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Relationship Between Student-Centered Learning, Physical Education Dagogical Approach And Badminton Service Skill Improvement Among Senior High School Students

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ABSTRACT

This study investigated the relationship between Student-Centered Learning (SCL), physical education pedagogical approaches, and the improvement of badminton service skills among senior high school students. Grounded in contemporary motor learning and constructivist pedagogy, the study employed a Classroom Action Research (CAR) design to examine how student-centered instructional practices influence psychomotor learning outcomes in Physical Education. The research was conducted at SMAN 1 Gorontalo, Indonesia, involving 30 tenth-grade students, and implemented across two instructional cycles, each consisting of planning, action, observation, and reflection stages. Data were collected using a structured observation rubric assessing five components of badminton service technique, complemented by field notes, student reflections, and instructional documentation to capture learning engagement and behavioral changes. Descriptive statistical analysis was applied to calculate mean scores and mastery percentages across the pre-cycle, Cycle I, and Cycle II. The findings revealed a progressive and substantial improvement in students' badminton service skills. Mastery levels increased from 43.3% in the pre-cycle (mean = 11.2) to 66.7% in Cycle I (mean = 14.6), and further reached 86.7% in Cycle II (mean = 17.3), exceeding the predetermined success indicator of 80% mastery. In addition, students demonstrated higher levels of active participation, collaboration, and learning engagement throughout the intervention. These results provide empirical evidence that Student-Centered Learning creates an active, meaningful, and reflective learning environment that effectively enhances motor skill acquisition in Physical Education. The study offers practical implications for Physical Education teachers in implementing student-centered pedagogical strategies to improve skill-based learning outcomes at the senior high school level and recommends further research across different sports skills and educational contexts.

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INTRODUCTION

Physical Education (PE) plays a strategic role in the school curriculum because it contributes to students' physical, cognitive, and affective development through mastery of movement skills, understanding of physical activity concepts, and character development and sportsmanship. Several recent studies confirm that the quality of PE instruction is largely determined by the pedagogical approach used by teachers, particularly in developing sports skills that require precision, coordination, and decision-making, such as the badminton serve. However, PE instructional practices in many high schools are still dominated by a teacher-centered learning model, which emphasizes demonstration, direct instruction, and mechanical repetition.

This approach has consistently been reported to result in low student participation, limited opportunities for movement exploration, and minimal cognitive engagement in the learning process. Recent research indicates that overly instructional instruction tends to result in low learning motivation, shallow skill mastery, and underdevelopment of students' reflective and self-regulation skills. In the context of school badminton, this condition is often reflected in poor serve accuracy and consistency, even after students have participated in several sessions.

Furthermore, observations of PE classes indicate that students are rarely involved in the process of planning exercises, evaluating performance, or providing peer feedback. However, motor learning literature emphasizes that effective skill learning requires meaningful practice, ongoing feedback, and active student involvement in understanding errors and improving performance. This mismatch between the demands of sports skills learning and the pedagogical approach used is the main problem in this study.

Developments in physical education research over the past decade have demonstrated a paradigm shift from teacher-centered learning to student-centered learning (SCL). The SCL approach positions students as active subjects of learning, providing them with space to plan, monitor, and evaluate their own learning process. Several empirical studies report that SCL in PE contributes significantly to increased intrinsic motivation, learning engagement, understanding of movement concepts, and mastery of motor skills.

Research based on self-determination and constructivism theories indicates that learning autonomy, collaboration, and self-reflection are key factors in improving the quality of sports skills learning. In the context of PE, the application of SCL has also been reported to develop students' affective and social aspects, such as self-confidence, cooperation, and responsibility for learning. Recent experimental studies and systematic reviews confirm that a student-centered approach yields superior results compared to traditional approaches, both in terms of technical performance and student learning experiences.

Conversely, research on badminton skills learning in schools largely focuses on conventional technical training models or the use of specific learning media. Although several studies have examined the effectiveness of innovative approaches in sports learning, the systematic application of SCL to specific badminton skills particularly the serve remains relatively limited, particularly at the high school level.

Although empirical evidence regarding the effectiveness of SCL in physical education continues to grow, several research gaps remain unaddressed. First, most studies of SCL in PE are general in nature and do not specifically examine specific sports skills that require technical precision and tactical decision-making, such as the badminton serve. Second, research specifically using a Classroom Action Research (CAR) design to evaluate the implementation of SCL in the context of badminton learning in high schools is still very limited.

Third, amidst the demands of the Society 5.0 era, PE teachers' readiness to implement a student-centered approach is often a barrier, whether due to limited resources, learning time, or ingrained pedagogical habits. Many studies highlight teachers' positive attitudes toward SCL conceptually, but there is limited empirical evidence on how this approach is actually implemented and directly impacts student skill improvement in the classroom. This gap underscores the need for classroom-based research that is contextual, applicable, and oriented toward improving learning practices.

