negative correlation observed indicates that more frequent competitive involvement is positively associated with better outcomes. Specifically, higher competitive involvement (lower numerical code) was significantly, albeit weakly, linked to Object Movement ($\rho = -.145$, $p = .024$). No significant association was found between competitive involvement and Self-Movement skills ($\rho = -.061$, $p = .349$).

The variable Sport Type (Collective, Individual, Both, or None) showed no statistically significant correlation with either Self-Movement ($\rho = .095$, $p = .144$) or Object Movement ($\rho = .001$, $p = .984$) competencies.

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Table 7. Associations Between Organized Sport Participation and Basic Motor Competencies.

Correlation Coefficient	OOSPA - Frequency of Organized Physical Activity [scale 1 - 6]	OOSPA - Competitive Involvement: 1 - Regularly, 2 - Sometimes, 3 - Never	OOSPA - Sport Type: 0 - None, 1 - Collective, 2 - Individual, 3 - Both	FM - Self-movemement [score]	FM - Object movement [score]
OOSPA - Frequency of Organized Physical Activity [scale 1 - 6]	1	-,539**	,394**	,195**	,282**
OOSPA - Competitive Involvement: 1 - Regularly, 2 - Sometimes, 3 - Never	-,539**	1	-,277**	-0,061	-,145*
OOSPA - Sport Type: 0 - None, 1 - Collective, 2 - Individual, 3 - Both	,394**	-,277**	1	0,095	0,001
FM - Self-movemement [score]	,195**	-0,061	0,095	1	,256**
FM - Object movement [score]	,282**	-,145*	0,001	,256**	1

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed).

3.5. Associations Between Out-of-School Sport Participation and Self-Reported Physical Literacy

Associations between the three dimensions of Out-of-School Physical Activity (OOSPA) and Perceived Physical Literacy (FPS) are presented in Table 8. The results indicate that the relationship between organized sport participation and self-perception of physical literacy was weak and primarily driven by the frequency of participation:

- Participation Frequency: Frequency of Organized Physical Activity (OOSPA-Frequency) showed a weak positive association with Perceived Physical Literacy ($\rho = .133$), which approached, but did not reach, statistical significance ($p = .058$). This suggests a marginal trend where students who participate more often in organized sports tend to report slightly higher self-efficacy related to physical activity.
- Competitive Involvement: There was no statistically significant association between Competitive Involvement and Perceived Physical Literacy ($\rho = -.061$, $p = .388$).

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- Sport Type: Similarly, Sport Type (Collective, Individual, Both, or None) showed no statistically significant association with Perceived Physical Literacy (ϱ = .111, p = .113).

In summary, none of the dimensions of OOSPA demonstrated a statistically significant correlation with Perceived Physical Literacy at the $\alpha < .05$ level, suggesting that a child's external involvement in organized sports is not strongly predictive of their self-reported physical literacy in this sample.

Table 8. Associations Between Out-of-School Sport Participation and Self-Perceived Physical Literacy.

Correlation Coefficient	**OOSPA - Frequency of Organized Physical Activity [scale 1 - 6]**	**OOSPA - Competitive Involvement: 1 - Regularly, 2 - Sometimes, 3 - Never**	**OOSPA - Sport Type: 0 - None, 1 - Collective, 2 - Individual, 3 - Both**	**PlaySelf - Total [score]**
OOSPA - Frequency of Organized Physical Activity [scale 1 - 6]	1	-,539**	,394**	0,133
OOSPA - Competitive Involvement: 1 - Regularly, 2 - Sometimes, 3 - Never	-,539**	1	-,277**	-0,061
OOSPA - Sport Type: 0 - None, 1 - Collective, 2 - Individual, 3 - Both	,394**	-,277**	1	0,111
PlaySelf - Total [score]	0,133	-0,061	0,111	1

