



The Effectiveness of Student-Centered Learning Models in Volleyball Education: Evidence From a PRISMA-Based Systematic Review

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Abstract. The adoption of student-centered pedagogical approaches has become increasingly important in physical education due to the growing demand for learning environments that foster critical thinking, collaboration, and active participation. This study systematically reviews the implementation and effectiveness of student-centered learning models in volleyball instruction, with particular emphasis on Teaching Games for Understanding (TGfU), Cooperative Learning (CL), and Problem-Based Learning (PBL). The review was conducted using the PRISMA 2020 framework to ensure methodological transparency and rigor. Relevant articles published between 2015 and 2025 were retrieved from Scopus, Web of Science, ERIC, and Google Scholar databases using predefined inclusion and exclusion criteria. The findings demonstrate that student-centered learning models consistently produce more favorable learning outcomes than conventional teacher-centered approaches across cognitive, affective, and psychomotor domains. TGfU was found to significantly enhance tactical awareness, game intelligence, and decision-making performance through contextualized gameplay activities. Cooperative Learning strengthened interpersonal communication, teamwork, social responsibility, and student engagement, while PBL improved analytical thinking, problem-solving capacity, and learner autonomy during volleyball practice and competition simulations. Several studies also reported increased motivation, participation rates, and self-confidence among students exposed to these pedagogical models. The review further reveals a global trend toward integrating innovative and constructivist-oriented instructional strategies in sport pedagogy, particularly in volleyball education where tactical understanding and collaborative interaction are essential components of performance development. Despite these advantages, implementation challenges remain evident, including inadequate teacher pedagogical competence, limited instructional time, insufficient institutional support, and restricted access to learning resources and technology. These barriers may reduce the consistency and sustainability of student-centered instruction in physical education settings. In conclusion, student-centered learning approaches provide a comprehensive pedagogical framework for enhancing

volleyball instruction and promoting 21st-century competencies. The integration of TGfU, Cooperative Learning, and PBL is strongly recommended to support holistic student development, improve tactical and technical performance, and create more meaningful learning experiences in physical education. This review contributes theoretically and practically to the advancement of sport pedagogy research and offers evidence-based recommendations for educators, curriculum developers, and policymakers seeking to modernize volleyball learning practices.

Keywords: Student-centered learning, volleyball instruction, Teaching Games for Understanding, Cooperative Learning, Problem-Based Learning, physical education, sport pedagogy.

1 Introduction

The transformation of educational paradigms in the 21st century has significantly influenced instructional practices across various disciplines, including physical education. Contemporary learning environments increasingly emphasize student-centered learning (SCL), which positions learners as active participants in the construction of knowledge rather than passive recipients of information. This pedagogical orientation promotes critical thinking, collaborative interaction, creativity, problem-solving, and learner autonomy, all of which are considered essential competencies for 21st-century education and lifelong learning [1], [2]. In physical education contexts, student-centered pedagogies are increasingly viewed as effective approaches for improving learning engagement, enhancing motor performance, and fostering meaningful learning experiences through active participation and contextualized practice [3], [4].

Within sport pedagogy, volleyball represents one of the most widely implemented team sports in school and university physical education programs. Volleyball instruction requires the integration of technical proficiency, tactical understanding, communication skills, spatial awareness, and cooperative decision-making during dynamic game situations. However, conventional instructional approaches in volleyball education have traditionally relied on teacher-centered strategies characterized by repetitive drills, direct command styles, and isolated technical exercises [5]. Although these approaches may contribute to short-term technical acquisition, they frequently limit students' opportunities to develop tactical intelligence, creativity, and problem-solving abilities during authentic gameplay situations [6].

Recent developments in sport pedagogy research have encouraged the adoption of innovative student-centered instructional models designed to improve both learning quality and game performance. Among the most prominent approaches are Teaching Games for Understanding (TGfU), Cooperative Learning (CL), and Problem-Based Learning (PBL). TGfU emphasizes tactical awareness and decision-making through modified game situations that encourage students to understand strategic aspects of play before focusing on isolated technical execution [7]. Cooperative Learning promotes interpersonal interaction, teamwork, communication, and shared responsibility among learners through structured collaborative activities [8]. Meanwhile, Problem-Based

Learning encourages students to analyze game-related problems, generate solutions, and apply reflective thinking during learning processes, thereby supporting higher-order cognitive development and learner autonomy [9].