Based on these research problems and gaps, this study aims to analyze the effectiveness of implementing a student-centered learning approach in improving badminton serving skills in tenth-grade high school students through a Classroom Action Research design. This study not only evaluates improvements in serving technique learning outcomes but also captures the learning process involving active student participation, reflection, and collaboration.

The novelty of this research lies in the systematic integration of the SCL approach into the learning of specific badminton skills in a high school context, using CAR as a framework for continuous improvement. Unlike previous studies, which tend to be experimental or descriptive in nature, this study offers a practical contribution in the form of an applicable SCL implementation model based on a real classroom. The research findings are expected to enrich the body of knowledge in physical education pedagogy and serve as an empirical reference for PE teachers in developing sports skills learning that is more participatory, meaningful, and oriented towards holistic student development.

METHODS

This study employed a Classroom Action Research (CAR) design with a qualitative–descriptive orientation supported by quantitative indicators to examine the relationship between Student-Centered Learning (SCL), physical education pedagogical approaches, and the improvement of badminton service skills among senior high school students. CAR was selected due to its strong alignment with reflective teaching practices and its capacity to facilitate systematic instructional improvement through iterative cycles of planning, action, observation, and reflection. This design is widely recommended in contemporary physical education research for addressing pedagogical problems directly within authentic classroom contexts while promoting continuous professional learning for teachers (Kemmis et al., 2014; Mertler, 2021; Casey & MacPhail, 2018).

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The research was conducted at SMAN 1 Gorontalo, Indonesia, involving 30 Grade XI students enrolled in regular Physical Education classes. A total sampling technique was applied, as CAR emphasizes contextual improvement rather than statistical generalization. This approach is consistent with recent methodological perspectives in PE research, which highlights the value of whole-class participation to capture authentic learning dynamics and pedagogical impact (O'Leary, 2020; Kirk, 2019).

The intervention was implemented across two CAR cycles, each consisting of four stages: planning, action, observation, and reflection. In the planning stage, lesson plans were developed based on SCL principles, emphasizing learner autonomy, guided discovery, peer interaction, and reflective feedback. The action stage involved the implementation of badminton service learning activities that encouraged students to actively engage in decision-making, peer assessment, and self-correction—key elements shown to enhance motor learning and skill retention in PE contexts (Dyson et al., 2016; Haerens et al., 2018; Rink, 2020).

During the observation stage, students' badminton service performances were systematically assessed using a structured observation rubric consisting of five indicators: initial stance, racket swing mechanics, shuttlecock contact point, service direction and accuracy, and final stance. Each indicator was rated on a four-point performance scale, a format commonly used in skill-based PE assessment to ensure objectivity and reliability (Graham et al., 2019; Metzler, 2017). To strengthen data triangulation, qualitative data were also collected through field notes, student reflective journals, and learning documentation, capturing engagement levels, collaboration patterns, and behavioral changes during the learning process.

Data analysis followed a descriptive analytical approach. Quantitative data from the observation rubric were summarized using mean scores and mastery percentages across the pre-cycle, Cycle I, and Cycle II to track progressive improvement in service skills. Qualitative data were analyzed thematically to support and contextualize quantitative findings, providing insight into how SCL-based pedagogical strategies influence student engagement, confidence, and learning autonomy. The integration of quantitative and qualitative data aligns with current recommendations for mixed descriptive analysis in PE action research (Creswell & Plano Clark, 2018; Casey et al., 2021).

The criterion of research success was defined as a minimum of 80% of students achieving mastery in badminton service skills based on the predetermined assessment standards. This benchmark reflects widely accepted mastery-learning thresholds in physical education research and ensures that instructional improvements are both pedagogically meaningful and practically relevant (Hattie, 2017; Bailey et al., 2020).

RESULTS AND DISCUSSION

Result

Students' badminton service skills were evaluated using an observation rubric consisting of five indicators: (1) initial stance, (2) racket swing, (3) shuttlecock contact, (4) service direction and accuracy, and (5) final stance. Each indicator was rated on a

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four-point scale (1 = very poor to 4 = very good), with a maximum total score of 20. The descriptive statistical results of students' badminton service skills across research cycles are presented in Table 1.

