

PREFACE TO THE EDITION

It is with great pleasure that we present the inaugural issue of the *Eduschool Journal of Physical Education Research Studies (EJPERS)*, a scholarly platform dedicated to advancing research, innovation, and critical discourse in the field of physical education. As contemporary education increasingly recognizes the importance of holistic development, physical education has emerged as a vital domain that nurtures physical competence, cognitive growth, emotional well-being, and social responsibility. This first issue of EJPERS reflects that evolving vision by bringing together research that bridges pedagogy, practice, technology, and learner-centered development in physical education settings.

The articles featured in this issue collectively explore transformative approaches that are reshaping the landscape of physical education. A significant theme emerging across the contributions is the movement from traditional teacher-centered instruction toward more participatory, reflective, and student-centered pedagogies. The comparative study on direct instruction and inquiry-based teaching provides important insights into how different instructional models influence student engagement and physical literacy, highlighting the complementary strengths of varied pedagogical approaches. Similarly, the investigation into the transition from traditional physical education to the Sport Education model examines institutional readiness and pedagogical transformation, emphasizing the importance of teacher preparedness and organizational support in educational reform.

Another major contribution of this issue lies in its focus on assessment and feedback as drivers of meaningful learning. The study on formative assessment strategies demonstrates how structured feedback systems, self-assessment practices, and peer evaluation can significantly enhance motor proficiency, tactical understanding, and metacognitive awareness among learners. Complementing this perspective, the research on teacher feedback quality illustrates the critical role of timely, specific, and constructive feedback in fostering student motivation and performance within sport-based curricula. The issue also highlights the growing relevance of collaborative and socially responsive learning environments in physical education. The article examining peer teaching and cooperative learning underscores how student-centered instructional strategies contribute not only to skill acquisition but also to social competence, teamwork, and positive peer interaction. These findings reinforce the idea that physical education serves as a powerful context for social and emotional learning alongside physical development.

In addition, this issue addresses the increasing integration of technology in educational practice. The study on technology-enhanced pedagogy explores the impact of video analysis tools and wearable technologies on teaching effectiveness, student engagement, and self-regulated learning. Importantly, the findings remind educators that meaningful technological integration must remain grounded in pedagogical purpose rather than technological novelty alone.

Taken together, the contributions in this inaugural issue reflect the dynamic and interdisciplinary nature of contemporary physical education research. They emphasize evidence-based practice, learner engagement, inclusive pedagogy, and innovative instructional design, offering valuable implications for teachers, researchers, curriculum developers, and policymakers alike.

As EJPERS begins its academic journey, we hope this journal will become a vibrant forum for scholarly exchange and a catalyst for advancing quality research in physical education and related disciplines. We extend our sincere gratitude to the authors, reviewers, editorial board members, and all contributors whose dedication and scholarly commitment made this first issue possible.

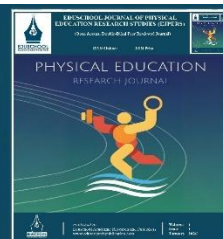
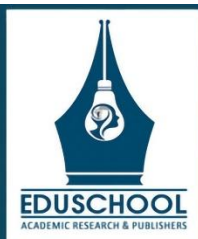
We warmly welcome readers, researchers, and practitioners to engage with the ideas presented in this issue and to join us in strengthening the future of physical education research and practice.

Chief Editor

Dr . Metilda Thomas

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Direct Versus Inquiry-Based Teaching on Engagement And Physical Literacy

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Abstract

This study presents a comparative analysis of direct instruction (DI) and inquiry-based teaching (IBT) models and their respective effects on student engagement and physical literacy development in secondary school physical education (PE). Using a randomized crossover design, 210 students (ages 13–16) from three secondary schools experienced both instructional models across two 8-week units. Student engagement was measured using the Student Engagement Instrument for Physical Education (SEI-PE), systematic observation of academic learning time in PE (ALT-PE), and accelerometry. Physical literacy was assessed through a composite measure incorporating physical competence, knowledge and understanding, motivation and confidence, and daily physical activity behavior. Results revealed that IBT produced significantly higher cognitive engagement ($p < .001$, $d = 0.82$) and affective engagement ($p < .01$, $d = 0.61$), while DI yielded greater motor engagement time ($p < .05$, $d = 0.44$). Physical literacy composite scores favored the IBT condition ($p < .01$, $d = 0.57$), primarily driven by improvements in knowledge, motivation, and confidence domains. The findings suggest that both models have complementary strengths, and an integrated pedagogical approach may best serve physical literacy development.

Keywords: - Direct Instruction, Inquiry-Based Teaching, Student Engagement, Physical Literacy, Physical Education Pedagogy

I. INTRODUCTION

The debate between teacher-centered and student-centered pedagogies has long been central to physical education discourse (Mosston & Ashworth, 2008). Direct instruction (DI), characterized by explicit teacher demonstration, structured practice sequences, and systematic feedback, has traditionally dominated PE teaching due to its efficiency in transmitting motor skills and managing large groups (Rink, 2020). Conversely, inquiry-based teaching (IBT), which encompasses guided discovery, problem-solving, and divergent production approaches, has gained increasing attention for its potential to develop critical thinking, creativity, and deeper understanding of movement concepts (Light, 2013).

The emergence of physical literacy as a holistic educational outcome has intensified this debate. Physical literacy, defined as the motivation, confidence, physical competence, knowledge, and understanding to value and take responsibility for engagement in physical activities for life (Whitehead, 2019), demands pedagogical approaches that extend beyond mere skill acquisition. While DI may efficiently develop physical competence, IBT may be better positioned to cultivate the affective and cognitive dimensions of physical literacy (Dudley, 2015).

Student engagement, a multidimensional construct encompassing behavioral, cognitive, and affective components (Fredricks et al., 2004), is a critical mediator of learning outcomes in PE. Research suggests that different instructional models activate different engagement dimensions, yet few studies have directly compared DI and IBT on comprehensive engagement measures within PE contexts (Chen & Darst, 2001).

This study addresses this gap by conducting a systematic comparison of DI and IBT across multiple engagement dimensions and physical literacy outcomes. The crossover design allows each student to experience both conditions, controlling for individual differences and providing a robust basis for comparison.

II. LITERATURE REVIEW

2.1. Direct Instruction in Physical Education

Direct instruction in PE follows a structured sequence: teacher explanation, demonstration, guided practice, independent practice, and assessment (Rink, 2020). Research consistently demonstrates that DI is effective for developing specific motor skills, particularly during early stages of learning when learners benefit from explicit guidance and modeling (Magill & Anderson, 2017). Silverman et al. (1995) found that DI maximized academic learning time in PE (ALT-PE), a proxy for motor engagement that is strongly correlated with skill improvement.

However, critics argue that exclusive reliance on DI may foster passive learning, limit student autonomy, and fail to develop the metacognitive and problem-solving skills necessary for independent physical activity engagement (Kirk, 2010). Metzler (2017) noted that while DI excels in achieving psychomotor objectives, it may underserve the cognitive and affective domains that are increasingly recognized as essential PE outcomes.

2.2. Inquiry-Based Teaching in Physical Education

Inquiry-based teaching encompasses pedagogical approaches that position students as active constructors of knowledge through exploration, questioning, and problem-solving (Light, 2013). In PE, IBT manifests through teaching styles such as guided discovery, divergent production, and Teaching Games for Understanding (TGfU), which challenge students to develop tactical awareness and movement solutions rather than reproducing predetermined motor patterns (Bunker & Thorpe, 1982).

Research on IBT in PE has yielded promising results. Harvey and Jarrett (2014) conducted a systematic review of game-based approaches and found consistent evidence of improved tactical knowledge, decision-making, and game performance compared to technique-focused approaches. Light and Wallian (2008) demonstrated that inquiry-based pedagogies enhanced student motivation, engagement, and understanding of movement concepts in secondary PE.

However, concerns remain about the efficiency of IBT for developing foundational motor skills, particularly for novice learners who may lack the prerequisite knowledge to engage productively in open-ended inquiry tasks (Kirschner et al., 2006). Additionally, IBT places greater demands on teacher pedagogical content knowledge and classroom management skills (Wright et al., 2005).

2.3. Physical Literacy as an Integrated Outcome

Physical literacy provides a comprehensive framework for evaluating PE outcomes that transcends traditional skill-based measures. Whitehead's (2019) conceptualization encompasses four interrelated domains: physical competence, knowledge and understanding, motivation and confidence, and engagement in physical activity. Edwards et al. (2017) developed assessment tools capturing these domains, enabling researchers to evaluate how different pedagogical approaches contribute to holistic physical literacy development.

III. METHODOLOGY

3.1. Research Design

A randomized crossover design was employed, in which all participants experienced both DI and IBT conditions across two 8-week instructional units. The order of conditions was counterbalanced across classes to control for sequence effects. Unit 1 covered invasion games (basketball/soccer) and Unit 2 covered net/wall games (badminton/volleyball). Half of the classes received DI first and IBT second, while the remaining classes received the reverse order.

3.2. Participants

A total of 210 students (112 males, 98 females; ages 13–16, $M = 14.5$, $SD = 1.2$) from three secondary schools participated. Six PE teachers (3 male, 3 female; mean teaching experience = 9.4 years) delivered both conditions after receiving specialized training in each approach. Students with physical disabilities that prevented full participation were excluded from quantitative analyses but were included in all lessons with appropriate modifications.

3.3. Instructional Conditions

The DI condition followed Rink's (2020) task progression model: teacher demonstration, explanation of key performance criteria, structured practice with progressive complexity, specific corrective feedback, and summative skill assessment. Lessons followed a consistent format of warm-up (10 min), skill instruction and practice (25 min), and application activity (10 min).

The IBT condition employed a TGfU framework (Bunker & Thorpe, 1982) integrated with guided discovery elements. Lessons began with modified game forms that highlighted tactical problems, followed by guided questioning to elicit student understanding, practice tasks designed by students to address identified needs, and return to game play. The teacher's role shifted from demonstrator to facilitator, using questioning strategies to guide student thinking.

3.3. Measures

Student engagement was assessed through three measures:

- The Student Engagement Instrument for PE (SEI-PE; Shen et al., 2012), measuring cognitive, affective, and behavioral engagement via self-report;

- Systematic observation using the ALT-PE instrument (Siedentop et al., 1982) to quantify motor engagement time; and
- Actigraph GT3X accelerometers worn during lessons to measure physical activity intensity.

Physical literacy was assessed using a composite measure adapted from Edwards et al. (2017), incorporating: physical competence (sport-specific skill tests), knowledge and understanding (written tactical/strategic knowledge test), motivation and confidence (Physical Activity Enjoyment Scale and physical self-efficacy scale), and daily physical activity (7-day accelerometry outside PE).

3.4. Data Analysis

Linear mixed-effects models were used to account for the crossover design, with instructional condition as a fixed effect and participant and school as random effects. Period effects and carry-over effects were tested. Effect sizes (Cohen's *d*) were calculated for all comparisons. Significance was set at $p < .05$ with Bonferroni corrections for multiple comparisons.

IV. RESULTS

4.1. Student Engagement

The IBT condition produced significantly higher cognitive engagement scores ($M = 4.12$, $SD = 0.71$) compared to DI ($M = 3.41$, $SD = 0.83$), $t(209) = 8.94$, $p < .001$, $d = 0.82$. Affective engagement was also significantly higher under IBT ($M = 4.28$, $SD = 0.65$) than DI ($M = 3.87$, $SD = 0.74$), $t(209) = 5.71$, $p < .01$, $d = 0.61$. However, DI yielded significantly more ALT-PE motor engaged time ($M = 38.2\%$, $SD = 8.4$) compared to IBT ($M = 33.7\%$, $SD = 9.1$), $t(209) = 3.42$, $p < .05$, $d = 0.44$.

