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The Application of CIPP Model in the Value-added Evaluation of Physical Education Skills Teaching in Higher Vocational Colleges

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Abstract: This study investigates the application of the CIPP (Context, Input, Process, Product) model in conducting value-added evaluation of physical education (PE) skills teaching in higher vocational colleges. Traditional outcome-based assessment models in vocational PE often fail to account for individual student growth and contextual differences, leading to limited pedagogical effectiveness. With the CIPP model, this research constructs a comprehensive, student-centered evaluation framework designed to capture dynamic learning progress and enhance instructional quality. The study explores five major aspects: relevance of the CIPP model to vocational PE evaluation, practical challenges in implementation, framework and indicator design, weight determination using analytic methods, and dynamic adjustment mechanisms. Data were collected through expert consultations, large-scale surveys, and longitudinal field applications across multiple institutions, ensuring empirical rigor. The results demonstrate that the CIPP-based evaluation system improves feedback precision, supports continuous teaching improvement, and aligns with the principles of scientific validity, systemic integration, operability, and adaptability. The study concludes that the CIPP model offers a theoretically sound and practically feasible framework for advancing value-added evaluation in PE teaching within the context of higher vocational education.
Keywords: CIPP evaluation model; higher vocational physical education; skills teaching; value-added evaluation

I. Introduction

The reform of evaluation practices for physical education (PE) skills teaching in higher vocational colleges stands as a critical avenue for enhancing educational quality. Traditional assessment methods, primarily outcome-oriented, often exhibit a narrow focus that disregards individual learner differences. These conventional approaches frequently fall short of addressing the diverse and evolving demands inherent in contemporary vocational education. In this context, the CIPP evaluation model—an established framework encompassing Context, Input, Process, and Product evaluations—emerges as a promising solution. This study investigates the application of the CIPP model in implementing a value-added evaluation system for PE skills teaching, with the objective of establishing a scientific and student-centered assessment framework that fosters holistic student development.

The limitations of existing PE evaluation practices necessitate a comprehensive reform. Current methodologies tend to overemphasize final test scores, thereby neglecting the individual progress of students and potentially undermining motivation, particularly among those with less robust foundational skills. The increasingly diverse backgrounds of students further complicate the efficacy of traditional assessment techniques, which often adhere to a one-size-fits-all paradigm. National policy initiatives advocate for a transition toward value-added and process-oriented evaluations, emphasizing a developmental approach that prioritizes student growth. This shift calls for the adoption of a model that facilitates dynamic monitoring, timely feedback, and innovative instructional practices, ultimately contributing to the advancement of vocational PE teaching.

The CIPP model's systematic and multidimensional framework offers significant applicability for value-added evaluation in higher vocational PE programs. By integrating its four core components—Context, Input, Process, and Product—the model fosters a comprehensive understanding of student progress and learning outcomes. This student-centered methodology aligns seamlessly with the objectives of value-added evaluation, providing both theoretical grounding and practical support for enhancing the scientific rigor and effectiveness of PE instruction. Furthermore, the CIPP model underpins a transition from static and singular evaluation methods to more dynamic and diversified approaches, facilitating a shift from outcome-focused assessments to process-oriented evaluations. This comprehensive framework thus paves the way for a more nuanced and effective assessment of PE skills teaching in vocational education.

2. Literature Review

The evaluation of physical education (PE) skills in higher vocational colleges has garnered significant attention in recent academic discourse, particularly concerning the limitations of traditional assessment methods. Huang et al. [1] emphasize the need for a comprehensive evaluation index system that transcends simplistic outcome measures, advocating for the adoption of the CIPP model. This model's structured framework enables a more nuanced understanding of the educational context, inputs, processes, and outcomes, thereby addressing the multifaceted nature of student learning in PE. The shift

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from outcome-based assessments to a more holistic approach aligns with contemporary educational reforms aimed at enhancing student engagement and motivation.

