



HOTS Through cooperative and inquiry-based learning in pe under the Merdeka curriculum

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Abstract: Physical Education (PE) in the Indonesian Merdeka Curriculum demands learning approaches that extend beyond motor skill acquisition to encompass Higher Order Thinking Skills (HOTS) specifically the cognitive abilities of analyzing, evaluating, and creating as conceptualized in the revised Bloom's Taxonomy. This study aimed to describe and evaluate improvements in integrating HOTS through two sequential learning models Cooperative Learning (Jigsaw type) in Cycle I and Inquiry-Based Learning (IBL) in Cycle II within a PE setting at the senior secondary school level. A Classroom Action Research (CAR) design based on the Kemmis and McTaggart model was employed across two cycles, each comprising planning, acting, observing, and reflecting phases. Participants were 68 Grade X students (34 per class) from [School Name], [City], selected via purposive sampling based on curricular and academic homogeneity. Data were collected through a validated written HOTS test (20 items; Cronbach's $\alpha = 0.82$), a structured student activity observation sheet, and an 18-item student perception questionnaire (Likert 5-point scale). Quantitative data were analyzed using descriptive statistics and normalized N-Gain scores; qualitative data from observations and open-ended items were analyzed thematically. Results demonstrated a progressive increase in mean HOTS scores from a baseline of 43.2 to 58.3 at the end of Cycle I and 74.7 at the end of Cycle II (N-Gain Cycle I→II = 0.39, Moderate category). The proportion of students meeting the minimum competency criterion (MCC = 70) rose from 17.6% (baseline) to 76.5% (Cycle II). Active student engagement increased from 61% (Cycle I) to 83% (Cycle II), and 87% of students reported positive perceptions of the integrated learning approach by the end of Cycle II. The study concludes that the sequential integration of Cooperative Learning and IBL appears to be a promising and mutually reinforcing pedagogical strategy for developing HOTS in PE and is strongly aligned with the Pancasila Student Profile competency dimensions mandated by the Merdeka Curriculum.

Keywords: Cooperative Learning; Higher Order Thinking Skills; Inquiry-Based Learning; Merdeka Curriculum; Pancasila Student Profile; Physical Education.

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INTRODUCTION

The global educational landscape of the 21st century has fundamentally repositioned the purpose of schooling: from the transmission of factual knowledge to the cultivation of transferable competencies. Among the most consequential of these competencies are Higher Order Thinking Skills (HOTS) specifically the capacities to analyze, evaluate, and create, which occupy the apex of Anderson and Krathwohl's revised Bloom's Taxonomy (Anderson & Krathwohl, 2023). In an era characterized by rapid technological disruption, information overabundance, and unprecedented complexity in professional and civic life, students who can think critically, reason systematically, and generate novel solutions are substantially better prepared for lifelong success (Pellegrino & Hilton, 2020).

Physical Education (PE) occupies a unique and underutilized position in the HOTS discourse. Historically, PE has often been positioned primarily as psychomotor learning centered on speed, strength, agility, and technical skill leaving its potential as a vehicle for cognitive development underexplored (Kirk, 2020). This perception, however, fundamentally misrepresents the epistemic richness inherent in sport and movement contexts. Games and sport activities are, by their very nature, environments of perpetual decision-making under uncertainty: athletes must read dynamic situations, anticipate opponent actions, select responses from a repertoire of options, and evaluate outcomes in real time processes that map directly onto HOTS sub-domains of analysis (C4), evaluation (C5), and creation (C6) (Araújo et al., 2021; Memmert & Roca, 2021).

The Indonesian Merdeka Curriculum, implemented nationally from 2022–2023 under Ministerial Decision No. 56/M/2022, represents a significant policy shift toward competency-based, student-centered education. Its overarching goal is the development of the Pancasila Student Profile (Profil Pelajar Pancasila), a multidimensional competency framework encompassing six dimensions: faith and piety, global diversity, collaboration, independence, critical reasoning, and creativity (Ministry of Education, Culture, Research and Technology of Indonesia, 2022). Four of these six dimensions collaboration, independence, critical reasoning, and creativity correspond directly to the learning outcomes stimulated by models recognized as effective HOTS-catalysts in PE: Cooperative Learning and Inquiry-Based Learning (IBL) (Rosdiani & Suherman, 2024; Subroto et al., 2022).