Empirical evidence from recent studies indicates that these pedagogical innovations positively influence multiple dimensions of learning in physical education. Previous investigations have reported improvements in students' motivation, tactical understanding, motor skill performance, engagement, and social interaction following the implementation of student-centered learning models [10], [11]. Furthermore, the integration of digital technology and game-based learning environments has expanded opportunities for interactive and contextualized instruction in sports education [12]. Such developments reflect a broader global transition toward constructivist and learner-oriented pedagogies in physical education curricula.

Despite the growing body of literature on student-centered learning in sport education, research concerning volleyball instruction remains fragmented and methodologically diverse. Existing studies often examine isolated instructional models, limited participant groups, or specific educational settings, resulting in inconsistent conclusions regarding pedagogical effectiveness. In addition, few review studies have systematically synthesized evidence related to the implementation trends, instructional characteristics, and multidimensional learning outcomes of student-centered approaches in volleyball education. Consequently, there remains insufficient comprehensive understanding regarding how these pedagogical models contribute to cognitive, affective, social, and psychomotor development in volleyball learning environments.

A systematic review is therefore necessary to consolidate current evidence and critically evaluate the effectiveness of student-centered pedagogical models in volleyball instruction. Through a structured synthesis of empirical studies, this review seeks to identify prevailing research trends, instructional practices, methodological patterns, and learning outcomes associated with TGfU, Cooperative Learning, and Problem-Based Learning in volleyball education. The review also aims to highlight implementation challenges and future research opportunities that may contribute to the advancement of evidence-based pedagogical practices in physical education.

Accordingly, this study aims to systematically review the literature related to student-centered learning models in volleyball instruction published between 2015 and 2025. Specifically, the study investigates the implementation characteristics, effectiveness, and educational implications of TGfU, Cooperative Learning, and Problem-Based Learning within volleyball learning contexts. The findings are expected to provide theoretical and practical contributions for educators, researchers, curriculum developers, and policymakers seeking to improve instructional quality and promote holistic student development through innovative sport pedagogy approaches.

2 Methodology

This study employed a systematic review design to examine the implementation and effectiveness of student-centered learning models in volleyball instruction within physical education settings. The review procedure followed the Preferred Reporting Items

for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines to ensure methodological transparency, consistency, and replicability throughout the review process [1]. A systematic review approach was considered appropriate because it enables the structured synthesis of empirical evidence, facilitates critical evaluation of pedagogical interventions, and identifies research trends and gaps within sport pedagogy literature [2].

2.1 Search Strategy

A comprehensive literature search was conducted between January and March 2026 using four major international academic databases, namely Scopus, Web of Science, ERIC, and Google Scholar. These databases were selected because they provide extensive coverage of sport science, physical education, and educational research publications [3]. The search strategy utilized combinations of keywords, Boolean operators, and synonym variations to maximize retrieval accuracy and coverage of relevant studies.

The primary keywords included “student-centered learning,” “learner-centered learning,” “volleyball instruction,” “physical education,” “sport pedagogy,” “Teaching Games for Understanding,” “Cooperative Learning,” and “Problem-Based Learning.” An example of the search syntax used in Scopus was as follows:

(“student-centered learning” OR “learner-centered learning” OR “constructivist learning”) AND (“volleyball” OR “volleyball instruction”) AND (“physical education” OR “sport pedagogy”).

To improve search comprehensiveness, backward and forward citation tracking techniques were also employed to identify additional relevant articles from reference lists and citation networks [4]. Only studies published in English between 2015 and 2025 were considered to ensure the inclusion of recent and internationally relevant evidence concerning pedagogical innovation in physical education.