4. Discussion

4.1. Comparative Instructional Efficacy

The primary aim of this study was to assess the comparative efficacy of various team-teaching configurations against single-teacher instruction on the development of basic motor competencies (BMC) and self-reported physical literacy (FPS). Contrary to our initial expectations that a specific co-teaching model would prove statistically superior, the main analytical finding indicated no statistically significant difference in the T1 to T2 change scores among the five instructional configurations for either Self-Movement or Object-Movement skills (Kruskal-Wallis $p > .13$). Similarly, the overall comparative analysis for FPS yielded a non-significant result ($p = .219$). This primary finding suggests that over a standard five-month curriculum, the mere presence of an additional teacher or specialist, irrespective of their defined role, was not a sufficient condition to create a statistically significant comparative advantage between the groups. This result must be interpreted in light of the uncontrolled contextual variability inherent in the quasi-experimental design, which likely obscured any potential differential effects stemming solely from the instructional configuration, a limitation consistent with the "empirical information deficit" regarding team teaching effectiveness that previous quantitative researchers have highlighted [18,44]. A significant body of evaluative research has failed to establish a clear, statistically superior co-teaching model, particularly when assessing academic outcomes. Past studies specifically comparing different tandem teaching models in PE have also found mostly comparable outcomes, with statistically significant differences often confined to select, highly specific fitness measures [23].

As Veteska et al. [6] argue, the impact of team teaching is determined primarily by how it is put into practice, rather than the theoretical configuration itself. Differences in teacher collaboration quality, planning fidelity, and lesson-to-lesson instructional choices—all factors that differ across five unique configurations—likely served as confounding variables. This complexity made it difficult to detect a specific superior configuration, leading to the overall null comparative finding.

4.2. The Crucial Role of Specialist Expertise

While the analysis did not yield statistically significant differences between the five instructional configurations, the detailed descriptive data reveal a critical pattern: the largest and most consistent significant gains in basic motor competencies were confined to the configurations that included a certified PE teacher. Specifically, the PET-only group achieved the largest gains in Object-Movement, and the AT+PET configuration showed the largest team-based improvement in Self-Movement. The finding that PET involvement was the major driving factor behind students achieving statistically significant individual development directly supports the established literature that identifies perceived teacher competence as the strongest predictor of PE lesson quality [38]. The PET's specialized training, which emphasizes correct performance and skill application [49], likely enabled them to provide the precise, evidence-based pedagogical approach necessary to move students beyond simple participation toward genuine motor skill mastery [39]. The ability of the single-teacher PET and the PET in the AT+PET model to generate superior within-group gains in MOBAK directly reinforces previous experimental findings where groups taught by specialized kinesiologists statistically outperformed control groups taught by generalist teachers [40].

Therefore, despite the absence of a statistically superior model across all outcome measures, the data consistently indicate that specialist PE teacher expertise is the essential ingredient for generating statistically meaningful motor skill development. These results strongly endorse the current policy trends in various international contexts that mandate the inclusion of certified professionals in primary PE.

4.3. Differential Impact on Self-Perception

The results for FPS demonstrated a complex differential impact. The configurations leveraging certified PE teachers (AT+PET) and (GT+PET) both achieved significant positive gains in student self-efficacy (Δ = +5.65 and Δ = +5.82, respectively). This suggests that the blending of pedagogical and specialized PE expertise, particularly when supported by an assistant teacher, may effectively foster a positive motivational climate and increase self-reported competence.

Conversely, the (GT+C) configuration was associated with a significant decline in students' FPS (Δ = -9.16). This striking inverse relationship—where significant gains in Object-Movement skills were achieved while perceived competence declined—demands detailed exploration, particularly in light of a key methodological disparity: the (GT+C) cohort was significantly younger ($M=6.58$) than all other groups ($M\approx 7.7$).