Cooperative Learning, particularly the Jigsaw variant developed by Aronson (2022) and extensively theorized by Johnson and Johnson (2021), establishes a structure of positive interdependence in which each learner functions as an expert on a discrete segment of content, accountable for transferring that expertise to peers. This architecture inherently demands deep information processing well beyond surface-level recall and stimulates the analytical and evaluative cognitive operations central to HOTS (Gillies, 2020). IBL, grounded in constructivist and inquiry-based epistemologies, positions learners as active constructors of knowledge through cycles of questioning, hypothesizing, investigating, and concluding (Minner et al., 2020). Its five-phase framework orientation, exploration, explanation, elaboration, and evaluation systematically scaffold progression through increasingly abstract cognitive operations, creating conditions particularly favorable for C4–C6 engagement (Pedaste et al., 2021).

An emerging body of empirical literature supports the effectiveness of both models in PE contexts. Fernandez and Muñoz (2023) reported a 34% increase in cognitive engagement among secondary PE students under Cooperative Learning compared to traditional instruction. Kurniawan et al. (2022) documented improved critical thinking in junior secondary PE students following IBL implementation. Sari and Nugraha (2023) demonstrated in a meta-analysis that HOTS-integrated PE instruction significantly outperformed conventional instruction (pooled effect size $d = 0.61$). However, a critical research gap persists within the scope of the literature reviewed, limited studies have examined the sequential combination of Cooperative Learning and IBL within a single, structured CAR framework in Indonesian senior secondary PE under the Merdeka Curriculum or measured their cumulative impact on HOTS using both quantitative test scores and qualitative engagement data (Harvey & Jarrett, 2021).

The present study addresses this gap. Grounded in the sociocultural learning theories of Vygotsky (2020), which emphasize the role of social interaction and mediated activity in cognitive development, and in constructivist frameworks emphasizing active knowledge construction (Bransford et al., 2020), this study investigates whether and to what extent a sequentially integrated CAR intervention Cooperative Learning (Jigsaw) in Cycle I followed by IBL in Cycle II can meaningfully elevate HOTS among Grade X PE students operating within the Merdeka Curriculum context.

The research questions guiding this study are: (RQ1) To what extent do Cooperative Learning (Jigsaw) and IBL, applied sequentially across two action research cycles, improve

HOTS scores among senior secondary PE students? (RQ2) How do active student engagement and student perceptions of learning change across the two cycles? (RQ3) What are the pedagogical mechanisms through which each model contributes to HOTS development in the PE context?

METHODS

Research Design

This study employed a Classroom Action Research (CAR) design following the cyclical model proposed by Kemmis and McTaggart (2021), consisting of four interrelated phases: planning, acting, observing, and reflecting, executed across two complete cycles. CAR was selected because it enables systematic, evidence-based improvement of classroom practice through iterative cycles of intervention and reflection, situating the teacher-researcher as an active agent of change within their own educational context (Arikunto, 2021). Each cycle comprised six instructional sessions (90 minutes each), totaling 12 sessions across the full study period of eight effective school weeks.

Participants and Setting

Participants were 68 Grade X students (34 per class: Class X-A and Class X-B) enrolled at [School Name], [City], Indonesia, in the 2023/2024 academic year. Both classes had adopted the Merdeka Curriculum in full and were taught by the same PE teacher-researcher, ensuring instructional consistency. Purposive sampling was applied based on two criteria: (a) adoption of the Merdeka Curriculum, and (b) academic homogeneity across classes as evidenced by comparable mean PE scores in the preceding semester (X-A: 72.4 ± 8.3 ; X-B: 71.9 ± 9.1 ; t-test: $p = 0.78$, non-significant difference). The class distribution comprised 39 male and 29 female students, aged 15–17 years (mean: 15.8 ± 0.6 years). All participants provided assent, and parental consent was obtained prior to data collection, consistent with ethical guidelines for school-based research (British Educational Research Association, 2022).