2.2 Inclusion and Exclusion Criteria

To maintain the quality and relevance of the selected studies, predefined inclusion and exclusion criteria were established before the screening process. Studies were included if they met the following criteria: (1) published in peer-reviewed journals, (2) focused on student-centered pedagogical approaches in volleyball or physical education contexts, (3) reported empirical findings using quantitative, qualitative, or mixed-method designs, and (4) were published between 2015 and 2025. Conversely, studies were excluded if they: (1) consisted of conference abstracts, editorials, dissertations, or non-peer-reviewed publications, (2) did not specifically address volleyball or physical education learning contexts, (3) lacked empirical evidence, or (4) represented duplicate publications.

The study selection procedure followed the four PRISMA stages, namely identification, screening, eligibility assessment, and final inclusion [1]. During the identification phase, all retrieved records were exported into a reference management system, and duplicate studies were removed. Titles and abstracts were subsequently screened based

on the eligibility criteria, followed by full-text evaluation of potentially relevant studies. This structured selection procedure reduced selection bias and enhanced review reliability.

2.3 Data Extraction

Data extraction was conducted systematically using a standardized extraction form designed to organize and synthesize information from each included study. The extracted variables included authors, publication year, country, participant characteristics, research design, intervention model, learning duration, instruments used, and primary findings related to cognitive, affective, social, and psychomotor outcomes.

Particular attention was given to identifying the specific pedagogical models implemented, including Teaching Games for Understanding (TGfU), Cooperative Learning (CL), and Problem-Based Learning (PBL). Information regarding instructional characteristics, tactical learning outcomes, student engagement, and collaborative performance was also documented to support comparative analysis across studies. To ensure extraction reliability and minimize interpretation bias, all extracted data were cross-checked and reviewed repeatedly during the synthesis process.

2.4 Quality Assessment

The methodological quality of the selected studies was evaluated using general appraisal criteria adapted from systematic review procedures in educational research [5]. The assessment focused on several indicators, including clarity of research objectives, appropriateness of methodological design, adequacy of sampling procedures, validity and reliability of instruments, transparency of intervention procedures, and robustness of data analysis techniques.

Studies demonstrating clear research frameworks, systematic intervention implementation, and rigorous analytical procedures were categorized as having stronger methodological quality. This quality assessment process was essential to ensure the credibility, trustworthiness, and interpretive validity of the synthesized findings within the context of sport pedagogy research.

2.5 Data Analysis

The collected data were analyzed using qualitative synthesis combined with thematic analysis techniques. This analytical approach enabled the identification of recurring patterns, conceptual similarities, pedagogical trends, and implementation characteristics associated with student-centered learning models in volleyball instruction [6].

The synthesis focused on three major dimensions: (1) implementation characteristics of student-centered pedagogies, (2) effectiveness of instructional models in improving cognitive, affective, social, and psychomotor learning outcomes, and (3) emerging challenges and future directions in volleyball pedagogy. Narrative synthesis was subsequently employed to interpret the findings comprehensively and contextually. In addi-

tion, summary tables were utilized to present comparative information regarding research characteristics and pedagogical outcomes in a concise and Atlantis-friendly format.

The use of thematic synthesis provided deeper interpretation of the pedagogical implications of TGfU, Cooperative Learning, and Problem-Based Learning in physical education settings. This approach also strengthened the evidence-based foundation for evaluating innovative instructional strategies designed to improve volleyball learning experiences and promote holistic student development.

3 Result and Discussion

The synthesis of the selected studies demonstrates that student-centered learning models in volleyball instruction are primarily represented by three dominant pedagogical approaches, namely Teaching Games for Understanding (TGfU), Cooperative Learning (CL), and Problem-Based Learning (PBL). These instructional models collectively reflect a pedagogical transition from traditional teacher-centered methods toward learner-oriented approaches that integrate cognitive, affective, social, and psychomotor dimensions within physical education environments. Contemporary sport pedagogy increasingly recognizes that effective volleyball instruction should not merely emphasize technical mastery, but also develop tactical awareness, communication skills, collaboration, and critical decision-making during authentic gameplay situations [1], [2].