Table 1. Student Engagement Outcomes by Instructional Condition

Engagement Dimension	DI M(SD)	IBT M(SD)	T	p	d
Cognitive (SEI-PE)	3.41 (0.83)	4.12 (0.71)	8.94	<.001	0.82
Affective (SEI-PE)	3.87 (0.74)	4.28 (0.65)	5.71	<.01	0.61
Behavioral (SEI-PE)	3.92 (0.69)	3.98 (0.72)	0.84	.40	0.09
Motor Engaged (ALT-PE %)	38.2 (8.4)	33.7 (9.1)	3.42	<.05	0.44
MVPA minutes/lesson	18.4 (4.2)	16.8 (4.8)	2.87	<.05	0.35

4.2. Physical Literacy Outcomes

The physical literacy composite score was significantly higher under IBT ($M = 72.4$, $SD = 11.2$) compared to DI ($M = 66.8$, $SD = 12.6$), $F(1, 208) = 12.34$, $p < .01$, $d = 0.57$. Domain-level analysis revealed that IBT advantages were concentrated in knowledge and understanding ($d = 0.78$) and motivation and confidence ($d = 0.65$), while physical competence scores did not differ significantly between conditions ($d = 0.18$, $p = .21$).

Table 2. Physical Literacy Domain Scores by Instructional Condition

Physical Literacy Domain	DI M(SD)	IBT M(SD)	F	p	d
Physical Competence	74.2 (13.1)	76.5 (12.8)	1.58	.21	0.18
Knowledge & Understanding	58.4 (14.7)	69.8 (13.2)	28.64	<.001	0.78
Motivation & Confidence	68.3 (11.9)	75.8 (10.4)	18.92	<.001	0.65
Daily PA Behavior	66.4 (15.2)	67.5 (14.8)	0.24	.62	0.07
Composite Score	66.8 (12.6)	72.4 (11.2)	12.34	<.01	0.57

4.3. Moderating Effects

Gender moderated the relationship between instructional condition and affective engagement, with female students showing a larger IBT advantage ($d = 0.81$) compared to males ($d = 0.42$). Prior experience also moderated physical competence outcomes: novice students showed greater skill gains under DI ($d = 0.52$), while experienced students demonstrated comparable skill development across conditions.

V. DISCUSSION

This study provides nuanced evidence regarding the comparative effectiveness of direct and inquiry-based instruction in PE. Rather than identifying a universally superior approach, the findings reveal complementary strengths that inform a more sophisticated understanding of instructional model selection.

The cognitive and affective engagement advantages of IBT align with constructivist learning theory and self-determination theory (Deci & Ryan, 2000). By positioning students as active problem-solvers and decision-makers, IBT inherently supports autonomy and competence needs, fostering deeper investment in the learning process. The substantial effect size for cognitive engagement ($d = 0.82$) is particularly significant given the importance of tactical understanding and strategic thinking in lifelong physical activity participation (Light, 2013).

Conversely, DI's advantage in motor engaged time confirms its efficiency for maximizing practice opportunities, which is especially important for novice learners who require repetition to develop foundational movement patterns (Magill & Anderson, 2017). The finding that novice students benefited more from DI in physical competence aligns with the expertise reversal effect described by Kirschner et al. (2006), whereby explicit instruction benefits learners who lack the prior knowledge to engage effectively in open-ended tasks.

The physical literacy analysis provides perhaps the most important finding: while both models produced comparable physical competence outcomes, IBT significantly enhanced the cognitive and motivational dimensions of physical literacy.

This suggests that exclusive reliance on DI may produce technically proficient but motivationally disengaged students a concerning outcome given that physical literacy aims to foster lifelong physical activity engagement (Whitehead, 2019).

The gender moderation effect suggests that IBT may be particularly beneficial for female students, who have historically reported lower PE engagement and satisfaction (Gibbons, 2009). The collaborative, less competitive nature of IBT environments may create more inclusive participation structures that better serve diverse learner populations.

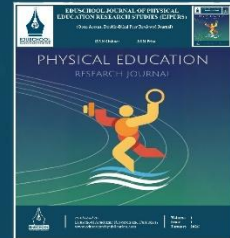
Limitations include the relatively short intervention periods, which may not capture long-term pedagogical effects. The study relied on teachers implementing both conditions, introducing potential contamination effects despite the washout period. Future research should examine optimal sequencing and integration of DI and IBT within single units.

VI. CONCLUSION

This study demonstrates that direct instruction and inquiry-based teaching make distinct but complementary contributions to student engagement and physical literacy development in PE. DI excels in maximizing motor practice time and developing foundational skills for novice learners, while IBT promotes deeper cognitive and affective engagement and enhances the knowledge, motivation, and confidence dimensions of physical literacy. These findings support a pedagogical approach that strategically integrates both models, leveraging DI for skill development phases and IBT for tactical understanding and motivational development. PE teacher education programs should prepare teachers to be proficient in both approaches and to make informed decisions about when and how to deploy each model based on learning objectives, student characteristics, and content demands.

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Formative Assessment Strategies Enhancing Learning Outcomes in K-12 PE Programs

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Abstract

Formative assessment is increasingly recognized as a cornerstone of effective pedagogy, yet its implementation in physical education (PE) remains inconsistent and under-researched compared to classroom-based subjects. This study examines the role of formative assessment strategies in enhancing learning outcomes within K–12 PE programs through a mixed-methods approach combining a systematic review of existing literature ($n = 42$ studies) with an empirical investigation across six schools ($n = 312$ students, grades 3–11). The intervention embedded four formative assessment strategies—learning intentions and success criteria, peer assessment, self-assessment checklists, and descriptive feedback loops—into PE units over 16 weeks. Pre-post comparisons revealed significant improvements in motor skill proficiency ($p < .001$, $d = 0.71$), tactical understanding ($p < .001$, $d = 0.64$), and metacognitive awareness ($p < .01$, $d = 0.58$) in the formative assessment group compared to controls. Teacher interviews ($n = 12$) identified implementation enablers including structured observation tools, student-friendly rubrics, and digital assessment platforms. Barriers included time constraints, large class sizes, and limited professional development. The study concludes that systematic formative assessment integration significantly enhances PE learning outcomes and recommends a phased implementation framework for K–12 programs.

Keywords: - Formative Assessment, Physical Education, Learning Outcomes, K–12, Assessment For Learning

I. INTRODUCTION

Assessment in physical education has historically been dominated by summative practices focused on fitness testing, skill performance scores, and participation grades (Lund & Tannehill, 2015). While summative assessment serves accountability functions, it provides limited information to guide ongoing instruction or support student learning during the educational process. Formative assessment, alternatively described as assessment for learning (AfL), represents a paradigm shift in which assessment information is used by teachers and students to modify teaching and learning activities in real time (Black & Wiliam, 2009).

Black and Wiliam's (1998) seminal review established that formative assessment produces substantial learning gains in classroom subjects, with effect sizes ranging from 0.4 to 0.7. However, the translation of these findings to PE contexts has been slow and uneven. The embodied, dynamic, and often non-verbal nature of PE presents unique assessment challenges that differ fundamentally from academic classrooms (Hay, 2006). Movement performances are transient, occur simultaneously across multiple students, and require specialized observational skills to assess accurately.

Recent curriculum frameworks, including SHAPE America's National Standards (2014) and the Australian Curriculum for Health and Physical Education (ACARA, 2015), emphasize the integration of assessment with instruction. Yet research indicates that many PE teachers lack confidence and training in formative assessment practices, defaulting to informal, unsystematic observation rather than structured assessment for learning approaches (Ni Chroinin & Cosgrave, 2013).

This study addresses this gap by investigating the implementation and impact of structured formative assessment strategies on learning outcomes across K–12 PE programs. The dual methodology systematic review combined with empirical intervention provides both a synthesis of existing evidence and new empirical data to advance understanding of formative assessment in PE.

II. LITERATURE REVIEW

2.1. Conceptual Framework: Assessment for Learning

Formative assessment encompasses a range of practices unified by the principle that evidence of student learning is gathered and used to adapt instruction (Wiliam, 2011). Five key strategies constitute the AfL framework:

- Clarifying and sharing learning intentions and success criteria
- Engineering effective classroom discussions and tasks that elicit evidence of learning
- Providing feedback that moves learners forward
- Activating students as instructional resources for one another
- Activating students as owners of their own learning (wiliam & thompson, 2008).

Each strategy shifts assessment from an event that follows learning to a process embedded within learning.

2.2. Formative Assessment in Physical Education

Research on formative assessment in PE, while growing, remains limited compared to other subject areas. Hay (2006) argued that PE assessment practices must account for the embodied nature of physical learning, requiring observational assessment tools, video analysis, and performance-based rubrics rather than written tests alone. Leirhaug and Annerstedt (2016) found that Norwegian PE teachers who implemented AfL strategies reported improved student motivation and more purposeful teaching, though they also noted challenges in managing assessment within active, movement-based lessons.

Ni Chroinin and Cosgrave (2013) examined formative assessment in Irish primary PE, finding that while teachers valued AfL in principle, practical implementation was hindered by inadequate training, lack of PE-specific assessment tools, and the perception that PE content is less amenable to formal assessment than academic subjects. Similarly, MacPhail and Halbert (2010) reported that AfL in PE requires PE-specific adaptations, including visual rubrics, movement cards, and peer observation frameworks.

Peer assessment has shown particular promise in PE contexts. Johnson (2004) demonstrated that peer assessment of swimming skills improved both assessor and assessee performance, as the observation process deepened understanding of skill criteria. Lounsbury and Coker (2008) found that structured peer feedback in volleyball units enhanced skill execution and tactical decision-making, with students developing greater metacognitive awareness of their own performance through the assessment process.

2.3. Self-Assessment and Metacognition in PE

Self-assessment involves students evaluating their own performance against established criteria, fostering metacognitive skills and self-regulated learning (Zimmerman, 2002). In PE, self-assessment has been linked to improved movement skill accuracy, greater self-awareness, and enhanced goal-setting behaviors (Dyson, 2014). However, the accuracy of student self-assessment in PE depends on the clarity of success criteria and students' developmental level, with older and more experienced students demonstrating greater self-assessment validity (Oslin et al., 1998).

III. METHODOLOGY

3.1. Phase 1: Systematic Review

A systematic review was conducted following PRISMA guidelines. Databases searched included SPORTDiscus, ERIC, PubMed, and Scopus using terms related to formative assessment, assessment for learning, and physical education. Inclusion criteria specified empirical studies published between 2000 and 2024 in English, examining formative assessment interventions in K–12 PE settings. Of 387 initial records, 42 studies met inclusion criteria after screening and quality assessment using the Mixed Methods Appraisal Tool (MMAT).

3.2. Phase 2: Empirical Investigation

A cluster-randomized controlled trial was conducted across six schools (3 intervention, 3 control) with 312 students across elementary (grades 3–5, $n = 124$), middle school (grades 6–8, $n = 104$), and high school (grades 9–11, $n = 84$) levels. The intervention embedded four formative assessment strategies into PE instruction over 16 weeks.

The four strategies were:

- Explicit learning intentions and success criteria shared with students at the start of each lesson using visual displays and student-friendly language;
- Peer assessment using structured observation sheets with criteria aligned to lesson objectives;
- Self-assessment checklists completed by students after practice tasks, incorporating criteria-referenced self-evaluation and goal-setting;
- Descriptive feedback loops in which teacher feedback was criteria-referenced, specific, and accompanied by a forward-looking action step.