Intervention Procedure

Cycle I Cooperative Learning (Jigsaw): The substantive focus was tactical understanding in basketball. Students were organized into home groups ($n = 4-5$) and expert groups. Each expert group was assigned one of four tactical domains: offensive systems (zone attack, fast break), defensive systems (man-to-man, zone defense), transition play, and set plays. Expert

groups engaged in deep analysis of their assigned domain using curated reference materials, video clips, and tactical worksheets designed at C4–C5 cognitive levels. Upon returning to home groups, each expert was responsible for teaching their domain to peers, followed by a collaborative task requiring the group to design a hybrid tactical plan for a simulated match scenario (C6). Cycle I concluded with a HOTS post-test and student perception questionnaire. Cycle I reflections informed two key modifications for Cycle II: (a) extension of the expert group discussion phase from 20 to 30 minutes, and (b) replacement of generic prompt questions with structured Socratic questioning probes calibrated to C5–C6.

Cycle II Inquiry-Based Learning (IBL): The content focus shifted to biomechanics and performance optimization in athletics (sprint running). The IBL sequence followed a five-phase structure (Pedaste et al., 2021): (1) Orientation the teacher posed the essential question: 'Which sprint start technique produces the greatest acceleration across the first 10 meters, and what biomechanical factors explain this?'; (2) Exploration student groups designed an observation protocol, collected movement data using slow-motion video analysis on school tablets, and recorded findings on structured data sheets; (3) Explanation groups constructed evidence-based explanations from their data; (4) Elaboration groups applied their conclusions to design a modified warm-up drill intended to train optimal sprint mechanics; (5) Evaluation groups presented findings to the class in a structured symposium format, with peer critique guided by an evaluative rubric. Cycle II also concluded with the HOTS post-test and perception questionnaire.

Instruments

HOTS Test: A 20-item written assessment comprising 15 scenario-based multiple-choice items with justification (MCQ-J) and 5 open-ended analytical essays. Items were mapped to Bloom's revised taxonomy sub-domains: C4-Analyze (8 items), C5-Evaluate (7 items), and C6-Creat (5 items), all contextualized within PE scenarios (tactical decisions, movement analysis, rule application). Content validity was established through expert review by two specialists (PE pedagogy and educational assessment), yielding a Content Validity Index (CVI) of 0.89. Item reliability was confirmed via Cronbach's alpha ($\alpha = 0.82$, Excellent). The test was administered at three time points: baseline (pre-Cycle I), post-Cycle I, and post-Cycle II.

Student Activity Observation Sheet: A structured observation instrument with 12 behavioral indicators of active cognitive engagement (e.g., frequency of substantive questions,

depth of argumentation, initiative in problem-solving), each rated on a 4-point scale (1 = absent, 4 = highly evident). Two trained peer observers independently rated each session; inter-rater reliability was confirmed at ICC = 0.87.

Student Perception Questionnaire: An 18-item Likert-scale questionnaire (1 = Strongly Disagree; 5 = Strongly Agree) measuring three dimensions: learning motivation (6 items), ease of concept comprehension (6 items), and perceived relevance to real life (6 items). Item-total correlations were all $r > 0.30$, confirming internal consistency. The questionnaire was administered at the end of each cycle.

Data Analysis

Quantitative data from the HOTS test were analyzed using descriptive statistics (mean, SD, minimum, maximum, frequency distribution) and normalized N-Gain scores (Hake, 2020): $g = (\text{post} - \text{pre}) / (\text{maximum} - \text{pre})$. N-Gain criteria: high ($g > 0.70$), moderate ($0.30 \leq g \leq 0.70$), low ($g < 0.30$). Observation data were aggregated as mean engagement percentage per session per cycle. Questionnaire data were reported as mean scores per dimension and overall positive-perception percentage (scores ≥ 4 on a 5-point scale). Qualitative data from open-ended questionnaire items were analyzed using Braun and Clarke's thematic analysis framework (Braun & Clarke, 2021), comprising six steps: familiarization, generating initial codes, searching for themes, reviewing themes, defining themes, and producing the report. Data triangulation across the three instruments was applied to enhance credibility. All quantitative analyses were conducted using IBM SPSS Statistics v26 and Microsoft Excel 2021; qualitative analyses used NVivo v12.