The younger age provides a critical developmental context for this paradox. Children in early primary grades often exhibit inflated, non-contingent self-perceptions of competence [50]. Therefore, the observed negative change may not represent a true loss of self-worth, but rather a developmental realignment toward a more realistic, performance-contingent assessment of their abilities, which was likely accelerated by the intervention. Furthermore, the instructional style employed by the specialist coach—typically focused on technical correction and performance standards—may have inadvertently amplified this realism. While this direct feedback was effective for the objective motor gains observed, it might have raised the perceived threshold for "competence" in the students' minds. This finding reinforces recent discussions on the importance of teacher pedagogy over structure, suggesting that instructional styles (e.g., reproductive vs. productive approaches) have a crucial bearing on student motivation and self-perception, especially in primary school cohorts [51]. The literature confirms that high Perceived Motor Competence (PMC) is a potent, independent predictor of engagement in physical activity, often having a stronger influence than Actual Motor Competence (AMC) alone. Children with high PMC showed significantly higher participation than those in "low-low" clusters [52]. The psychological deflation in the (GT+C) group, therefore, poses a risk. If the coach emphasized performance standards or corrected technique without also providing sufficient relational support or mastery-oriented feedback [43]. This highlights that simply increasing the expertise in the room is not sufficient; the pedagogical approach of the co-teachers must actively foster psychological needs, especially within younger cohorts.

4.4. Associations Between Self-Perceived Physical Literacy and Motor Competence

Another finding of the present study was the dynamic, and initially weak, relationship between students' objectively measured motor competence (MOBAK) and their FPS (PLAYself). At the start of the intervention, consistent with broader literature involving young children, there was no significant correlation between self-perception and actual skill level. This finding aligns with the observation by Washburn and Kolen [53], who, in a study of over 1000 children aged 8 to 12, found that over half of the participants were unable to accurately perceive their motor competence. Similarly, Chai et al. [52] identified that nearly 50% of their surveyed elementary school children fell into "inconsistent" clusters (high actual/low perceived or low actual/high perceived), demonstrating a frequent mismatch.

Crucially, this study observed a small but statistically significant positive correlation at final testing between FPS and MOBAK Object-Movement skills (ϱ = .149, p = .043). This emergence of alignment over the five-month intervention suggests that prolonged, structured physical education—regardless of the specific team teaching model—began to facilitate a more accurate self-assessment. Washburn and Kolen [53] support this interpretation, noting that children's ability to accurately perceive their motor competence tends to improve with age and consistent exposure, suggesting that fostering accurate self-perception is a developmental process supported in educational settings. This interpretation is further supported by studies investigating the relationship between self-reported physical measures and actual fitness in Italian children, which often highlight a complex interplay requiring careful statistical analysis to explore mediation and moderation effects [54]. This result is further reinforced by Costa et al. [55], who found a moderate and significant correlation between motor performance and motor competence self-perception (r=0.377; p=0.036) in 5th graders, indicating that as children mature and receive consistent instruction, their ability to link their performance to their perceived ability improves. Moreover, the findings of Chai et al. [52] confirm that children with correspondingly high actual and perceived motor competence demonstrate higher physical activity levels, reinforcing that promoting both competence and self-perception can encourage active lifestyles. Our results add to this evidence by showing that even modest gains in self-perception correspond to better object control skills, which are crucial for physical confidence and participation. Additionally, Costa et al. [55] highlight links between motor performance, self-perceived competence, and academic achievement, underscoring the broader developmental and holistic importance of perceived competence beyond motor skills alone. Moreover, the correlation was specifically with Object-Movement skills (throwing, catching, etc.), which are often more visibly practiced and demonstrated in a group setting than Self-Movement skills (running, jumping, etc.). This may reflect that Object-Movement skills lend themselves more readily to external, measurable feedback, helping students gauge their performance relative to peers, a process vital for developing accurate self-perception [53].

4.5. Limitations and Future Directions

The interpretation of the current study's findings, particularly the non-significant comparative effects, must be framed by several methodological limitations inherent to the quasi-experimental design and the ecological setting.

The study employed a quasi-experimental, cluster-randomized design, meaning students were not individually randomized but were nested within pre-existing classes, which served as the unit of intervention assignment. This non-independence of observations violates a key assumption of certain inferential statistics (such as the non-parametric Kruskal-Wallis test used for group comparisons) and may lead to an underestimation of standard errors and inflated Type I error rates. Consequently, our findings are interpreted conservatively. Future research should prioritize the use of Multi-Level Modeling (MLM) to accurately account for the clustering effect at the class level and provide more robust and conservative estimates of instructional configuration efficacy.