Control schools continued with their regular PE instruction and assessment practices. All teachers ($n = 12$, 6 per condition) participated in the study. Intervention teachers received 12 hours of professional development on formative assessment implementation.

3.3. Measures

Learning outcomes were measured across three domains:

- Motor skill proficiency, assessed using standardized skill rubrics validated for each unit (basketball, gymnastics, track and field), with inter-rater reliability > .88;
- Tactical understanding, measured through Game Performance Assessment Instrument (GPAI; Oslin et al., 1998) and written tactical knowledge tests;
- Metacognitive awareness, measured using the Junior Metacognitive Awareness Inventory adapted for PE contexts (Sperling et al., 2002).

Teacher perceptions were gathered through semi-structured interviews and implementation fidelity observations.

3.4. Data Analysis

Multilevel modeling was used to account for the nested data structure (students within classes within schools). Fixed effects included condition (intervention/control), time (pre/post), grade level band, and their interactions. Random intercepts were specified for school and class. Qualitative interview data were analyzed using thematic analysis (Braun & Clarke, 2006). Effect sizes were calculated using Hedges' *g* to account for unequal group sizes.

IV. RESULTS

4.1. Systematic Review Findings

The 42 included studies revealed a clear trend favoring formative assessment approaches in PE. The most commonly implemented strategies were peer assessment (*n* = 18 studies), self-assessment (*n* = 15), teacher descriptive feedback (*n* = 22), and learning intentions/success criteria (*n* = 11). Reported effect sizes ranged from 0.31 to 0.89, with a weighted mean effect of 0.54 across motor skill outcomes and 0.62 across cognitive/affective outcomes. Studies implementing multiple AfL strategies simultaneously reported larger effects than single-strategy studies.

Table 1. Systematic Review Summary: Formative Assessment Strategies in PE

AfL Strategy	Studies (n)	Mean Effect (d)	Range	Primary Outcomes
Peer Assessment	18	0.58	0.34–0.89	Skill execution, tactical knowledge
Self-Assessment	15	0.47	0.31–0.72	Metacognition, goal-setting
Descriptive Feedback	22	0.61	0.38–0.85	Skill improvement, motivation
Learning Intentions/Criteria	11	0.44	0.31–0.63	Task focus, self-regulation
Multi-Strategy	8	0.72	0.54–0.89	Holistic learning outcomes

4.2. Empirical Investigation Results

Multilevel modeling revealed significant condition × time interactions for all three outcome domains, indicating that the formative assessment intervention produced greater pre-to-post gains than the control condition.

Table 2. Learning Outcome Scores by Condition and Time

Outcome	Intervention Pre M(SD)	Intervention Post M(SD)	Control Pre M(SD)	Control Post M(SD)	<i>g</i>	<i>p</i>
Motor Skill Proficiency	52.3 (12.8)	67.1 (10.4)	51.8 (13.1)	57.9 (12.2)	0.71	<.001
Tactical Understanding	38.7 (14.2)	54.6 (12.1)	39.1 (13.8)	45.2 (13.5)	0.64	<.001
Metacognitive Awareness	3.12 (0.74)	3.68 (0.61)	3.08 (0.78)	3.24 (0.72)	0.58	<.01

4.3. Grade Level Differences

The three-way interaction (condition × time × grade level) was significant for metacognitive awareness, $F(2, 304) = 4.12, p < .05$. High school students showed the largest metacognitive gains ($g = 0.78$), followed by middle school ($g = 0.54$) and elementary ($g = 0.38$). Motor skill effects were consistent across grade levels (g range = 0.65–0.76), suggesting that formative assessment benefits skill development equally across the K–12 spectrum.

4.4. Teacher Perceptions

Thematic analysis of teacher interviews yielded four themes:

- Increased instructional intentionality teachers reported that formative assessment practices compelled them to clarify learning objectives and align activities more precisely;
- Enhanced student ownership teachers observed that students became more self-directed and purposeful in their practice when given explicit criteria and self-assessment opportunities;
- Time management challenges all teachers noted the initial time cost of implementing structured assessment, though this diminished with practice;
- Need for PE-specific tools teachers emphasized the importance of visual, movement-based assessment tools rather than adaptations from classroom subjects.

V. DISCUSSION

This study provides converging evidence from both systematic review and empirical investigation that formative assessment strategies significantly enhance learning outcomes in K–12 PE programs. The empirical findings are consistent with the broader AfL literature (Black & Wiliam, 2009) while demonstrating that the effects transfer successfully to movement-based learning contexts.

The robust motor skill effects ($g = 0.71$) indicate that making learning criteria explicit, providing structured opportunities for peer and self-assessment, and delivering criteria-referenced descriptive feedback enhances the quality of practice and accelerates skill acquisition. This aligns with motor learning research emphasizing the role of augmented feedback and error detection in skill refinement (Schmidt & Lee, 2020). When students understand what proficient performance looks like and can evaluate their own performance against clear criteria, they engage in more purposeful, self-regulated practice.

The tactical understanding gains ($g = 0.64$) are particularly noteworthy, as this domain often receives insufficient attention in PE assessment. The formative assessment framework encouraged teachers to make tactical concepts explicit learning objectives rather than assuming they would develop incidentally through game play. The GPAI-based peer assessment process required students to observe and evaluate decision-making, which deepened their own tactical understanding a finding consistent with Johnson's (2004) observation that the assessment process itself is a learning experience.

The developmental trend in metacognitive awareness effects supports the hypothesis that formative assessment's impact on self-regulation increases with cognitive maturity. Older students are better equipped to engage in meaningful self-evaluation and goal-setting, suggesting that self-assessment strategies should be introduced gradually and scaffolded across grade levels (Zimmerman, 2002).

The identified barriers time constraints, large class sizes, and limited professional development echo findings from previous studies (Ni Chroinin & Cosgrave, 2013) and highlight the need for systemic support for formative assessment implementation. The finding that time costs diminished with practice suggests that initial implementation challenges should not be viewed as permanent obstacles but rather as an investment in pedagogical transformation.

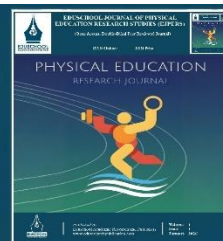
Limitations include the non-random assignment at the student level (cluster randomization at school level), potential Hawthorne effects in the intervention group, and the 16-week duration, which may not capture sustained implementation effects. The study focused on teacher-initiated formative assessment; future research should examine student-initiated assessment practices and the long-term impact on assessment literacy and self-regulated learning in PE.

VI. CONCLUSION

This study establishes that formative assessment is a powerful pedagogical tool for enhancing motor skill proficiency, tactical understanding, and metacognitive awareness in K–12 PE programs. The integration of learning intentions, peer assessment, self-assessment, and descriptive feedback loops creates a learning environment in which students are active participants in the assessment process rather than passive recipients of grades. A phased implementation framework is recommended: Phase 1- establish learning intentions and success criteria; Phase 2-introduce peer assessment with structured tools; Phase 3-implement self-assessment and goal-setting; Phase 4-develop comprehensive descriptive feedback practices. This sequenced approach, supported by PE-specific professional development and assessment tools, can transform assessment from an afterthought to a central driver of learning in physical education.

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Transition from Traditional PE to Sport Education: Readiness and Outcomes

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Abstract

The Sport Education model (SE) has been proposed as a transformative alternative to traditional physical education (TPE), yet the transition between these approaches presents significant pedagogical, institutional, and cultural challenges. This study examines the transition from TPE to SE across 10 secondary schools, investigating teacher readiness, student outcomes, and institutional challenges through a longitudinal mixed-methods design spanning two academic years. Teacher readiness was assessed using a purpose-designed PE Pedagogical Change Readiness Scale ($n = 32$ teachers), while student outcomes ($n = 548$) were measured across skill development, game performance, personal-social responsibility, and PE enjoyment. Institutional challenges were identified through administrator interviews ($n = 10$) and school context analysis. Results indicate that teacher readiness significantly predicted implementation fidelity ($r = .72, p < .001$), which in turn mediated student outcomes. SE produced superior outcomes in game performance ($d = 0.68$), enthusiasm ($d = 0.74$), and personal-social responsibility ($d = 0.61$) compared to TPE. However, skill acquisition showed no significant difference between models ($d = 0.14, p = .31$). Key institutional barriers included scheduling constraints, equipment needs, colleague resistance, and assessment alignment with standardized requirements. A staged transition framework is proposed, incorporating teacher development, structural modifications, and stakeholder engagement strategies.

Keywords: - Sport Education, Traditional Physical Education, Pedagogical Transition, Teacher Readiness, Student Outcomes

I. INTRODUCTION

Physical education has faced persistent criticism for its failure to achieve its stated aims of developing physically literate, lifelong participants in physical activity (Kirk, 2010). The dominant multi-activity, teacher-directed model here termed traditional physical education (TPE) has been characterized as promoting superficial engagement with brief sport units that provide insufficient time for meaningful skill development, tactical understanding, or genuine sport appreciation (Siedentop, 1994). In response, curriculum models such as Sport Education (SE) have been developed to provide more authentic and educationally rich sport experiences within PE.

Sport Education, developed by Siedentop (1994) and elaborated in subsequent work (Siedentop et al., 2011), aims to create competent, literate, and enthusiastic sportspersons through six key features: seasons (extended units), affiliation (persistent team membership), formal competition, culminating events, record keeping, and festivity. These features are designed to replicate the authentic elements of sport participation that are absent from typical PE instruction, creating contexts where students develop not only skills and tactics but also the social and affective dispositions associated with meaningful sport involvement.

Despite three decades of research supporting SE's effectiveness (Hastie et al., 2011), widespread adoption has been limited. The transition from TPE to SE requires fundamental changes in teacher roles, lesson structures, assessment practices, and school organizational patterns that may meet resistance at individual, departmental, and institutional levels (Curtner-Smith

et al., 2008). Understanding the dynamics of this transition is essential for scaling SE implementation beyond research-supported demonstration sites.

This study addresses three research questions:

- What factors constitute teacher readiness for SE implementation, and how does readiness relate to implementation fidelity?
- How do student outcomes under SE compare with TPE across skill development, game performance, personal-social responsibility, and enjoyment?
- What institutional challenges emerge during the transition from TPE to SE, and how can they be addressed?

II. LITERATURE REVIEW

2.1. The Sport Education Model

Research on SE has accumulated substantially since its introduction. Hastie et al. (2011) conducted a comprehensive review of 64 SE studies, concluding that SE consistently produces positive outcomes in student enthusiasm, fair play behaviors, and game performance, with more equivocal findings for motor skill development. The model's emphasis on persistent team membership and student roles (coach, captain, referee, statistician) promotes social responsibility and leadership development (Wallhead & O'Sullivan, 2005).

Comparative studies between SE and TPE have generally favored SE for affective and social outcomes. Perlman (2010) found that unmotivated students showed significant increases in intrinsic motivation under SE but not TPE, suggesting that the model's structural features particularly team affiliation and role responsibility may address disengagement among students who find traditional PE unappealing. Hastie and Sinelnikov (2006) demonstrated that SE seasons in Russian secondary schools produced greater tactical competence and more equitable participation compared to traditional instruction.