3.1 Teaching Games for Understanding (TGfU)

Among the reviewed pedagogical approaches, TGfU emerged as the most frequently implemented model in volleyball instruction. The findings indicate that TGfU prioritizes tactical understanding and contextual game awareness through modified gameplay scenarios rather than isolated technical drills. This approach allows students to actively interpret game situations, evaluate strategic options, and make appropriate decisions during dynamic volleyball activities.

Several empirical studies reported that students exposed to TGfU demonstrated significantly higher tactical awareness, decision-making ability, and game intelligence compared with students instructed through traditional drill-based methods [3], [4]. Improvements were particularly evident in positioning strategies, movement anticipation, spatial awareness, and shot selection during offensive and defensive transitions. Furthermore, TGfU contributed positively to student motivation and engagement because learners participated directly in authentic game contexts that simulated real competitive situations.

From a theoretical perspective, these findings are strongly aligned with constructivist learning theory, which emphasizes experiential learning, active participation, and knowledge construction through social interaction [5]. In volleyball learning environ-

ments, TGfU supports the integration of technical execution and tactical cognition simultaneously, thereby enabling students to understand not only “how” to perform volleyball skills, but also “when” and “why” those skills should be applied during gameplay.

Recent studies also suggest that TGfU contributes to improved game performance assessment outcomes and enhances students’ intrinsic motivation toward physical activity participation [6]. Consequently, TGfU is considered particularly effective for developing tactical competence and contextual understanding in volleyball education.

3.2 Cooperative Learning (CL)

Cooperative Learning represents another prominent student-centered pedagogical approach identified in the reviewed studies. This instructional model emphasizes structured group interaction, shared responsibility, positive interdependence, and collaborative achievement among learners. In volleyball instruction, CL creates opportunities for students to engage in peer-supported learning activities involving passing, serving, blocking, and attacking exercises within cooperative team structures.

The reviewed evidence indicates that Cooperative Learning positively influences both technical skill acquisition and affective learning outcomes. Students participating in CL-based volleyball instruction demonstrated higher levels of communication, teamwork, peer interaction, and learning satisfaction compared with students in conventional instructional settings [7]. Furthermore, the collaborative structure of CL encouraged active participation among less-skilled students, thereby reducing learning anxiety and improving overall classroom inclusivity.

The social dimension of volleyball makes CL particularly relevant because successful game performance depends heavily on coordination, communication, and mutual trust among team members. Previous investigations revealed that CL contributes substantially to the development of interpersonal competence, leadership, responsibility, and group cohesion within sport education contexts [8]. These findings support social constructivist perspectives, which argue that knowledge acquisition occurs effectively through collaborative interaction and shared learning experiences.

In addition, Cooperative Learning has been associated with increased student motivation and improved classroom climate in physical education settings [9]. Such outcomes are highly relevant for contemporary sport pedagogy, which increasingly prioritizes holistic student development alongside technical and tactical performance enhancement.

3.3 Problem-Based Learning (PBL)

Although less frequently implemented than TGfU and Cooperative Learning, Problem-Based Learning demonstrated promising pedagogical potential in volleyball instruction. PBL emphasizes inquiry-based learning processes in which students collaboratively solve authentic problems encountered during gameplay situations. Within volleyball education, these problems commonly involve tactical decision-making, defensive organization, offensive strategy selection, and optimization of team positioning.

The findings indicate that PBL contributes significantly to the development of higher order thinking skills, including critical thinking, analytical reasoning, and strategic problem-solving abilities [10]. Students exposed to PBL-based instruction showed greater autonomy in learning and improved capability to analyze complex game scenarios independently. Moreover, PBL encouraged reflective learning practices that enabled students to evaluate performance outcomes and generate alternative tactical solutions collaboratively.

From a pedagogical perspective, PBL aligns with inquiry-based and self-directed learning frameworks that promote active cognitive engagement and deeper conceptual understanding [11]. In volleyball instruction, this approach enables students to develop strategic awareness while simultaneously enhancing communication and collaborative problem-solving skills.

However, the reviewed studies also identified several practical limitations associated with PBL implementation. Effective application of PBL requires substantial instructional preparation, advanced facilitation skills, and sufficient instructional time. Teachers must carefully design authentic learning problems and maintain balanced guidance to prevent cognitive overload among students. Consequently, PBL implementation may present challenges in educational contexts characterized by limited instructional resources or insufficient teacher training.