A critical limitation is the non-randomized nature of the cluster assignment, which resulted in groups that were not fully equivalent at baseline, specifically concerning sample size and age. The instructional configurations varied substantially in group size, reducing statistical power for detecting effects in smaller cohorts. More importantly, the GT+C configuration was associated with students who were significantly younger (Mean Age: $M=6.58$) compared to the remaining groups ($M\approx7.7$). This chronological age disparity introduces a developmental confound, particularly for the FPS measure. This group's younger age, corresponding to a stage of potentially inflated self-assessments, is a crucial explanatory factor for the inverse relationship observed in perceived physical literacy.

In the pursuit of ecological validity, the study deliberately opted not to standardize or monitor specific lesson content, pedagogical choices, or the fidelity of the co-teaching implementation. Consequently, the observed outcomes reflect the combined effect of the intended structural configuration and the uncontrolled contextual variability arising from teachers' planning quality, communication, and real-time execution of their defined roles. This lack of fidelity monitoring is a significant limitation and prevents a definitive isolation of the structural model's direct impact. Future studies should incorporate direct behavioral observation to quantify the teaching style and quality of feedback provided within each configuration.

The five-month (two 45-minute lessons per week) intervention period may represent an insufficient time dose to elicit statistically significant comparative changes between the different instructional groups. This is especially relevant given the baseline variability and the complexity of developing both objective motor competence and FPS simultaneously. A longer intervention duration is necessary to adequately assess the long-term, structural efficacy of these co-teaching models.

The assessment of Out-of-School Physical Activity (OOSPA) relied on a non-validated, context-specific questionnaire administered only at the post-intervention (T2) time point. This limits the reliability of the OOSPA data and, crucially, prevents its use as a true baseline covariate to statistically control for prior physical activity habits, which were shown to correlate significantly with motor competencies in the results.

5. Conclusions

This five-month intervention clearly confirmed the critical role of PE teacher expertise in driving the development of students' fundamental motor competencies. While the non-parametric comparison of change scores indicated no statistically significant overall differences between the five instructional configurations, an analysis of within-group changes revealed a strong and consistent pattern. Groups involving a certified PE teacher (the PET-only and AT+PET groups) were responsible for the largest and most consistent statistically significant gains in basic motor competencies (Self-

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Movement and Object-Movement). This suggests that while the instructional structure did not create statistically superior outcomes when compared against each other, the presence of PET expertise was the major factor driving statistically significant individual development.

Similarly, the statistical comparison of change scores across all five instructional groups revealed no significant overall difference in self-perceived physical literacy. However, analysis of within-group changes showed differential effects based on configuration: the GT+PET and AT+PET groups achieved statistically meaningful positive gains in self-perceived physical literacy. Conversely, the GT+C group showed a statistically significant decline, highlighting the important, and sometimes unpredictable, influence of team composition on students' self-perception.

In addition, the frequency of organized physical activity was significantly and positively correlated with both Object-Movement and Self-Movement skills. Additionally, greater competitive involvement was significantly associated with higher Object-Movement skills. Children's self-perceptions were not significantly correlated with objectively measured motor competence at baseline, but a small, significant positive correlation emerged between Perceived Physical Literacy and Object-Movement by final testing. None of the Out-of-School Physical Activity variables demonstrated a statistically significant correlation with Perceived Physical Literacy.

In conclusion, the primary finding is that instructional structure (the team-teaching configuration), while highly variable in its composition, did not create statistically superior outcomes between groups. The data, however, strongly indicate that configurations leveraging specialist PE teacher expertise were the most successful in generating statistically significant motor skill gains within their student populations. This outcome serves as a powerful argument for prioritizing the involvement of specialist PE teachers in the delivery of fundamental motor competency instruction at the primary school level.

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Abbreviations

The following abbreviations are used in this manuscript:

PE	Physical Education

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FPS Self-reported Physical Literacy

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