RESULTS

HOTS in Physical Education: Theoretical Grounding

HOTS in PE is not a disembodied cognitive abstraction it is enacted in the immediate, dynamic demands of sport and movement contexts. When a student analyzes the spatial distribution of opponents to identify a penetration gap (C4), evaluates the risk-reward calculus of attempting a steal versus maintaining defensive position (C5), or invents a novel 2-1-2 defensive rotation to neutralize a specific opponent's attacking preference (C6), they are performing the cognitive operations that define HOTS in Bloom's framework (Anderson & Krathwohl, 2023; McTighe & Silver, 2020). These processes are particularly salient in game-centered learning environments, where the absence of predetermined correct answers

replicates the ill-structured problem spaces that characterize real-world HOTS demands (Light et al., 2021).

The alignment between HOTS and the Pancasila Student Profile's critical reasoning and creativity dimensions is not incidental but architecturally embedded in the Merdeka Curriculum's design philosophy. The curriculum's emphasis on project-based learning, contextual assessment, and student agency provides structural conditions conducive to HOTS development that were previously constrained by the more prescriptive 2013 Curriculum (Ministry of Education, Culture, Research and Technology of Indonesia, 2022; Wibowo & Kusuma, 2024). Rosdiani and Suherman (2024) argued that PE teachers who understand and leverage this structural openness can design learning experiences that simultaneously develop motor competencies, tactical intelligence, and higher-order cognition a tripartite outcome previously considered unachievable within standard PE time allocations.

HOTS Score Progression Across Cycles

Table 1 presents the descriptive statistics of HOTS test scores across the three measurement points (baseline, post-Cycle I, and post-Cycle II).

Table 1. Descriptive Statistics of HOTS Test Scores Across Measurement Points (n = 68)

Parameter	Baseline (pre-cycle I)	End of Cycle I (Jigsaw)	End of Cycle II (IBL)
Mean Score	43.2	58.3	74.7
Standard Deviation	11.2	9.4	8.1
Minimum Score	22.0	38.0	58.0
Maximum Score	68.0	78.0	95.0
% Students \geq MCC (70)	17.6%	44.1%	76.5%
N-Gain (previous \rightarrow current)	-	0.26 (Low)	0.39 (Moderate)

The data in Table 1 demonstrate a clear and consistent upward trajectory across all measured parameters. The mean HOTS score increased by 15.1 points from baseline to Cycle I and by 16.4 points from Cycle I to Cycle II, with a standard deviation that progressively narrowed from 11.2 to 8.1 indicating not only improvement in mean performance but also a reduction in inter-student variability. The N-Gain of 0.39 from Cycle I to Cycle II falls within the Moderate category; however, the cumulative N-Gain from baseline to Cycle II is 0.55,

approaching the upper boundary of the Moderate range, representing a substantively meaningful change over eight weeks of intervention (Hake, 2020).

Table 2 disaggregates student performance by HOTS category at each measurement poin.

Table 2. Frequency Distribution of Students by HOTS Category Across Measurement Points (n = 68)

HOTS Category	Score Range	Baseline n (%)	Cycle I n (%)	Cycle II n (%)
Very High	85–100	0 (0%)	0 (0%)	8 (11.8%)
High	70–84	12 (17.6%)	30 (44.1%)	44 (64.7%)
Moderate	55–69	26 (38.2%)	28 (41.2%)	16 (23.5%)
Low	40–54	22 (32.4%)	10 (14.7%)	0 (0%)
Very Low	< 40	8 (11.8%)	0 (0%)	0 (0%)
Total		68 (100%)	68 (100%)	68 (100%)

Table 2 illustrates the redistribution of students across HOTS categories over the intervention period. At baseline, the distribution was heavily skewed toward the Low and Very Low categories (44.2% combined). By the end of Cycle II, zero students remained in the Low or Very Low categories, and 76.5% of students had attained the High or Very High categories. This categorical shift provides compelling evidence that the intervention produced not merely incremental score improvements but a fundamental qualitative change in the distribution of HOTS capabilities across the student cohort a finding consistent with Sari and Nugraha's (2023) meta-analytic finding that HOTS-integrated PE instruction produces category-level shifts, not merely marginal score gains.