2.2. Teacher Readiness for Pedagogical Change

The concept of teacher readiness for implementing new pedagogical models extends beyond content knowledge to encompass beliefs, attitudes, self-efficacy, and contextual factors (Curtner-Smith et al., 2008). Research on SE implementation has identified teacher biography—including their own sport experiences, coaching backgrounds, and pedagogical socialization as a significant factor shaping implementation fidelity (McMahon & MacPhail, 2007).

Ko et al. (2006) found that teachers' occupational socialization experiences heavily influenced their willingness and ability to implement SE. Teachers whose own PE experiences aligned with teacher-directed models found the shift to student-centered pedagogy particularly challenging, often reverting to direct instruction during perceived 'loss of control' moments. Conversely, teachers with coaching experience adapted more readily to SE's game-centered, team-based structure.

Deenihan and MacPhail (2017) examined the process of SE implementation by pre-service teachers, identifying a developmental trajectory from mechanical replication of SE features to sophisticated pedagogical adaptation. This trajectory was influenced by mentor support, school context, and the pre-service teacher's developing understanding of the model's theoretical foundations.

2.3. Institutional Challenges

The implementation of SE is not merely a pedagogical decision but an institutional one that intersects with scheduling, facility allocation, assessment policies, and departmental culture (MacPhail et al., 2014). SE's requirement for extended seasons (typically 15–20 lessons) conflicts with the short-unit scheduling common in many schools. Team-based assessment may not align with individual reporting requirements. The student-led nature of SE may be perceived as inconsistent with school disciplinary expectations.

III. METHODOLOGY

3.1. Research Design

A longitudinal mixed-methods design was employed across two academic years. Year 1 served as a baseline (TPE) and readiness assessment period. In Year 2, five schools transitioned to SE (transition group) while five continued with TPE (comparison group). The staggered design allowed within-school and between-school comparisons.

3.2. Participants

Ten secondary schools participated, selected for diversity in size (enrollment 400–1,200), socioeconomic context, and geographic location. Thirty-two PE teachers (18 male, 14 female; mean experience = 10.8 years, SD = 6.2) and 548 students (287 male, 261 female; ages 13–16) were included. Transition group teachers received 20 hours of SE professional development including theoretical foundations, planning workshops, micro-teaching, and ongoing mentoring.

3.3. Teacher Readiness Assessment

The PE Pedagogical Change Readiness Scale (PE-PCRS) was developed and validated for this study. The instrument comprises five subscales:

- Pedagogical beliefs alignment (8 items; $\alpha = .88$)
- Self-efficacy for student-centered teaching (7 items; $\alpha = .84$)

- Content knowledge for SE (6 items; $\alpha = .81$)
- Openness to pedagogical change (5 items; $\alpha = .79$)
- Perceived institutional support (6 items; $\alpha = .86$).

Confirmatory factor analysis supported the five-factor structure (CFI = .94, RMSEA = .05).

3.4. Student Outcome Measures

Four student outcome domains were assessed:

- Skill development sport-specific skill tests (validated rubrics, ICC > .87) for the sports covered in each unit (soccer, volleyball);
- Game performance Game Performance Assessment Instrument (GPAI; Oslin et al., 1998) measuring decision-making, skill execution, and support play;
- Personal-social responsibility Personal and Social Responsibility Questionnaire (PSRQ; Li et al., 2008);
- PE enjoyment Physical Activity Enjoyment Scale adapted for PE (PACES-PE; Kendzierski & DeCarlo, 1991).

Assessments were administered at the beginning and end of each sport unit.

3.5. Implementation Fidelity

SE implementation fidelity was assessed using the SE Benchmark Fidelity Instrument (Sinelnikov, 2009), evaluating the presence and quality of the six SE features. Each feature was rated on a 4-point scale (0 = absent, 3 = fully implemented with quality). Total fidelity scores ranged from 0 to 18. Three independent observers rated fidelity with inter-rater reliability of .91.

3.6. Qualitative Data

Semi-structured interviews were conducted with all 32 teachers (pre- and post-intervention) and 10 school administrators. Student focus groups (n = 24 groups, 4–6 students each) were conducted in transition schools. All interviews were audio-recorded, transcribed, and analyzed using thematic analysis (Braun & Clarke, 2006).

IV. RESULTS

4.1. Teacher Readiness and Implementation Fidelity

PE-PCRS total scores ranged from 2.18 to 4.62 (M = 3.54, SD = 0.61) among transition group teachers. Teacher readiness was strongly correlated with implementation fidelity ($r = .72, p < .001$). The strongest predictor of fidelity was self-efficacy for student-centered teaching ($\beta = .41, p < .001$), followed by perceived institutional support ($\beta = .33, p < .01$). Teachers with higher readiness scores achieved mean fidelity scores of 14.2/18 (high implementers) compared to 8.7/18 for those with lower readiness (low implementers).

Table 1. Teacher Readiness Subscale Scores and Correlations with Implementation Fidelity

PE-PCRS Subscale	M (SD)	Correlation with Fidelity	p
Pedagogical Beliefs	3.72 (0.68)	.58	<.001
Self-Efficacy	3.41 (0.74)	.67	<.001
Content Knowledge	3.28 (0.82)	.51	<.01
Openness to Change	3.89 (0.64)	.44	<.01
Institutional Support	3.38 (0.91)	.62	<.001
Total PE-PCRS	3.54 (0.61)	.72	<.001

4.2. Student Outcomes

Comparison of SE and TPE conditions on student outcomes revealed significant advantages for SE in game performance, enjoyment, and personal-social responsibility, but not skill development.

Table 2. Student Outcomes by Instructional Model

Outcome Domain	SE Pre M(SD)	SE Post M(SD)	TPE Pre M(SD)	TPE Post M(SD)	d	p
Skill Development	48.2 (13.4)	62.7 (11.8)	47.8 (12.9)	61.1 (12.4)	0.14	.31
Game Performance (GPAI)	41.3 (14.1)	62.8 (11.2)	40.8 (13.7)	52.4 (13.8)	0.68	<.001
PE Enjoyment (PACES)	3.42 (0.81)	4.24 (0.62)	3.38 (0.84)	3.61 (0.79)	0.74	<.001
Personal-Social Resp.	3.18 (0.72)	3.87 (0.58)	3.21 (0.69)	3.38 (0.71)	0.61	<.001

4.3. Implementation Fidelity as Mediator

Mediation analysis confirmed that implementation fidelity significantly mediated the relationship between teacher readiness and student outcomes. For game performance, the indirect effect through fidelity was $\beta = .34, p < .001$ (95% CI [.21, .47]). For enjoyment, the indirect effect was $\beta = .29, p < .001$ (95% CI [.16, .42]). High-fidelity SE classrooms (fidelity ≥ 14) produced significantly stronger effects (mean d = 0.82) compared to low-fidelity SE classrooms (mean d = 0.31), underscoring the importance of quality implementation.

4.4. Institutional Challenges

Thematic analysis identified five major institutional challenges during the TPE-to-SE transition:

4.4.1. Scheduling constraints:

SE's requirement for extended seasons (15–20 lessons) conflicted with existing scheduling models. Schools with rotating timetables found it particularly difficult to guarantee the continuous blocks needed for meaningful season progression. Three of five transition schools required scheduling modifications to accommodate SE seasons.

4.4.2. Assessment alignment:

Teachers reported tension between SE's emphasis on team-based performance, social responsibility, and game understanding and school assessment policies requiring individual, standards-based grades. Developing assessment rubrics that captured SE's broader learning outcomes while satisfying reporting requirements was a significant challenge.

4.4.3. Colleague and departmental resistance:

In schools where not all PE teachers adopted SE, departmental tensions emerged regarding curriculum coherence, shared facility use, and differing pedagogical philosophies. Non-adopting colleagues sometimes viewed SE as 'less rigorous' or 'letting students play without teaching.'

4.4.4. Equipment and facility demands:

The simultaneous operation of multiple teams within SE required more equipment and often more complex facility arrangements than TPE. Schools with limited equipment budgets or shared facilities found this particularly challenging.

4.4.5. Student role adaptation:

Students accustomed to teacher-directed instruction required significant time to develop the self-management skills needed for SE roles (captain, coach, referee). Initial lessons were often characterized by confusion and off-task behavior, which some teachers interpreted as evidence that SE was 'not working' rather than a normal developmental phase.

Table 3. Institutional Challenges During TPE-to-SE Transition

Challenge	Schools Affected (n/5)	Severity (1-5 M)	Resolution Strategy
Scheduling constraints	5	4.2	Block scheduling, semester restructuring
Assessment alignment	4	3.8	SE-specific rubrics, portfolio assessment
Colleague resistance	3	3.4	Department workshops, observation visits
Equipment/facility	4	3.1	Equipment rotation, modified game formats
Student role adaptation	5	3.6	Gradual role introduction, scaffolding

V. DISCUSSION

This study provides a comprehensive examination of the transition from TPE to SE, revealing that successful implementation depends on an interplay of teacher readiness, institutional support, and implementation fidelity. The strong relationship between teacher readiness and implementation fidelity ($r = .72$) confirms that pedagogical change is not merely a matter of providing new curriculum materials but requires genuine shifts in teacher beliefs, self-efficacy, and professional identity (Curtner-Smith et al., 2008).

The student outcome findings largely corroborate previous SE research (Hastie et al., 2011). SE's advantages in game performance ($d = 0.68$) reflect the model's emphasis on tactical decision-making within authentic game contexts, where students develop understanding through repeated application rather than isolated drill practice. The enjoyment advantages ($d = 0.74$) align with self-determination theory, as SE's structural features team affiliation, role responsibility, meaningful competition inherently support autonomy, competence, and relatedness needs (Perلمان, 2010).

The absence of significant differences in skill development challenges the assumption that SE's reduced emphasis on direct instruction compromises motor skill acquisition. This finding is consistent with Hastie and Sinelnikov's (2006) conclusion that SE seasons provide sufficient practice opportunities within game contexts to develop sport-specific skills at rates comparable to direct instruction approaches. However, this equivalence may depend on implementation fidelity and the teacher's ability to embed skill instruction within the SE framework.

The institutional challenges identified illuminate the systemic nature of pedagogical change. The finding that scheduling was the most severe barrier ($M = 4.2/5$) reflects a fundamental tension between SE's pedagogical requirements and the organizational structures of schools designed around short, rotating units. Curriculum leaders and administrators play a crucial role in creating conditions that enable rather than constrain innovative PE practice (MacPhail et al., 2014).

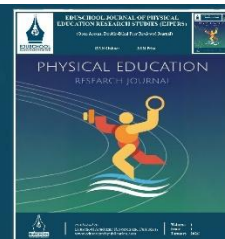
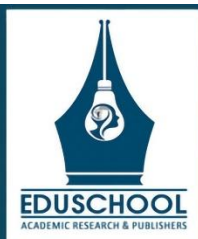
Limitations include the non-random assignment of schools to conditions, the potential influence of researcher involvement on implementation quality, and the focus on secondary schools, which limits generalizability to primary or higher education contexts. The two-year duration, while longer than most SE studies, may not capture full institutionalization patterns. Future research should examine multi-year implementation trajectories and the sustainability of SE outcomes beyond the research period.

VI. CONCLUSION

The transition from traditional PE to Sport Education is a complex process that requires coordinated attention to teacher readiness, student adaptation, and institutional restructuring. This study proposes a staged transition framework: Stage 1 (Foundation) assess teacher readiness and provide targeted professional development addressing identified gaps; Stage 2 (Pilot) implement SE in one sport unit with high-readiness teachers while maintaining TPE for other units; Stage 3 (Expansion) extend SE to additional units and teachers, with peer mentoring from experienced implementers; Stage 4 (Institutionalization) embed SE within department policy, assessment frameworks, and scheduling structures. This graduated approach, supported by ongoing professional learning communities and administrative engagement, can facilitate sustainable pedagogical transformation that enhances student outcomes in game performance, enjoyment, and personal-social responsibility while maintaining comparable skill development.