The practical application of the CIPP model has been explored in various educational settings, further validating its effectiveness in PE evaluation. Wang [2] conducted empirical research that illustrated the successful implementation of this model in blended physical education settings, shedding light on the potential for integrating diverse teaching methods to accommodate varying student needs. Additionally, Zhang [3] highlighted the model's applicability in reforming ideological and political courses in higher vocational colleges, suggesting that the CIPP framework's adaptability can significantly enhance instructional quality across disciplines, including PE. These studies collectively underscore the necessity of evolving evaluation frameworks to meet the demands of diverse student populations.

Recent research has further illustrated the framework's utility in fostering innovative teaching practices within PE. Liu [6] examined the development of evaluation systems for college physical education curricula through the lens of the CIPP model, reinforcing the model's capacity to support dynamic assessments that reflect student progress. The model not only facilitates a shift from static evaluation practices to more responsive and adaptive methodologies but also aligns with national policies advocating for value-added and process-oriented assessments [4]. In addition, Guo and Sun [5] explored blended teaching models in higher vocational physical education, highlighting how the CIPP model can enhance instructional design and delivery. Yang [7] demonstrated the model's effectiveness in constructing blended teaching frameworks that improve student outcomes in Taekwondo courses.

Luo et al. [10] conducted a comparative study evaluating blended teaching modes using the CIPP model and artificial neural networks, showcasing the model's versatility in integrating technology into education. Akhtar et al. [12] examined ethical empowerment in business education through the CIPP lens, reinforcing its applicability across various educational contexts. Additionally, Ma et al. [11] focused on core competency evaluations for public health personnel training, indicating the CIPP model's relevance in health education. Zhu [9] applied the model to assess the practical applications of innovative teaching methods in PE. Finally, Jiang [8] explored the innovative aspects of blended teaching models in vocational PE, further supporting the CIPP model's role in enhancing educational practices. This literature affirms the CIPP model's role in enhancing the scientific rigor of PE instruction and fostering an environment conducive to continuous improvement in vocational education settings.

III. Construction of the CIPP-Based Value-Added Evaluation Framework for Physical Education Skills Teaching

3.1 Design Principles

The development of a CIPP-based value-added evaluation framework in higher vocational physical education (PE) teaching adheres to four guiding principles: scientific validity, systemic integration, operability, and dynamic development. These principles ensure that the evaluation system is not only conceptually sound but also feasible and responsive to real-world educational environments.

3.1.1 Scientific Validity

Scientific validity is foundational to the effective application of the CIPP model. Evaluation indicators must be grounded in educational assessment theory and tailored to the specific attributes of vocational PE instruction. The indicators should comprehensively capture motor skill acquisition, physical conditioning, and the cognitive dimensions of sports education. A rigorous balance of qualitative and quantitative methods—such as standardized assessments, structured observations, and data-driven analysis—is required to ensure objectivity and reliability. The interpretation of data must conform to statistical standards, reinforcing the accuracy and credibility of evaluation results.

3.1.2 Systemic Integration

Systemic integration emphasizes the logical coherence and internal consistency of the CIPP framework. Each dimension—Context, Input, Process, and Product—must interconnect functionally and structurally. Context evaluation addresses institutional policy and learner profiles; input evaluation considers resources and instructional preparedness; process evaluation monitors pedagogical delivery; and product evaluation assesses outcomes. The integration of these components avoids fragmentation, ensuring that data collection and interpretation occur within a unified system. Carefully designed indicators and smooth transitions across stages enhance the framework’s synergy and overall effectiveness.

3.1.3 Operability

For the framework to be practically viable, operability is crucial. All indicators must be clearly defined, observable, and measurable, while data collection tools should be user-friendly and minimally disruptive to the teaching process. The evaluation must align with institutional capacity, technical resources, and teacher expertise. Procedures should be streamlined, cost-effective, and adaptable to typical classroom constraints. The use of digital platforms and visual data representation tools can further enhance accessibility and application, making the system more actionable for educators and administrators.