3.4 Comparative Analysis of Student-Centered Learning Models

A comparative analysis of TGfU, Cooperative Learning, and PBL indicates that each pedagogical model possesses distinct instructional strengths and educational contributions within volleyball learning environments. TGfU was particularly effective in improving tactical awareness, game intelligence, and decision-making performance. Cooperative Learning demonstrated superior effectiveness in promoting teamwork, communication, and social interaction, whereas PBL contributed substantially to the enhancement of critical thinking and analytical problem-solving abilities.

Despite these differences, the three pedagogical models share several fundamental characteristics associated with student-centered learning. These include active learner participation, contextualized instruction, collaborative interaction, reflective learning processes, and the integration of cognitive and psychomotor development. The collective findings suggest that student-centered pedagogical approaches are more effective than traditional teacher-centered instruction in achieving comprehensive learning outcomes across cognitive, affective, and psychomotor domains [12].

The comparative findings also indicate that TGfU and Cooperative Learning are generally easier to implement within school-based volleyball instruction because they can be adapted to various class sizes and learning conditions. Conversely, PBL requires higher levels of cognitive readiness, instructional planning, and classroom management, making its implementation relatively more complex in practice.

3.5 Implementation Challenges and Pedagogical Implications

Although the reviewed studies demonstrated substantial benefits associated with student-centered learning models, several implementation challenges were consistently identified. Teachers frequently experienced difficulties transitioning from traditional instructional approaches toward student-centered pedagogies due to limited professional training, insufficient pedagogical competence, restricted instructional time, and inadequate learning resources.

Furthermore, effective implementation of TGfU, CL, and PBL requires systematic lesson planning, adaptive facilitation skills, and continuous performance assessment. Without adequate institutional support and professional development opportunities, teachers may struggle to apply these approaches consistently and effectively. These findings emphasize the importance of teacher readiness and curriculum support in promoting successful pedagogical innovation within physical education.

From a sport pedagogy perspective, the integration of student-centered learning models into volleyball instruction provides substantial opportunities for developing 21st-century competencies, including collaboration, communication, creativity, critical thinking, and problem-solving skills. These competencies are increasingly recognized as essential educational outcomes in modern physical education curricula [13].

Overall, the findings of this review confirm that TGfU, Cooperative Learning, and Problem-Based Learning provide meaningful pedagogical contributions to volleyball education. Beyond improving technical and tactical performance, these approaches promote holistic student development through experiential, collaborative, and reflective learning processes. Future research should therefore explore hybrid pedagogical frameworks that combine the strengths of TGfU, CL, and PBL, as well as investigate their long-term effects on student motivation, tactical performance, and learning sustainability across diverse educational contexts.

Table 1. Comparison of Student-Centered Learning Models in Volleyball Instruction.

Aspect	Teaching Games for Understanding (TGfU)	Cooperative Learning (CL)	Problem-Based Learning (PBL)
Pedagogical Focus	Tactical awareness and game understanding	Social interaction and teamwork	Problem-solving and critical thinking
Learning Approach	Game-based and contextual learning	Group-based collaborative learning	Inquiry-based and problem-driven learning
Main Objective	Develop decision-making in game situations	Enhance cooperation and interpersonal skills	Develop analytical and reasoning abilities
Role of Teacher	Facilitator and game designer	Organizer and group facilitator	Facilitator and guide in problem-solving
Role of Students	Active players and decision-makers	Team members responsible for group success	Independent learners and problem solvers

Learning Activities	Modified games, tactical scenarios	Group tasks, peer teaching, teamwork drills	Case analysis, tactical problem scenarios
Strengths	Improves tactical skills and engagement	Enhances teamwork, communication, and motivation	Develops higher-order thinking skills
Weaknesses	Limited focus on isolated technical skills	May depend on group dynamics	Requires high cognitive readiness and time
Learning Outcomes (Cognitive)	High (tactical understanding)	Moderate	High (critical thinking)
Learning Outcomes (Affective)	High (motivation, engagement)	Very High (social skills, cooperation)	Moderate–High
Learning Outcomes (Psychomotor)	Moderate–High	Moderate–High	Moderate
Suitability in Volleyball	Very suitable for game strategy and positioning	Highly suitable for team-based drills	Suitable for tactical problem-solving situations
Assessment Approach	Game performance assessment	Peer and group evaluation	Problem-solving and reflective assessment
Implementation Complexity	Moderate	Low–Moderate	High
Best Use Scenario	Teaching game tactics and decision-making	Building teamwork and collaboration	Developing strategic thinking and analysis