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Teacher Feedback Quality and Student Motivation in Sport-Based PE curricula

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Abstract

Teacher feedback is a critical instructional variable in physical education (PE), yet the relationship between feedback quality and student motivational and performance outcomes in sport-based curricula remains insufficiently understood. This study investigated how different dimensions of teacher feedback quality—specificity, timing, valence, and congruence—relate to student motivation and motor performance in secondary school sport-based PE programs. A multi-method design combined systematic observation of teacher feedback behaviors ($n = 18$ teachers, 864 lessons) with student surveys ($n = 428$) and motor performance assessments. Structural equation modeling revealed that feedback specificity ($\beta = .42, p < .001$) and congruence with learning objectives ($\beta = .38, p < .001$) were the strongest predictors of intrinsic motivation, which in turn mediated the relationship between feedback quality and performance improvement (indirect effect $\beta = .26, p < .001$). Immediate feedback was more effective for simple skills, while slightly delayed feedback benefited complex skill learning. Positive-corrective feedback (combining encouragement with specific correction) produced superior outcomes compared to purely positive or purely corrective feedback. The findings provide evidence-based guidelines for optimizing teacher feedback practices in sport-based PE curricula.

Keywords: - Teacher Feedback, Feedback Quality, Student Motivation, Motor Performance, Sport-Based Physical Education

I. INTRODUCTION

Feedback is widely regarded as one of the most powerful influences on learning and achievement (Hattie & Timperley, 2007). In physical education, teacher feedback serves multiple functions: providing information about performance errors, reinforcing successful execution, motivating continued effort, and guiding learners toward desired movement outcomes (Rink, 2020). Despite its acknowledged importance, research on feedback in PE has historically focused on frequency and type (e.g., general vs. specific, positive vs. corrective) while paying insufficient attention to the multidimensional nature of feedback quality and its motivational implications (Koka & Hein, 2003).

Sport-based PE curricula present unique feedback demands. Unlike traditional multi-activity PE programs, sport-based approaches such as Sport Education (Siedentop et al., 2011) emphasize extended engagement with specific sports, creating contexts where feedback must support progressive skill development, tactical sophistication, and team dynamics over sustained periods. The quality of feedback in these extended units may be particularly consequential for maintaining student motivation and facilitating skill refinement beyond initial learning stages.

Self-determination theory (SDT; Deci & Ryan, 2000) provides a robust framework for understanding how feedback quality influences motivation. SDT posits that intrinsic motivation is fostered when environments support three basic psychological needs: competence, autonomy, and relatedness. Feedback that is specific, informational, and delivered in an autonomy-supportive manner enhances perceived competence and intrinsic motivation, while controlling or vague feedback may undermine these needs (Mouratidis et al., 2008).

This study aims to advance understanding of the feedback-motivation-performance relationship in sport-based PE by:

- Developing and validating a multidimensional framework for assessing teacher feedback quality
- Examining which feedback dimensions most strongly predict student motivation and performance
- Identifying moderating factors that influence the effectiveness of different feedback approaches.

II. LITERATURE REVIEW

2.1. Dimensions of Feedback Quality

Hattie and Timperley's (2007) model of effective feedback identifies four levels: task, process, self-regulation, and self. Task-level feedback addresses the correctness of performance, process-level feedback targets the strategies used, self-regulation feedback encourages self-monitoring and adjustment, and self-level feedback (e.g., 'good girl!') provides personal evaluation without performance information. Research consistently indicates that task and process-level feedback produce greater learning gains than self-level feedback (Kluger & DeNisi, 1996).

In PE contexts, Silverman et al. (1992) identified specificity as a key quality dimension, distinguishing between general feedback ('good job') and specific feedback ('your follow-through extended fully toward the target'). Specific feedback provides actionable information that guides subsequent performance attempts, whereas general feedback offers motivational support without instructional content. Magill (1994) further distinguished between knowledge of results (KR, outcome information) and knowledge of performance (KP, movement process information), noting that KP is generally more beneficial for complex motor skill acquisition.

2.2. Feedback and Motivation in PE

The relationship between teacher feedback and student motivation in PE has been examined through several theoretical lenses. Koka and Hein (2003) found that perceived positive general feedback and positive nonverbal feedback significantly predicted intrinsic motivation in PE. Mouratidis et al. (2008) demonstrated that positive informational feedback (combining encouragement with specific performance information) enhanced intrinsic motivation and effort, while positive but controlling feedback ('you did well, as you should') had weaker effects.

Nicaise et al. (2006) revealed gender differences in PE feedback patterns, with teachers providing more technical feedback to boys and more organizational feedback to girls. This differential feedback was associated with gender disparities in perceived competence and motivation, highlighting the equity implications of feedback quality. Koka and Hein (2005) further showed that the congruence between feedback content and students' personal goals moderated the motivation-feedback relationship.

2.3. Feedback Timing and Motor Skill Learning

The timing of feedback has important implications for motor learning. Traditional research supported immediate feedback for skill acquisition (Adams, 1971), but more recent work suggests a more nuanced picture. Swinnen (1996) proposed that immediate feedback benefits early learning stages by providing error correction, while delayed or reduced-frequency feedback enhances learning by promoting self-error detection and self-regulation. In PE settings, the practical challenge is that delayed feedback may lose its connection to the specific performance attempt, particularly when students are continuously active (Lee et al., 1994).

III. METHODOLOGY

3.1. Participants and Context

Eighteen PE teachers (10 male, 8 female; mean experience = 11.3 years, SD = 5.7) and their students (n = 428; 224 male, 204 female; ages 13–17, M = 15.1, SD = 1.3) from six secondary schools participated. All schools implemented sport-based PE curricula featuring extended sport units (basketball, soccer, volleyball, badminton) of 8–10 weeks duration. Schools were purposively selected to represent urban, suburban, and rural contexts.

3.2. Data Collection

Teacher feedback behaviors were systematically observed and coded during 864 lessons (48 lessons per teacher) using a purpose-designed Teacher Feedback Quality Instrument (TFQI) developed for this study. The TFQI codes feedback along four dimensions:

- Specificity (general, specific-KR, specific-KP);
- Timing (immediate ≤ 5 sec, short delay 5–30 sec, delayed > 30 sec);
- Valence (positive, corrective, positive-corrective combined);
- Congruence (aligned with stated learning objectives vs. unrelated).

Two trained observers coded all lessons with inter-observer agreement exceeding 92% across all categories (Cohen's $\kappa = .87$).

Student motivation was assessed using the Situational Motivation Scale adapted for PE (SIMS-PE; Guay et al., 2000), measuring intrinsic motivation, identified regulation, external regulation, and amotivation. Student perceived feedback quality was measured using a 16-item instrument adapted from Koka and Hein (2003). Motor performance was assessed through sport-specific skill tests (validated rubrics with ICC $> .90$) and game performance (GPAI; Oslin et al., 1998) at the beginning and end of each sport unit.

3.3. Data Analysis

Structural equation modeling (SEM) using Mplus 8.0 was employed to test the hypothesized relationships between feedback quality dimensions, student motivation, and performance outcomes. Multilevel SEM accounted for the nested data structure (students within classes within teachers). Moderation analyses examined the effects of student gender, skill level, and sport type on feedback effectiveness. Model fit was evaluated using CFI, TLI, RMSEA, and SRMR criteria.

IV. RESULTS

4.1. Descriptive Feedback Patterns

Teachers delivered an average of 64.3 feedback statements per lesson (SD = 18.7). The predominant feedback type was general positive (38.2%), followed by specific-KP (22.4%), specific-KR (15.1%), corrective (14.8%), and positive-corrective (9.5%). Only 52.3% of feedback statements were congruent with the stated learning objectives for the lesson. Immediate feedback constituted 61.4% of all statements, short-delay 28.3%, and delayed 10.3%.

Table 1. Descriptive Summary of Teacher Feedback Patterns (N = 864 lessons)

Feedback Dimension	Category	Frequency (%)	M per Lesson (SD)
Specificity	General	38.2%	24.6 (8.1)
	Specific-KR	15.1%	9.7 (4.3)
	Specific-KP	22.4%	14.4 (5.8)
Valence	Positive only	47.6%	30.6 (9.2)
	Corrective only	14.8%	9.5 (4.1)
	Positive-Corrective	9.5%	6.1 (3.2)
Timing	Immediate	61.4%	39.5 (11.4)
	Short delay	28.3%	18.2 (6.8)
	Delayed	10.3%	6.6 (3.9)
Congruence	Aligned	52.3%	33.6 (10.7)
	Unrelated	47.7%	30.7 (9.8)

4.2. Structural Equation Model

The SEM demonstrated good fit (CFI = .952, TLI = .941, RMSEA = .048, SRMR = .039). Feedback specificity was the strongest predictor of intrinsic motivation ($\beta = .42, p < .001$), followed by congruence with learning objectives ($\beta = .38, p < .001$). Feedback valence, specifically positive-corrective feedback, predicted intrinsic motivation ($\beta = .31, p < .001$) more strongly than purely positive ($\beta = .18, p < .01$) or purely corrective ($\beta = .12, p < .05$) feedback. Intrinsic motivation significantly mediated the feedback-performance relationship (indirect effect $\beta = .26, p < .001$), accounting for 58% of the total effect.

Table 2. Structural Equation Model Path Coefficients

Path	β	SE	p	95% CI
Specificity → Intrinsic Motivation	.42	.06	<.001	[.30, .54]
Congruence → Intrinsic Motivation	.38	.07	<.001	[.24, .52]
Positive-Corrective → Intrinsic Motivation	.31	.06	<.001	[.19, .43]
Positive Only → Intrinsic Motivation	.18	.05	<.01	[.08, .28]
Corrective Only → Intrinsic Motivation	.12	.05	<.05	[.02, .22]
Intrinsic Motivation → Performance	.62	.05	<.001	[.52, .72]
Indirect: Specificity → Perf.	.26	.05	<.001	[.16, .36]
Indirect: Congruence → Perf.	.24	.05	<.001	[.14, .34]

4.3. Moderation Effects

Timing moderated the feedback-learning relationship as a function of skill complexity. For simple, discrete skills (e.g., volleyball serve), immediate feedback produced the largest performance gains ($d = 0.72$). For complex, continuous skills (e.g., basketball dribble-drive), short-delay feedback was more effective ($d = 0.61$ vs. $d = 0.43$ for immediate). Gender moderated the relationship between feedback valence and motivation: female students were more responsive to positive-corrective feedback ($\beta = .44$) than males ($\beta = .22$), while males responded more strongly to corrective-only feedback ($\beta = .28$) than females ($\beta = .08$).

Skill level also moderated feedback effects. Low-skilled students benefited most from specific-KP feedback ($d = 0.81$) and positive-corrective valence ($d = 0.74$), while high-skilled students showed greater responsiveness to specific-KR feedback ($d = 0.58$) and showed no differential effect of valence. These patterns suggest that feedback should be tailored to both the skill complexity and the learner's developmental stage.

V. DISCUSSION

This study advances understanding of teacher feedback in sport-based PE by demonstrating that feedback quality is multidimensional and that different quality dimensions have differential effects on motivation and performance. The finding that specificity and congruence are the strongest predictors of intrinsic motivation has important practical implications. Nearly half (47.7%) of observed feedback was incongruent with lesson objectives, representing substantial missed learning opportunities. Teachers may benefit from structured planning that explicitly aligns anticipated feedback messages with learning intentions.