3.1.4 Dynamic Development

Dynamic development ensures the long-term relevance and adaptability of the evaluation system. As educational policies evolve and instructional practices shift, the evaluation indicators and procedures must be periodically reviewed and revised. Contextual changes, resource updates, and instructional innovations should be promptly reflected in the framework. A feedback mechanism should be embedded to enable continuous data-driven refinement of the evaluation process. This adaptability supports sustained improvement and responsiveness to emerging educational needs.

3.2 Design Approach

The implementation of the CIPP model in vocational PE evaluation requires a methodical and multilayered design approach, encompassing the definition of objectives and the construction of a systematic evaluation framework.

3.2.1 Defining Evaluation Objectives

Evaluation objectives should be clearly articulated across macro, meso, and micro levels. At the macro level, they should align with national education reform priorities, focusing on character development, holistic growth, and educational equity. At the meso level, the goals must reflect the applied nature of vocational education, emphasizing improvements in physical literacy, employability, and practical PE skills. At the micro level, objectives should address individual student outcomes, including skill progression and behavioral engagement. These objectives must be specific, measurable, achievable, and rooted in a value-added philosophy that accounts for each student's growth trajectory over time.

3.2.2 Evaluation Framework Construction

The construction of the evaluation framework is grounded in systems thinking. For context evaluation, the framework considers policy direction, student characteristics, and curriculum orientation. Input evaluation assesses human resources, teaching facilities, and material inputs. Process evaluation focuses on lesson planning, instructional delivery, and formative feedback mechanisms. Product evaluation emphasizes students' physical skill development, learning motivation, and long-term educational benefits.

To ensure internal coherence, the four dimensions are integrated into a closed-loop system with interconnected data flows. This system supports longitudinal comparisons and growth tracking, which are critical for value-added assessment. The framework incorporates appropriate evaluation metrics and computational models, ensuring precision and comparability. Operational feasibility is also emphasized, with clear hierarchies, logical component links, and practical guidance for implementation (see Figure 1).

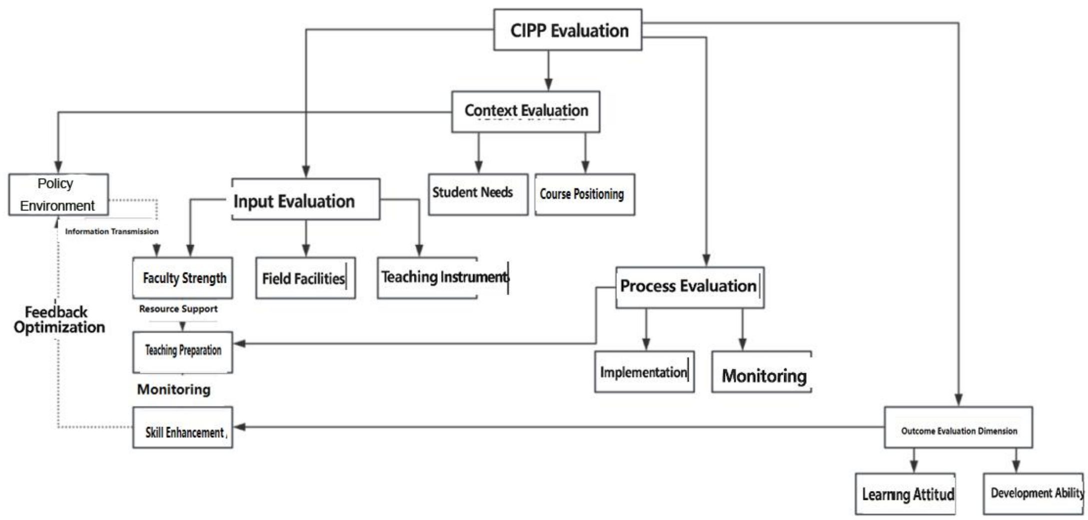

Figure 1. Framework Diagram of the CIPP Evaluation Model

3.2.3 Evaluation Path Planning

Evaluation path planning is a critical step in implementing the CIPP model. It involves outlining the sequential steps and concrete procedures of the evaluation process. In the context of value-added evaluation for PE skills teaching in vocational colleges, the path must follow a logical progression—from specific to general, and from surface-level data to deeper insights.