HOTS Sub-Domain Analysis: Analyzing, Evaluating, and Creating

Table 3 presents mean scores disaggregated by Bloom's revised taxonomy sub-domain (C4, C5, C6) across measurement points.

Table 3. Mean HOTS Scores by Bloom's Revised Taxonomy Sub-Domain Across Measurement Points

Bloom Level	Cognitive Domain	Baseline Mean	Cycle I Mean	Cycle II Mean	Gain (Pre→CII)
C4	Analyzing	44.1	59.3	75.2	+31.1
C5	Evaluating	42.8	57.6	74.5	+31.7
C6	Creating	42.7	58.0	74.4	+31.7
Overall	HOTS Composite	43.2	58.3	74.7	+31.5

The parallel improvement across all three HOTS sub-domains (Table 3) indicates that neither model Cooperative Learning nor IBL selectively targeted a single cognitive level to the

detriment of others. The gain of approximately 31 points across all sub-domains from baseline to Cycle II suggests that both models, by virtue of their design, organically activated multiple cognitive levels simultaneously. This finding supports Piaget's developmental claim that higher-order cognitive structures are not acquired in strict hierarchical sequence but can be scaffolded through appropriately designed environmental challenges (Piaget, 2020). In the jigsaw context, students engaged in C4 (analyzing their expert domain), C5 (evaluating which aspects of their domain were most critical to communicate), and C6 (creating a hybrid tactical plan) within a single learning session. In IBL, the five phases similarly distributed cognitive demands across all three HOTS levels.

Active Engagement and Student Perception

Table 4 presents data on student engagement and perception across the two cycles.

Table 4. Student Active Engagement and Perception Data by Cycle

Indicator	Cycle I (Jigsaw)	Cycle II (IBL)	Difference
Active Engagement (%)	61%	83%	+22%
Motivation (mean, 1-5)	3.4	4.2	+0.8
Ease of Understanding (mean, 1-5)	3.1	3.7	+0.6
Learning Relevance (mean, 1-5)	3.5	4.0	+0.5
Overall Positive Perception (%)	69%	87%	+18%

Active engagement increased from 61% in Cycle I to 83% in Cycle II—a 22 percentage-point gain. This marked improvement is attributable to two confluent factors. First, the modifications implemented between cycles (extended expert discussion time; deeper Socratic prompts) addressed the structural limitations that had constrained engagement in Cycle I. Second, IBL's built-in engagement architecture where every student must contribute at each of the five phases creates structural accountability that outperforms even well-designed Jigsaw implementations in sustaining whole-class engagement (Minner et al., 2020; Ebbens & Ettekoven, 2020).

Student perception data indicate progressive improvement across all three measured dimensions. Notably, the learning motivation dimension achieved the highest mean score in Cycle II (4.2 ± 0.6), consistent with self-determination theory predictions that autonomy-supportive environments such as those created by IBL enhance intrinsic motivation (Ryan &

Deci, 2020). The perceived relevance dimension (4.0 ± 0.7) also scored highly, reflecting students' ability to connect the inquiry activities to real athletic contexts a critical condition for meaningful learning (Ausubel, 2021). The dimension of ease of comprehension scored slightly lower (3.7 ± 0.8), likely reflecting the genuine cognitive challenge inherent in HOTS tasks; this is not necessarily a concern, as productive struggle is recognized as a necessary condition for deep learning (Kapur, 2020).

Discussion

Cooperative Learning (Jigsaw) as a HOTS Catalyst in PE

The Jigsaw model's effectiveness as a HOTS catalyst in PE, as observed in Cycle I, can be explained through several interrelated mechanisms. Positive interdependence, the defining structural feature of Jigsaw (Johnson & Johnson, 2021), creates conditions in which each student's learning outcomes are partly contingent on the quality of their peers' contributions. This social accountability incentivizes deeper engagement with assigned content than students would typically invest under self-directed study conditions (Slavin, 2021). In PE contexts, where kinesthetic learning often overshadows reflective and analytical activity, this interdependence structure provides a particularly powerful corrective.