The superiority of positive-corrective feedback over purely positive or purely corrective feedback supports Mouratidis et al.'s (2008) findings and aligns with SDT predictions. Positive-corrective feedback simultaneously satisfies competence needs (by acknowledging successful elements) and provides informational content (by identifying areas for improvement), creating an optimal motivational and instructional combination. The finding that general positive feedback constituted the largest category (38.2%) yet was a weaker motivational predictor suggests that PE teachers' natural feedback tendencies may not align with evidence-based best practices.

The mediating role of intrinsic motivation confirms the theoretical pathway from feedback quality through motivation to performance. This has important implications for PE practice: feedback practices that undermine intrinsic motivation, even if technically accurate, may produce short-term compliance but fail to develop the sustained engagement necessary for long-term skill development and physical activity participation (Hagger & Chatzisarantis, 2007).

The gender and skill-level moderation effects highlight the need for differentiated feedback approaches. The finding that female students respond more positively to combined positive-corrective feedback suggests that embedded encouragement may be particularly important for maintaining female engagement in sport-based PE, where gender-based confidence gaps have been documented (Nicaise et al., 2006). Similarly, the differential effectiveness of KP versus KR feedback across skill levels underscores the importance of adapting feedback content to the learner's developmental stage.

Limitations include the observational nature of the feedback-motivation link, which precludes causal claims. Teacher awareness of being observed may have altered feedback behaviors (Hawthorne effect). The study focused on verbal feedback and did not examine nonverbal or gestural feedback, which constitutes a significant portion of PE teacher communication. Future research should examine feedback in non-sport PE contexts and employ experimental designs to establish causal relationships.

VI. CONCLUSION

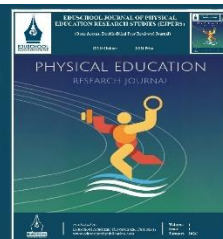
This study establishes that teacher feedback quality in sport-based PE is a multidimensional construct with significant implications for student motivation and performance. The evidence supports four key recommendations for PE teachers:

- Prioritize specific feedback (KP for novices, KR for advanced learners) over general praise.
- Combine positive and corrective elements within feedback statements.
- Ensure feedback is congruent with stated learning objectives.
- Adapt feedback timing to skill complexity.

Pre-service and in-service teacher education should emphasize feedback quality rather than feedback frequency, equipping teachers with the skills to deliver feedback that is simultaneously informative, motivating, and aligned with instructional goals.

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Technology-Enhanced Pedagogy And Teaching Effectiveness in Physical Education

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Abstract

The integration of technology into physical education (PE) has accelerated significantly, yet systematic evidence regarding its impact on teaching effectiveness remains fragmented. This study examines how technology-enhanced pedagogy—specifically video analysis tools and wearable activity monitors—influences teaching effectiveness in secondary PE settings. A mixed-methods design incorporated a 14-week quasi-experimental intervention across eight schools (n = 384 students, 16 teachers), comparing technology-enhanced instruction with conventional instruction. Teaching effectiveness was operationalized through student learning outcomes (motor skill proficiency, physical activity levels, cognitive understanding), instructional quality indicators (feedback precision, lesson pacing, individualization), and student engagement metrics. Results showed that video analysis integration significantly improved motor skill acquisition ($d = 0.66, p < .001$) and teacher feedback specificity ($d = 0.83, p < .001$). Wearable technology enhanced student self-regulation of physical activity intensity ($d = 0.72, p < .001$) and enabled data-driven instructional adjustments. However, technology use reduced active learning time during initial implementation phases. Teacher interviews revealed that effective technology integration requires pedagogical purposefulness rather than technological novelty. The findings support a TPACK-based framework for technology integration in PE that prioritizes pedagogical goals over technological capabilities.

Keywords: - Technology-Enhanced Pedagogy, Video Analysis, Wearable Technology, Teaching Effectiveness, Physical Education, TPACK

I. INTRODUCTION

The proliferation of digital technologies has transformed educational practice across disciplines, and physical education is no exception (Casey et al., 2017). Video analysis applications, wearable activity monitors, mobile fitness apps, digital assessment platforms, and augmented reality tools offer unprecedented opportunities to enhance PE teaching and learning. The global wearable technology market in education is projected to reach \$4.2 billion by 2026, reflecting the growing adoption of these tools in school settings (Grand View Research, 2021).

Despite enthusiasm for educational technology, research in PE has consistently warned against techno-centric approaches that prioritize technological novelty over pedagogical purpose (Juniu, 2011). The Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) provides a theoretical foundation for understanding effective technology integration, emphasizing that technology must be interwoven with content knowledge and pedagogical knowledge rather than treated as an add-on. In PE, this means technology should serve specific movement learning objectives and enhance rather than replace embodied physical experiences.

Video analysis has emerged as one of the most promising technologies for PE. By enabling students and teachers to observe, analyze, and review movement performances, video technology bridges the gap between kinesthetic experience and visual understanding (Palao et al., 2015). Wearable activity monitors (e.g., heart rate monitors, accelerometers, GPS trackers) provide real-time physiological data that can inform both instruction and student self-regulation (Dauenhauer et al., 2019).

This study addresses the need for rigorous, contextualized evidence regarding the impact of these two prominent technologies on teaching effectiveness in PE. Unlike previous studies that examined technology in isolation, this investigation positions technology within the broader framework of pedagogical practice, examining how technology reshapes teacher behaviors, student engagement, and learning outcomes simultaneously.

II. LITERATURE REVIEW

2.1. Video Analysis in Physical Education

Video analysis technology in PE encompasses applications ranging from simple video replay to sophisticated motion analysis software. Palao et al. (2015) conducted a systematic review of video feedback in sport and PE contexts, finding consistent positive effects on skill performance (mean $d = 0.58$) and technical understanding. The effectiveness of video feedback was moderated by the complexity of the skill analyzed, the frequency of video review, and whether guided observation protocols accompanied video viewing.

Kretschmann (2015) examined the use of tablet-based video analysis in secondary PE gymnastics. Students who used slow-motion video replay to analyze their own performances demonstrated significantly greater improvement in movement quality compared to verbal-feedback-only groups. Importantly, the study found that video analysis was most effective when combined with structured observation tasks and peer discussion, suggesting that the pedagogical design surrounding video use is as important as the technology itself.

O'Loughlin et al. (2013) explored teachers' perspectives on video technology integration in PE, identifying three key factors for successful implementation: teacher confidence with technology, alignment with pedagogical goals, and adequate time for meaningful video review within lesson structures. Teachers who viewed video as a pedagogical tool rather than a technological novelty reported more sustainable and effective integration.

2.2. Wearable Technology in Physical Education

Wearable activity monitors have gained traction in PE for their ability to provide objective, real-time data on student physical activity levels (Dauenhauer et al., 2019). Heart rate monitors, in particular, have been used to support individualized intensity monitoring, allowing students to work within personalized target zones rather than responding to uniform intensity prescriptions (Mohsen, 2012).

Lee et al. (2019) investigated the impact of Fitbit wearables on middle school students' physical activity during PE. Students wearing activity trackers demonstrated significantly higher moderate-to-vigorous physical activity (MVPA) levels and greater awareness of their activity patterns. However, the novelty effect diminished over time, suggesting that sustained engagement requires embedding wearable data into meaningful learning tasks rather than simple step-counting.

Goc Karp and Woods (2008) cautioned that technology should not reduce PE to a data collection exercise. They argued that wearable technology in PE should support the development of health-related fitness knowledge and self-management skills rather than replacing the joy of movement with screen-focused monitoring. This concern underscores the need for pedagogically grounded approaches to wearable technology integration.

2.3. TPACK Framework for PE Technology Integration

The TPACK framework (Mishra & Koehler, 2006) identifies the intersection of technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK) as essential for effective technology integration. In PE, TPACK requires understanding how specific technologies can represent and transform movement concepts (TCK), how technologies can support specific teaching strategies (TPK), and how all three knowledge domains interact to create effective technology-enhanced learning experiences (Krause & Lynch, 2018).

Gibbone et al. (2010) applied the TPACK framework to PE teacher education, finding that pre-service teachers who developed TPACK competencies were significantly better at designing technology-enhanced PE lessons than those who received technology training without the pedagogical integration component. This suggests that TPACK-based professional development may be a prerequisite for effective technology use in PE.

III. METHODOLOGY

3.1. Research Design

A quasi-experimental pretest-posttest control group design with embedded qualitative components was employed. Eight secondary schools were paired by demographic characteristics and randomly assigned to technology-enhanced (TE, $n = 4$ schools) or conventional instruction (CI, $n = 4$ schools) conditions. The intervention lasted 14 weeks, covering two sport/activity units per condition.

3.2. Participants

A total of 384 students (198 male, 186 female; ages 13–17, $M = 15.0$, $SD = 1.4$) and 16 PE teachers (8 per condition; mean experience = 8.7 years) participated. TE teachers received 16 hours of TPACK-based professional development covering video analysis applications (Coach's Eye, Dartfish Express) and wearable technology (Polar heart rate monitors, ActiGraph accelerometers).

3.3. Technology Integration Protocol

The TE condition integrated two technology strands:

- Video Analysis students recorded and analyzed their own and peers' skill performances using tablet-based applications. Structured observation protocols guided video review, and annotated video clips were used for self-assessment and goal-setting. Video analysis was integrated into 2–3 lessons per week;
- Wearable Monitors students wore heart rate monitors during all lessons, with personalized target zones displayed on a classroom screen. Students used wearable data to self-regulate intensity and reflected on activity patterns in post-lesson learning journals.

The CI condition used identical curriculum content and learning objectives but employed conventional instruction without technology. Both conditions addressed identical content standards and assessment criteria.

3.4. Measures

Teaching effectiveness was measured across three domains:

- Student learning outcomes: motor skill proficiency (validated sport-specific rubrics, ICC > .89), physical activity levels (ActiGraph GT3X worn by all students in both conditions during 4 assessment lessons), and cognitive understanding (written knowledge tests on tactics and fitness concepts);
- Instructional quality: teacher feedback precision (coded using the TFQI), lesson pacing (SOFIT time allocation analysis), and instructional individualization (differentiation frequency count);
- Student engagement: SEI-PE survey, on-task behavior observation, and technology engagement quality rubric (TE group only).

3.5. Data Analysis

MANCOVA was used for between-group comparisons with baseline scores as covariates. Multilevel modeling accounted for the nested data structure. Effect sizes (Cohen's *d*) were calculated for all comparisons. Teacher interviews (*n* = 16, semi-structured, 45–60 min) were analyzed using thematic analysis. Implementation fidelity was assessed through lesson observation checklists.

IV. RESULTS

4.1. Student Learning Outcomes

Table 1. Student Learning Outcomes by Condition

Outcome	TE Pre M(SD)	TE Post M(SD)	CI Pre M(SD)	CI Post M(SD)	<i>d</i>	<i>p</i>
Motor Skill Proficiency	54.2 (11.8)	68.7 (9.4)	53.8 (12.1)	61.3 (11.2)	0.66	<.001
MVPA (min/lesson)	16.8 (4.7)	22.4 (3.9)	17.1 (4.5)	18.6 (4.8)	0.72	<.001
Cognitive Understanding	42.1 (15.3)	64.8 (12.7)	41.6 (14.8)	54.2 (14.1)	0.58	<.001
Self-Regulation Score	2.84 (0.72)	3.81 (0.58)	2.91 (0.69)	3.14 (0.71)	0.89	<.001

4.2. Instructional Quality Indicators

The TE condition demonstrated significant improvements in teacher feedback specificity. Video analysis enabled teachers to provide more precise, criteria-referenced feedback based on observable evidence rather than real-time impressions. TE teachers delivered 42.3% specific-KP feedback compared to 18.7% in the CI condition (*d* = 0.83, *p* < .001). However, TE lessons initially showed reduced active learning time (ALT-PE motor engaged: TE = 31.4% vs. CI = 37.8% in weeks 1–4), which equalized by weeks 9–14 as technology routines became established (TE = 38.2% vs. CI = 37.1%).