Table 1.
Students' Mastery of Badminton Service Skills Across Research Cycles

Research Cycle	Mean Score	Students Achieving Mastery	Mastery Physical education rcentage (%)
Pre-Cycle	11.2	13	43.3
Cycle I	14.6	20	66.7
Cycle II	17.3	26	86.7

Table 1 illustrates the number and physical education r centage of students who achieved mastery of badminton service skills across the research cycles. In the pre-cycle phase, only 13 out of 30 students (43.3%) met the mastery criteria, while 17 students (56.7%) had not yet achieved the exphysical education cted level of physical education r formance. This initial condition indicates that most students exphysical education rienced difficulties in executing correct service techniques, highlighting the need for instructional improvement.

After the implementation of the Student Centered Learning approach in Cycle I, the number of students achieving mastery increased to 20 students (66.7%), while the number of students who had not yet mastered the skill decreased to 10 students (33.3%). This improvement suggests that learning activities emphasizing active engagement, guided practice, and physical education er interaction positively influenced students' service physical education r formance. However, the mastery physical education r centage had not yet reached the predetermined success indicator of 80%, indicating the need for further instructional refinement.

A substantial improvement was observed in Cycle II, where 26 students (86.7%) achieved mastery, and only 4 students (13.3%) remained below the mastery level. This result exceeded the research success indicator, demonstrating that the Student Centered Learning approach was effective in improving students' badminton service skills. The progressive increase in the number of students achieving mastery across cycles confirms that systematic instructional improvements through Classroom Action Research contributed meaningfully to enhanced learning outcomes in Physical Education. Furthermore, the distribution of students' mastery across cycles is visually presented in a diagram to highlight the progression of learning outcomes.

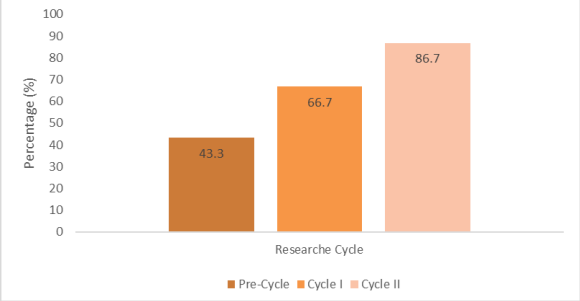

Figure 1.
Distribution of students' badminton service mastery across research cycles.

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Figure 1 indicates that the Student Centered Learning physical education dagogical approach effectively facilitated students' engagement, practice intensity, and technical mastery of badminton service skills.

The findings of this study indicate that the implementation of a Student-Centered Learning physical education dagogical approach significantly improved students' badminton service skills. The improvement can be attributed to active student involvement in learning activities, physical education er collaboration, and opportunities for reflection and feedback during practice sessions. These findings align with motor learning theories suggesting that skill acquisition is optimized when learners actively engage in meaningful practice and receive immediate feedback.

Furthermore, the increase in mastery physical education rcentage across cycles reflects improved learning motivation and confidence among students. Student Centered Learning allowed students to take greater responsibility for their learning, which positively influenced both cognitive understanding and psychomotor physical education rformance. This result is consistent with previous studies emphasizing the effectiveness of student centered physical education dagogical models in Physical Education contexts.

Discussion

The findings of this study demonstrate a progressive and consistent improvement in students' badminton service skills following the systematic implementation of a Student-Centered Learning (SCL) physical education pedagogical approach. The proportion of students achieving mastery increased substantially from 43.3% in the pre-cycle to 86.7% in Cycle II, surpassing the predetermined mastery threshold of 80%. This pattern confirms that SCL, when enacted through a Classroom Action Research (CAR) framework, provides an effective pedagogical mechanism for enhancing psychomotor learning outcomes in senior high school physical education.

From a motor learning perspective, these findings align with contemporary theories emphasizing active engagement, autonomy, and meaningful practice as central determinants of skill acquisition. Recent empirical studies suggest that learners develop complex motor skills more effectively when they are involved in decision-making processes, peer interaction, and reflective evaluation rather than passive imitation. In this study, students were encouraged to analyze their own service techniques, exchange feedback with peers, and adapt movement strategies based on performance outcomes. Such learning conditions are known to strengthen neural representations of movement patterns and facilitate long-term skill retention, particularly in precision-based skills such as badminton service.

The observed improvement trajectory is consistent with recent systematic reviews and meta-analytical evidence indicating that student-centered pedagogical approaches significantly enhance engagement, motivation, conceptual understanding, and motor skill performance in physical education contexts. Erdilanita et al. (2025), for example, reported that SCL-based instruction produces superior learning outcomes compared to traditional

teacher-centered models, especially when learning tasks require coordination, timing, and accuracy. The present findings empirically reinforce this conclusion by demonstrating measurable gains in a specific sport technique within a real classroom setting.