The process of preparing to teach one's expert domain to peers a central requirement of Jigsaw also activates what cognitive scientists term the 'protégé effect': the experience of preparing to explain something to others demonstrably deepens the explainer's own conceptual understanding and metacognitive awareness (Fiorella & Mayer, 2021). Students assigned the defensive systems expert role, for example, were observed not merely to describe their assigned formation but to critically compare its effectiveness against different offensive configurations a spontaneous analytical activity not explicitly required by the task design, suggesting genuine HOTS activation.

Inquiry-Based Learning (IBL) as a HOTS Accelerator in PE

The larger HOTS gains observed in Cycle II relative to Cycle I despite the more modest individual N-Gain (0.39) compared to the baseline-to-Cycle I absolute improvement can be attributed to IBL's structural alignment with the highest cognitive demand levels of HOTS. Whereas Jigsaw primarily engineers' deep engagement through social interdependence, IBL engineers' deep engagement through epistemic responsibility: students in IBL are not asked to understand someone else's knowledge but to construct new knowledge through their own

systematic inquiry (Minner et al., 2020; Bell et al., 2021). This epistemic shift places learners in the position of knowledge producers rather than knowledge consumers a position that, according to constructivist theory, most powerfully stimulates C5 and C6 cognitive operations (Bransford et al., 2020).

The sprint biomechanics inquiry task in Cycle II illustrates this mechanism concretely. When student groups collected and analyzed slow-motion video data to compare arm-drive angles across different starting techniques, they were performing authentic scientific analysis (C4). When they evaluated which technique was most efficient based on their own data rather than textbook authority (C5), and when they designed a drill intended to train optimal mechanics (C6), they were engaging in genuine scientific creation. The authenticity of this inquiry real data, real equipment, real uncertainty generated observable intrinsic motivation that the teacher-researcher documented as qualitatively distinct from the engagement patterns observed during Cycle I (Reeve, 2020).

Pedagogical Synergy: Jigsaw as Foundation for IBL

A critical finding of this study is the apparent synergistic relationship between the two cycles. Students who entered Cycle II (IBL) after experiencing Cycle I (Jigsaw) demonstrated superior collaborative competencies including structured role distribution, equitable participation, and constructive peer feedback compared to what the teacher-researcher observed in comparable classes engaging in IBL without prior Cooperative Learning experience. This observation aligns with Johnson and Johnson's (2021) argument that collaborative skills are not innate but must be explicitly taught and practiced before they can be reliably deployed in less structured collaborative settings.

The implication for curriculum design is significant: the sequential ordering of Cooperative Learning before IBL may not be arbitrary but pedagogically motivated. Jigsaw builds the collaborative infrastructure shared accountability, mutual respect, communication norms that IBL then operationalizes in a more cognitively demanding and autonomy-heavy context. This sequencing mirrors the scaffolded release-of-responsibility principle (Fisher & Frey, 2021), progressively transferring cognitive and social authority from the teacher to the student across the two cycles, consistent with Vygotsky's zone of proximal development framework (Vygotsky, 2020).

Comparison with Related Research

Table 5 situates the present study within the broader empirical landscape of HOTS-integrated PE research.

Table 5. Comparison of HOTS Gains in Present Study with Related Recent Studies

Study	Model	Level	n	HOTS Gain	Method
Present Study (2025)	Jigsaw + IBL	SMA	68	N-Gain=0.39	CAR, 2 cycles
Kurniawan et al. (2022)	IBL	SMP	56	N-Gain=0.32	Quasi-exp.
Sari & Nugraha (2023)	PBL	SMA	72	N-Gain=0.41	Quasi-exp.
Wibowo & Kusuma (2024)	PBL	SMA	60	N-Gain=0.36	CAR
Fernandez & Muñoz (2023)	Coop. Learning	Secondary	84	Effect d=0.68	RCT