Table 2. Instructional Quality Indicators by Condition

	TE M(SD)	CI M(SD)	<i>d</i>	<i>p</i>
Specific-KP Feedback (%)	42.3 (8.4)	18.7 (6.9)	0.83	<.001
Feedback Aligned to Objectives (%)	71.4 (9.2)	48.6 (11.3)	0.72	<.001
Individualized Tasks per Lesson	4.8 (1.7)	2.1 (1.3)	0.64	<.001
ALT-PE Motor Engaged (Weeks 1-4, %)	31.4 (7.8)	37.8 (6.4)	-0.44	<.01
ALT-PE Motor Engaged (Weeks 9-14, %)	38.2 (6.1)	37.1 (6.8)	0.08	.62

4.3. Student Engagement

The TE condition produced significantly higher cognitive engagement (*M* = 4.18, *SD* = 0.64 vs. *M* = 3.52, *SD* = 0.78; *d* = 0.71, *p* < .001) and affective engagement (*M* = 4.31, *SD* = 0.59 vs. *M* = 3.89, *SD* = 0.71; *d* = 0.54, *p* < .01). Behavioral engagement did not differ significantly between conditions. Qualitative data indicated that video analysis promoted metacognitive engagement, with students actively analyzing their movement patterns and setting specific improvement goals.

4.4. Teacher Perceptions

Thematic analysis of teacher interviews yielded five themes:

- Pedagogical purposefulness effective integrators consistently asked 'What learning problem does this technology solve?' before deploying tools;

- Initial time investment all TE teachers reported that technology routines required significant setup time that diminished with practice;
- Data-driven differentiation wearable data enabled teachers to identify students who were consistently under- or over-exerting, facilitating targeted interventions;
- Student empowerment video and wearable data gave students tangible evidence of their progress, enhancing self-efficacy and ownership of learning;
- Infrastructure barriers reliable Wi-Fi, device storage, charging logistics, and technical support were persistent practical challenges.

V. DISCUSSION

This study provides comprehensive evidence that technology-enhanced pedagogy can significantly improve teaching effectiveness in PE when integrated with pedagogical purposefulness. The differential effects of video analysis and wearable technology illuminate distinct mechanisms through which technology enhances PE teaching and learning.

Video analysis primarily enhanced the quality of instructional interactions. By enabling teachers and students to observe movement performances repeatedly and in slow motion, video technology transformed the feedback process from reliance on fleeting real-time observations to evidence-based analysis (Palao et al., 2015). The dramatic increase in specific-KP feedback (42.3% vs. 18.7%) suggests that video analysis addresses a fundamental challenge in PE instruction: the difficulty of providing precise movement feedback during dynamic, multi-student lessons. This finding aligns with and extends Kretschmann's (2017) work on video-enhanced skill analysis.

Wearable technology primarily enhanced student self-regulation and physical activity intensity. The large effect size for self-regulation scores ($d = 0.89$) indicates that real-time biometric feedback empowers students to take ownership of their activity levels, a crucial component of health-related physical literacy (Dauenhauer et al., 2019). The MVPA improvement ($d = 0.72$) demonstrates that wearable technology can address the persistent challenge of insufficient physical activity during PE lessons.

The initial reduction in active learning time in the TE condition is an important finding that confirms practitioner concerns about technology disrupting the flow of physical activity. However, the equalization by weeks 9–14 suggests this is a transitional cost rather than a permanent trade-off. This finding has important implications for implementation timelines and teacher expectations during technology adoption periods.

The TPACK framework proved essential for effective integration. Teachers who approached technology as a pedagogical tool asking what learning problems technology could solve achieved better outcomes than those who viewed technology as an end in itself. This finding reinforces Juniu's (2011) warning against techno-centrism and supports the position that technology professional development in PE must be grounded in pedagogical purpose rather than technical skill alone.

Limitations include the quasi-experimental design, potential Hawthorne effects, the focus on only two technology types, and the 14-week duration, which may not capture long-term sustainability. The cost and infrastructure requirements of the technology used may limit generalizability to under-resourced schools. Future research should examine long-term adoption patterns, cost-effectiveness, and the impact of emerging technologies such as augmented reality and AI-powered movement analysis.

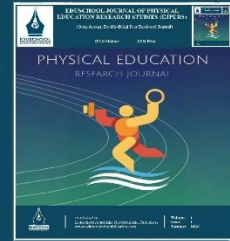
VI. CONCLUSION

Technology-enhanced pedagogy significantly improves teaching effectiveness in PE when guided by pedagogical purpose and supported by adequate professional development. Video analysis enhances feedback precision and motor skill acquisition, while wearable technology promotes student self-regulation and physical activity engagement. The key to effective technology integration lies not in the technology itself but in its alignment with clear learning objectives, seamless embedding within lesson routines, and purposeful use by teachers who possess strong TPACK competencies. PE programs should adopt a phased implementation approach, investing in teacher TPACK development before technology deployment and allowing sufficient time for technology routines to become established classroom practices.

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Peer Teaching and Cooperative Learning on Skill and Social Competence in PE

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Abstract

Peer teaching and cooperative learning represent student-centered pedagogical strategies with significant potential for physical education (PE), yet their combined and independent effects on skill development and social competence among adolescent learners remain inadequately understood. This study investigated the effectiveness of three instructional conditions—peer teaching (PT), cooperative learning (CL), and teacher-directed instruction (TDI)—on motor skill development and social competence in secondary school PE. A randomized controlled trial with 276 students (ages 13–16) across four schools employed a 12-week intervention during badminton and volleyball units. Motor skill proficiency was assessed using validated sport-specific rubrics and the Test of Gross Motor Development-3 (TGMD-3). Social competence was measured through the Social Skills Improvement System (SSIS), peer sociometric ratings, and systematic observation of prosocial behaviors during PE. Results indicated that CL produced the highest gains in social competence ($d = 0.79$, $p < .001$) and comparable skill development to TDI ($d = 0.12$, $p = .42$). PT yielded significant skill gains for both tutors ($d = 0.71$) and tutees ($d = 0.54$), with tutors showing the greatest metacognitive improvements. All student-centered conditions produced higher levels of positive peer interactions compared to TDI. The findings support the integration of peer teaching and cooperative learning as complementary strategies that develop both motor and social outcomes in adolescent PE.

Keywords: - Peer Teaching, Cooperative Learning, Skill Development, Social Competence, Adolescent Physical Education

I. INTRODUCTION

Physical education serves as a unique context for social development, providing opportunities for peer interaction, teamwork, conflict resolution, and leadership within physically active settings (Bailey et al., 2009). However, the extent to which PE fulfills its social development potential depends largely on the instructional structures employed. Teacher-directed instruction (TDI), while efficient for skill transmission, may limit meaningful peer interaction and collaborative problem-solving opportunities that foster social competence (Dyson & Casey, 2016).

Peer teaching and cooperative learning are two student-centered strategies that explicitly leverage social interaction as a mechanism for both cognitive and social learning. Peer teaching involves students taking instructional roles to guide their peers' learning, while cooperative learning structures learning tasks so that students must work together interdependently to achieve shared goals (Johnson & Johnson, 2009). Both approaches align with Vygotsky's (1978) social constructivist theory, which posits that learning is fundamentally a social process mediated through interaction with more capable others.

In PE, peer teaching has been shown to benefit both tutors and tutees. Tutors develop deeper understanding of skills through the process of explanation and demonstration, while tutees receive more individualized attention than is possible in teacher-led instruction (Ward & Lee, 2005). Cooperative learning in PE has been associated with improved skill performance, positive interdependence, and enhanced social relationships (Dyson, 2002). However, most studies have examined these strategies in isolation, and few have directly compared their independent and combined effects on both skill development and social competence in adolescent populations.

This study addresses this gap by comparing peer teaching, cooperative learning, and teacher-directed instruction across both motor and social outcome domains. Adolescence represents a particularly important developmental period for this

investigation, as peer relationships assume heightened significance and social competence becomes increasingly linked to psychological well-being and school engagement (Harter, 2012).

II. LITERATURE REVIEW

2.1. Peer Teaching in Physical Education

Peer teaching in PE encompasses several formats, including reciprocal teaching (Mosston & Ashworth, 2008), cross-age tutoring, class-wide peer tutoring (CWPT), and peer-assisted learning strategies (PALS). The common element is the assignment of instructional responsibility to students, who provide feedback, demonstrate skills, and support peers' learning within structured frameworks.

Ward and Lee (2005) conducted a meta-analysis of peer-mediated instruction in PE, reporting a weighted mean effect size of 0.62 for motor skill outcomes. The analysis revealed that structured peer teaching programs with trained tutors and clear assessment criteria produced larger effects than informal peer interaction. Importantly, tutors often benefited more than tutees, consistent with the 'protégé effect' described in educational psychology literature, whereby the act of teaching deepens the instructor's own understanding (Chase et al., 2009).

Ernst and Byra (1998) examined reciprocal teaching in PE, finding that students in the observer/feedback role developed superior analytical skills and movement understanding compared to those in the performer role alone. This suggests that the observational and communicative demands of peer teaching engage cognitive processes that complement the kinesthetic learning occurring during practice.

However, the quality of peer teaching varies considerably depending on tutor preparation, task structure, and the clarity of observation criteria. Poorly structured peer teaching may result in inaccurate feedback, social loafing, and reinforcement of errors (D'Arripe-Longueville et al., 2002). Effective peer teaching programs require explicit tutor training, structured observation protocols, and teacher monitoring to ensure quality interactions.

2.2. Cooperative Learning in Physical Education

Cooperative learning (CL) is distinguished from simple group work by five essential elements: positive interdependence, individual accountability, promotive interaction, social skills instruction, and group processing (Johnson & Johnson, 2009). In PE, CL structures have been implemented through jigsaw activities, think-pair-share, group investigation, and learning teams approaches (Dyson & Casey, 2016).

Dyson (2002) conducted pioneering research on CL in PE, demonstrating that elementary students in CL conditions showed greater improvement in motor skill performance and more positive social interactions compared to traditionally taught groups. Subsequent work by Dyson and Strachan (2004) confirmed these findings with adolescent learners, noting that CL particularly benefited students who were typically marginalized in PE due to low skill levels or social status.

Casey and Goodyear (2015) conducted a systematic review of CL research in PE, identifying 28 studies published between 1996 and 2014. The review found consistent positive effects on social skills, moderate effects on motor skill development, and emerging evidence for cognitive and affective benefits. The authors noted that implementation quality was a critical moderating factor, with studies reporting high-fidelity CL implementation demonstrating substantially larger effects.

2.3. Social Competence Development Through PE

Social competence encompasses the ability to initiate and maintain positive relationships, cooperate effectively, resolve conflicts constructively, and demonstrate empathy and prosocial behavior (Rose-Krasnor, 1997). In PE, social competence is developed through interactions during partner and group activities, game play, and structured peer learning opportunities (Bailey et al., 2009).