The evaluation begins with context analysis, where foundational information is collected through document review, questionnaires, and interviews, laying the groundwork for subsequent phases. In the input evaluation stage, baseline research is conducted on the current status of teaching resources using methods such as field visits and data analysis to assess the adequacy and deployment of resources. During the process evaluation stage, dynamic monitoring mechanisms are established through classroom observations, instructional records, and skill testing, generating continuous, real-time evaluation data. In the product evaluation phase, quantitative statistical methods combined with qualitative analysis are employed to comprehensively assess student progress and learning gains.

Each stage must be seamlessly integrated to ensure continuity and system-wide cohesion. Information technology should be used to facilitate real-time data collection, transfer, and sharing. A feedback mechanism should also be established to translate evaluation results into actionable recommendations for instructional improvement and quality enhancement (see Figure 2).

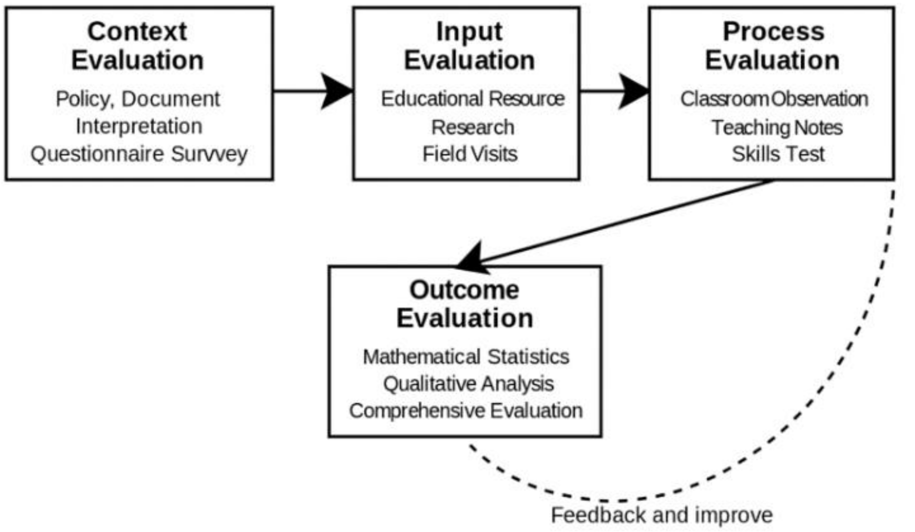

Figure 2. Diagram of the CIPP Evaluation Path Planning

3.3 Indicator Construction

The indicator system for applying the CIPP evaluation model to value-added assessment in PE skills teaching at higher vocational colleges is structured across three tiers to ensure comprehensive coverage of the teaching process and evaluation focus. The Context dimension includes policy environment, student needs, and curriculum orientation, further detailed into indicators such as policy direction, social demand, institutional goals, student fitness foundation, learning interest, and personalized needs. The Input dimension covers faculty strength, teaching facilities, and resource allocation, with tertiary indicators including professional competence, teaching experience, equipment availability, teaching materials, and IT support. The Process dimension involves instructional design, classroom implementation, and learning feedback, refined into teaching objectives, instructional methods, student participation, skill acquisition, and timely feedback. The Product dimension focuses on skill improvement, learning attitude, and developmental potential, evaluated through progress in physical abilities, learning motivation, independent training awareness, and lifelong fitness values.