4 Conclusion and Implications

This systematic review confirms that student-centered learning models, particularly Teaching Games for Understanding (TGfU), Cooperative Learning (CL), and Problem-Based Learning (PBL), provide substantial pedagogical contributions to volleyball instruction within physical education contexts. The synthesized findings indicate that these instructional approaches are consistently more effective than conventional teacher-centered methods in improving multidimensional learning outcomes across cognitive, affective, social, and psychomotor domains. TGfU was found to significantly strengthen tactical awareness, game intelligence, and decision-making abilities through contextualized gameplay experiences. Cooperative Learning effectively enhanced teamwork, communication, peer interaction, and social responsibility, while Problem-Based Learning promoted higher-order thinking, analytical reasoning, and

collaborative problem-solving skills. Collectively, these pedagogical models support the development of holistic competencies required not only for volleyball performance but also for broader 21st-century educational demands [1], [2].

The findings further demonstrate that student-centered pedagogies contribute to more meaningful and engaging learning experiences because students actively participate in the learning process rather than functioning as passive recipients of instruction. This shift reflects contemporary constructivist perspectives in sport pedagogy, which emphasize experiential learning, reflective practice, collaboration, and learner autonomy as essential components of effective physical education [3]. In volleyball learning environments, these approaches facilitate the simultaneous development of technical execution, tactical understanding, and interpersonal competence, thereby supporting comprehensive athlete and student development.

Despite these advantages, the implementation of student-centered learning models in volleyball instruction remains uneven across educational settings. Several challenges continue to limit effective application, including insufficient teacher preparation, limited professional development opportunities, inadequate instructional resources, and restricted instructional time. In addition, some teachers still encounter difficulties transitioning from traditional drill-based instruction toward facilitative and learner-centered pedagogical roles. These barriers indicate that successful implementation of TGfU, CL, and PBL requires systematic institutional support, pedagogical training, and curriculum adaptation to ensure instructional sustainability and effectiveness [4].

From a curriculum and policy perspective, the findings emphasize the importance of integrating student-centered pedagogical principles into physical education standards and instructional frameworks. Educational institutions and policymakers should encourage the development of competency-based curricula that prioritize not only technical skill mastery, but also tactical cognition, collaboration, creativity, and critical thinking. Structured teacher training programs, workshops, and evidence-based instructional guidelines are also necessary to strengthen educators' pedagogical competence in applying innovative sport teaching models effectively.

From a practical perspective, physical education teachers are encouraged to adopt flexible and context-sensitive instructional strategies by integrating elements of TGfU, Cooperative Learning, and Problem-Based Learning into volleyball instruction. Hybrid pedagogical approaches may provide more balanced learning environments by combining tactical gameplay, collaborative interaction, and problem-solving activities simultaneously. For example, modified games derived from TGfU can be combined with cooperative team structures and reflective tactical analysis tasks to optimize student engagement and learning effectiveness. Continuous assessment, reflective teaching practices, and adaptive instructional design are also essential to accommodate diverse student characteristics and learning needs.

Finally, future research should investigate integrated pedagogical frameworks that combine the strengths of multiple student-centered models within volleyball and broader sport education contexts. Further studies are also recommended to examine long-term impacts on student motivation, tactical performance, physical literacy, and learning sustainability. Additionally, the integration of digital technologies, video analysis, and interactive learning platforms into student-centered volleyball instruction

represents an important direction for future pedagogical innovation in physical education. Such efforts may contribute to the advancement of evidence-based, technologically supported, and sustainable sport pedagogy practices aligned with contemporary educational transformation.

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