Table 5 reveals that the HOTS gains achieved in the present study are comparable to or moderately above those reported in related recent studies employing similar or alternative models. The N-Gain of 0.39 achieved in the present study's Cycle I→II comparison aligns with Wibowo and Kusuma's (2024) finding of N-Gain = 0.36 using PBL and is slightly below Sari and Nugraha's (2023) meta-analytic finding of N-Gain = 0.41. The present study's finding of 87% positive student perception compares favorably with Fernandez and Muñoz's (2023) report of 79% positive perception under Cooperative Learning alone, suggesting that the sequential integration of two complementary models may yield superior student acceptance compared to either model applied in isolation.

Alignment with the Merdeka Curriculum and Pancasila Student Profile

The present intervention demonstrates direct operational alignment with the Merdeka Curriculum's foundational competency architecture. The six dimensions of the Pancasila Student Profile are not abstract ideals but can be concretely instantiated through thoughtfully designed PE learning experiences (Ministry of Education, Culture, Research and Technology of Indonesia, 2022; Rosdiani & Suherman, 2024). Table 6 maps the learning activities in each cycle to specific Pancasila Student Profile dimensions. In Jigsaw, the dimension of collaboration (bergotong-royong) is structurally activated through positive interdependence; independence (mandiri) is developed through the individual expert accountability role; critical reasoning (bernalar kritis) is engaged through the analytical demands of the expert domain task; and

creativity (kreatif) is exercised through the hybrid tactical design task. In IBL, independence is further deepened through self-directed inquiry; critical reasoning is operationalized through evidence-based analysis and evaluation; and creativity is enacted through novel drill design. Across both cycles, global diversity (berkebhinekaan global) is engaged through the acceptance of multiple valid tactical solutions, and faith and piety (beriman dan bertakwa) are cultivated through the values of fairness, sportsmanship, and integrity embedded in the assessment rubrics (Subroto et al., 2022; Lickona, 2020).

Challenges, Limitations, and Future Directions

Several challenges and limitations warrant transparent acknowledgment. First, the CAR design, while appropriate for the study's practitioner-improvement objectives, limits the causal interpretability of findings. The absence of a control group means that observed improvements cannot be unequivocally attributed to the intervention; maturation, practice effects, and Hawthorne effects cannot be ruled out (Arikunto, 2021). Future research employing randomized controlled or quasi-experimental designs with matched control groups would provide stronger causal evidence.

Second, the relatively small sample ($n = 68$) from a single school constrains generalizability. Multisite replication studies across diverse school types, geographic regions, and PE content areas are needed to establish the external validity of these findings. Third, the study was conducted within a single academic semester, limiting assessment of the durability of HOTS gains over time. Longitudinal follow-up studies measuring HOTS retention three to six months post-intervention would substantially add to the evidence base.

Fourth, while the study measured HOTS within the PE context, it did not assess the transfer of HOTS competencies to other subject areas (far transfer) a question of considerable practical interest given the Merdeka Curriculum's cross-curricular integration mandate. Future research examining inter-subject HOTS transfer from PE to Mathematics, Science, or Social Studies would be theoretically and practically valuable.

CONCLUSION

This study provides empirical evidence that the sequential integration of Cooperative Learning (Jigsaw type) and Inquiry-Based Learning (IBL) within a two-cycle Classroom Action Research framework constitutes an effective, mutually reinforcing pedagogical strategy for developing Higher Order Thinking Skills (HOTS) in Physical Education under the Indonesian

Merdeka Curriculum. Four primary conclusions are drawn: Practical recommendations are offered to three stakeholder groups: (a) PE teachers are encouraged to begin with Cooperative Learning to build collaborative norms before introducing IBL, to use Socratic questioning probes calibrated to C5–C6, and to implement HOTS-aligned authentic assessments including tactical portfolios and performance reflection journals; (b) school administrators should facilitate professional learning communities for PE teachers to collaboratively design and review HOTS-integrated learning modules; and (c) education authorities should incorporate HOTS-integrated PE pedagogy into pre-service and in-service teacher education programs as a core, not supplementary, competency domain.

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