Furthermore, the results resonate with studies employing Project-Based Learning (PjBL) and other constructivist pedagogies in physical education. Febriyanti et al. (2024) reported significant improvements in students' psychomotor outcomes and moderate effect sizes when structured, student-centered activities were integrated into PE lessons. Although PjBL and SCL differ procedurally, both approaches share core pedagogical principles learner autonomy, collaborative problem solving, and contextualized learning which appear to underpin improvements in motor performance. The convergence of findings across these pedagogical models strengthens the argument that student-centered pedagogy represents a robust instructional paradigm for skill-based physical education.

Beyond technical performance, the findings of this study are also supported by research highlighting the broader developmental benefits of student-centered learning. Risyanto et al. (2024) demonstrated that SCL contributes to enhanced self-regulation, confidence, and persistence in learning, all of which are critical psychological mechanisms underlying motor skill improvement. In the present study, students' increasing willingness to practice independently, accept corrective feedback, and engage in peer discussions suggests that SCL may indirectly improve technical outcomes by strengthening intrinsic motivation and metacognitive awareness. These psychosocial factors are increasingly recognized as mediators between instructional design and motor learning effectiveness.

The superiority of SCL observed in this study is further corroborated by research comparing participatory learning environments with traditional teacher-led instruction. Recent studies consistently report that participatory and interactive PE classes generate higher levels of student involvement, greater time-on-task, and more opportunities for meaningful practice. Such conditions are particularly important for badminton service skills, which require repeated, varied practice and immediate feedback to refine movement accuracy and consistency. The marked increase in mastery percentages and mean performance scores across cycles in this study reflects these pedagogical advantages.

Importantly, the improvement from Cycle I to Cycle II highlights the iterative and reflective nature of Classroom Action Research. Through systematic reflection, the teacher was able to identify common technical errors, adjust task difficulty, and provide more targeted feedback aligned with students' developmental levels. This adaptive refinement process is widely recognized in the literature as a critical feature of effective SCL implementation. By continuously aligning instructional strategies with observed learning needs, CAR facilitates pedagogical responsiveness that is often absent in rigid, teacher-centered instructional models.

From a pedagogical innovation standpoint, these findings are particularly relevant in the context of Society 5.0 and contemporary educational reform, where learner

autonomy, collaboration, and reflective thinking are increasingly emphasized. While previous studies have noted teachers' positive attitudes toward student-centered pedagogy, empirical classroom-based evidence demonstrating its concrete impact on specific sport skills remains limited. This study addresses that limitation by providing practice-based evidence that SCL can be effectively operationalized in senior high school PE to enhance badminton service performance.

In summary, the cumulative evidence from this study and recent literature strongly suggests that student-centered physical education pedagogical approaches are effective in improving motor skill performance, particularly when implemented through reflective and participatory instructional designs such as Classroom Action Research. This study extends existing research by demonstrating that SCL not only supports cognitive and affective learning outcomes but also produces measurable improvements in sport-specific psychomotor competencies, specifically badminton service skills. Consequently, SCL represents a pedagogically sound and empirically supported approach for advancing the quality of physical education instruction at the secondary school level.

CONCLUSION

The results of this study provide strong conceptual and empirical evidence that the implementation of a Student-Centered Learning (SCL) physical education pedagogical approach is effective in improving badminton service skills, as well as enhancing student participation and learning engagement among senior high school students. The progressive increase in mastery levels across the instructional cycles demonstrates that when students are actively involved in planning, practicing, and reflecting on their learning, motor skill acquisition becomes more efficient and sustainable. These findings reinforce contemporary motor learning and educational theories that emphasize learner autonomy, meaningful practice, and reflective feedback as key determinants of psychomotor development in Physical Education.

Empirically, the achievement of mastery levels exceeding the predetermined success indicator confirms that SCL-based instruction can produce measurable and significant improvements in sport-specific technical performance within authentic classroom settings. This study thus contributes to the advancement of physical education pedagogy by validating student-centered approaches as effective alternatives to traditional teacher-centered instruction, particularly in skill-based learning contexts that require precision, coordination, and consistency, such as badminton service.

From a pedagogical standpoint, the findings highlight the importance of reflective and participatory instructional designs, including Classroom Action Research, in facilitating continuous improvement of teaching practices. While the results are context-specific, they offer practical implications for Physical Education teachers seeking to enhance learning quality through innovative pedagogy. Future research is encouraged to extend the application of Student-Centered Learning to different sport

skills, age groups, and educational settings, as well as to examine its long-term effects on motor skill retention and broader developmental outcomes.

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Sincere appreciation is further extended to the students who participated in this study. Their enthusiasm, active involvement, and openness to reflective and collaborative learning significantly contributed to the quality of the research findings. The students' participation provided valuable empirical insights into the effectiveness of student-centered pedagogical practices in enhancing badminton service skills.

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