Hellison's (2011) Teaching Personal and Social Responsibility (TPSR) model provides a developmental framework for social outcomes in PE, progressing through levels of irresponsibility, self-control, involvement, self-direction, and caring. While TPSR is typically implemented as a standalone model, its principles can be integrated within peer teaching and CL frameworks to create conditions that simultaneously target motor and social development.

III. METHODOLOGY

3.1. Research Design

A cluster-randomized controlled trial was conducted with classes as the unit of randomization. Twelve classes from four schools were randomly assigned to three conditions (4 classes per condition): peer teaching (PT), cooperative learning (CL), and teacher-directed instruction (TDI). The 12-week intervention covered two sport units: badminton (weeks 1–6) and volleyball (weeks 7–12), with each unit comprising 12 lessons of 50 minutes.

3.2. Participants

A total of 276 adolescent students (148 male, 128 female; ages 13–16, $M = 14.4$, $SD = 1.1$) participated. Four PE teachers (2 male, 2 female; mean experience = 9.2 years) each taught one class per condition, controlling for teacher effects. All teachers received specialized training in PT and CL strategies (12 hours) and implemented all three conditions according to detailed lesson protocols.

3.3. Instructional Conditions

Peer Teaching (PT): Students were paired based on complementary skill levels (one higher-skilled, one lower-skilled). Pairs alternated between performer and observer/coach roles within each lesson. Tutors received training in observation skills,

feedback delivery (using criteria cards), and encouragement strategies. Task cards specified key performance criteria for observation and feedback.

Cooperative Learning (CL): Students worked in heterogeneous groups of four, with structured roles (performer, observer, recorder, encourager) that rotated across lessons. The jigsaw method was employed for skill learning (each group member learned one component skill and taught it to the group), and Learning Teams were used for game-play units (teams practiced together toward collective improvement goals). Five CL elements were explicitly structured: positive interdependence (shared group goals), individual accountability (individual skill assessments contributing to group scores), promotive interaction (face-to-face discussion requirements), social skills instruction (explicit teaching of communication, encouragement, conflict resolution), and group processing (end-of-lesson reflection on group functioning).

Teacher-Directed Instruction (TDI): The teacher provided direct instruction following a standard progression: warm-up, skill demonstration and explanation, guided practice, independent practice, and application game. Feedback was provided by the teacher. Students practiced individually or in informal groups without structured peer interaction requirements.

3.4. Measures

Motor skill proficiency was assessed using validated sport-specific rubrics for badminton (clear, drop shot, serve, smash; 0–4 scale per skill) and volleyball (serve, pass, set, spike; 0–4 scale per skill), with total scores calculated for each sport. Inter-rater reliability exceeded .90 for all assessments. The TGMD-3 locomotor and object control subtests were also administered at pre and post.

Social competence was measured through:

- Social Skills Improvement System (SSIS; Gresham & Elliott, 2008), a validated 46-item self-report measuring communication, cooperation, assertion, responsibility, empathy, engagement, and self-control;
- Peer sociometric ratings, where students rated each classmate on a 5-point likert scale for 'most like to work with in PE' and 'best at helping others learn';
- Systematic observation of prosocial behaviors during PE using a time-sampling protocol (10-second observe, 5-second record) coding for encouragement, helping, positive feedback, conflict resolution, and off-task/negative interactions. Two observers achieved inter-observer agreement of 94%.

Metacognitive awareness was assessed using the Metacognitive Awareness Inventory adapted for physical learning (Schraw & Dennison, 1994), including knowledge of cognition and regulation of cognition subscales.

3.5. Data Analysis

One-way ANCOVA with baseline scores as covariates was used to compare post-intervention scores across the three conditions. Planned contrasts compared:

- student-centered conditions (PT + CL) versus TDI, and
- PT versus CL. Within the PT condition, paired t-tests compared tutor and tutee outcomes.

Effect sizes (Cohen's d) were calculated for all pairwise comparisons. Multilevel modeling accounted for nesting within classes. The significance level was set at $p < .05$ with Bonferroni adjustment for multiple comparisons.

IV. RESULTS

4.1. Motor Skill Development

ANCOVA revealed a significant main effect of condition on badminton skill scores, $F(2, 272) = 4.87, p < .01$, and volleyball skill scores, $F(2, 272) = 3.94, p < .05$. Planned contrasts showed that PT produced significantly greater skill gains than TDI for badminton ($d = 0.48, p < .01$) but not volleyball ($d = 0.28, p = .11$). CL and TDI did not differ significantly on skill outcomes for either sport (badminton: $d = 0.12, p = .42$; volleyball: $d = 0.18, p = .24$).

Table 1. Motor Skill Scores by Condition and Sport

Condition	Badminton Pre M(SD)	Badminton Post M(SD)	Volleyball Pre M(SD)	Volleyball Post M(SD)
Peer Teaching	8.4 (2.8)	12.7 (2.1)	7.9 (2.6)	11.4 (2.3)
Cooperative Learning	8.2 (2.9)	11.8 (2.4)	8.1 (2.7)	11.1 (2.5)
Teacher-Directed	8.5 (2.7)	11.5 (2.6)	7.8 (2.5)	10.7 (2.7)

4.2. Tutor vs. Tutee Effects in Peer Teaching

Within the PT condition, tutors showed significantly greater skill improvement than tutees across both sports (badminton: tutor $d = 0.71$, tutee $d = 0.54$, difference $p < .05$; volleyball: tutor $d = 0.63$, tutee $d = 0.48$, difference $p < .05$). Tutors also demonstrated significantly greater metacognitive awareness gains ($d = 0.82$) compared to tutees ($d = 0.41$) and TDI students ($d = 0.28$), confirming the protégé effect.

Table 2. Tutor vs. Tutee Outcomes in the Peer Teaching Condition

Outcome	Tutors M Gain (SD)	Tutees M Gain (SD)	t	p	d (Tutors)	d (Tutees)
Badminton Skills	4.8 (1.9)	3.6 (2.1)	2.84	<.05	0.71	0.54
Volleyball Skills	3.9 (1.7)	3.1 (1.9)	2.41	<.05	0.63	0.48
Metacognitive Awareness	0.68 (0.34)	0.32 (0.38)	4.12	<.001	0.82	0.41

4.3. Social Competence

CL produced significantly greater improvements in overall social competence (SSIS total) compared to both PT and TDI. The effect was most pronounced for cooperation ($d = 0.84$), empathy ($d = 0.72$), and communication ($d = 0.67$) subscales. PT also produced significant social competence gains compared to TDI, particularly in communication and responsibility.

Table 3. Social Competence Scores by Condition (Post-Intervention, Adjusted for Baseline)

SSIS Subscale	CL Post M(SD)	PT Post M(SD)	TDI Post M(SD)	CL vs TDI d	PT vs TDI d	p (overall)
Communication	3.94 (0.58)	3.78 (0.64)	3.41 (0.71)	0.67	0.48	<.001
Cooperation	4.12 (0.52)	3.72 (0.61)	3.38 (0.68)	0.84	0.42	<.001
Assertion	3.68 (0.63)	3.61 (0.67)	3.42 (0.72)	0.34	0.24	.08
Responsibility	3.87 (0.54)	3.82 (0.59)	3.51 (0.64)	0.52	0.48	<.01
Empathy	3.91 (0.57)	3.58 (0.68)	3.34 (0.74)	0.72	0.31	<.001
SSIS Total	3.90 (0.44)	3.70 (0.51)	3.41 (0.58)	0.79	0.47	<.001

4.4. Prosocial Behavior Observations

Systematic observation revealed significantly higher rates of prosocial behavior in CL ($M = 8.4$ per 10-min observation, $SD = 2.1$) and PT ($M = 6.7$, $SD = 2.4$) compared to TDI ($M = 3.2$, $SD = 1.8$). Negative interactions were lowest in CL ($M = 0.8$, $SD = 0.6$) compared to PT ($M = 1.4$, $SD = 0.9$) and TDI ($M = 2.1$, $SD = 1.3$). CL's structured social skills instruction and group processing components appear to create a social environment that both promotes prosocial behavior and reduces negative interactions.

V. DISCUSSION

This study demonstrates that both peer teaching and cooperative learning are effective strategies for developing motor skills and social competence in adolescent PE, with each approach offering distinct advantages. The findings extend previous research by providing direct comparisons between these student-centered approaches and teacher-directed instruction across both skill and social outcome domains.

The skill development findings reveal an important nuance: peer teaching produced superior skill gains compared to TDI, particularly for tutors, while cooperative learning produced comparable skill gains to TDI. This pattern suggests that the one-to-one feedback structure of peer teaching provides more targeted skill support than the group-based CL structure, where individual skill practice may be diffused across multiple social and organizational demands. The protégé effect observed in tutors ($d = 0.71$ – 0.82 across outcomes) confirms that the act of teaching is a powerful learning mechanism (Chase et al., 2009). Teaching requires tutors to analyze skill components, articulate performance criteria, observe errors, and formulate corrective feedback cognitive processes that deepen understanding beyond what passive practice provides.

The social competence findings clearly favor cooperative learning, with CL producing substantial effects across communication, cooperation, empathy, and responsibility. This advantage likely reflects CL's five essential elements (Johnson & Johnson, 2009), which explicitly structure positive interdependence and social skills instruction. While peer teaching creates social interaction opportunities, CL's requirement for collective goal achievement and its explicit attention to group dynamics create richer conditions for social skill development. The finding that CL reduced negative interactions more effectively than PT suggests that the social processing component end-of-lesson reflection on group functioning promotes awareness and regulation of social behavior.

The metacognitive advantage of peer teaching, particularly for tutors, has important implications for lifelong physical activity participation. Students who develop strong metacognitive skills the ability to plan, monitor, and evaluate their own learning are better equipped to continue learning independently beyond the school PE context (Zimmerman, 2002). This suggests that peer teaching may contribute to self-regulated learning capacity that extends beyond immediate skill gains.

From a practical standpoint, these findings support the strategic integration of both approaches within PE curricula rather than exclusive adoption of either. Peer teaching may be optimally deployed during skill-focused lesson phases where targeted feedback on specific techniques is the primary objective. Cooperative learning may be most effective during tactical and game-play phases where collaboration, communication, and strategic thinking are central. Teacher-directed instruction retains value for introducing new skills, establishing safety procedures, and providing expert demonstrations.

Limitations include the 12-week duration, which may not capture long-term social development trajectories. The study focused on individual sports (badminton) and team sports (volleyball), but findings may differ for other activity types. The reliance on four teachers teaching all three conditions, while controlling for teacher effects, may have introduced carry-over effects. Future research should examine the long-term retention of social skills developed through CL, the optimal frequency and duration of peer teaching episodes, and the combined use of PT and CL within integrated instructional models.

VI. CONCLUSION

This study establishes that peer teaching and cooperative learning make distinct yet complementary contributions to adolescent development in PE. Peer teaching excels in promoting motor skill acquisition (especially for tutors) and metacognitive awareness, while cooperative learning produces superior social competence outcomes across multiple dimensions. Both approaches significantly outperform teacher-directed instruction in developing prosocial behaviors and positive peer interactions. PE programs should adopt integrated instructional approaches that strategically deploy peer teaching for skill-focused phases and cooperative learning for game and tactical phases, creating comprehensive learning environments that develop the whole student physically, socially, and cognitively. Teacher education programs must prepare pre-service teachers to implement both strategies with fidelity, including tutor training protocols, cooperative learning structure design, and the social skill instruction necessary to maximize the potential of student-centered pedagogy in physical education.

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