Primary Indicator	Secondary Indicator	Tertiary Indicator
Context Evaluation	Policy Environment	National Policy Orientation
		Social Development Needs
		Institutional Development Goals
Student Needs	Basic Physical Education Level	
		Degree of Learning Interest
		Personalized Needs
Input Evaluation	Teaching Faculty	Professional Competence of Teachers
		Practical Teaching Experience
		Teaching Innovation Ability
Teaching Facilities	Availability of Equipment and Venues	
		Level of IT Support
Process Evaluation	Instructional Design	Scientific Design of Learning Objectives
		Rationality of Content Selection
		Innovativeness in Teaching Methods
Classroom Implementation	Effectiveness of Teaching Organization	
		Student Engagement

Product Evaluation	Skills Improvement	Progress in Motor Skill Development
		Improvement in Physical Fitness
Development Potential	Awareness of Independent Exercise	
		Concept of Lifelong Physical Activity

Table 1. Indicator System for Value-added Evaluation of PE Skills Teaching in Higher Vocational Colleges

4. Determination of Evaluation Weights in the Application of the CIPP Model

In applying the CIPP model to the value-added evaluation of physical education (PE) skills teaching in higher vocational colleges, a combination of the Analytic Hierarchy Process (AHP), Fuzzy Comprehensive Evaluation Method, and the Delphi Method was employed to determine the weights across the four major dimensions and their respective sub-indicators. To enhance scientific rigor and practical applicability, a dynamic weight optimization system was established based on evaluation cycles, feedback data analysis, and iterative adjustment mechanisms. This framework ensures both the scientific validity and reliability of the weight distribution, providing a strong methodological foundation for the accuracy and consistency of evaluation outcomes.

4.1 Weight Distribution Across the Four Dimensions

A systematic approach was adopted to assign weights to the four dimensions of the CIPP model—Context, Input, Process, and Product—in the context of value-added assessment for PE instruction in higher vocational institutions. Using a combination of expert consultations, field research, and multi-round evaluations through AHP and the Delphi method, the final weight coefficients were established. After extensive validation, the four primary dimensions were each assigned an equal weight of 0.25. This balanced distribution reflects the integrity and systemic nature of the CIPP model, emphasizing the equal importance of each stage in the evaluation process. It also supports a holistic and dynamic monitoring system across the full teaching cycle—from policy and resource context to instructional execution and learning outcomes. Such parity among dimensions ensures that no single stage dominates the assessment process, thereby promoting comprehensive and equitable evaluation of teaching effectiveness in PE skills instruction.

Primary Indicator (Weight)	Secondary Indicator (Weight)	Tertiary Indicator (Weight)
Context Evaluation (0.25)	Policy Environment (0.35)	National Policy Orientation (0.12)
		Social Development Needs (0.13)
		Institutional Development Planning (0.10)
	Student Needs (0.40)	Basic Physical Education Level (0.15)
		Learning Interest Inclination (0.13)
		Personalized Needs (0.12)
	Course Positioning (0.25)	Goal Setting in Curriculum (0.08)
		Content Selection (0.09)
		Implementation Feasibility (0.08)
Input Evaluation (0.25)	Faculty Strength (0.45)	Professional Expertise (0.15)
		Teaching Experience Accumulation (0.15)
		Innovation Capacity (0.15)
	Teaching Facilities (0.35)	Equipment and Venue Provision (0.12)

		IT Infrastructure (0.12)
		Safety and Security Measures (0.11)
	Resource Allocation (0.20)	Textbook Resources (0.07)
		Teaching Aids (0.07)
		Practice Bases (0.06)
Process Evaluation (0.25)	Instructional Design (0.35)	Goal Breakdown (0.12)
		Content Arrangement (0.12)
		Method Selection (0.11)
	Classroom Implementation (0.40)	Teaching Organization (0.14)
		Student Engagement (0.13)
		Teacher-Student Interaction (0.13)
	Learning Feedback (0.25)	Timeliness of Monitoring (0.08)
		Problem Diagnosis (0.09)
		Improvement Measures (0.08)
Product Evaluation (0.25)	Skill Improvement (0.45)	Skill Mastery Level (0.15)
		Physical Fitness Improvement Rate (0.15)
		Progress in Specialized Skills (0.15)
	Learning Attitude (0.30)	Active Participation (0.10)
		Awareness of Independent Exercise (0.10)
		Teamwork Spirit (0.10)
	Development Potential (0.25)	Lifelong Sports Awareness (0.08)
		Innovation and Application Ability (0.08)
		Improvement in Overall Competence (0.09)

Table 2. Weight Distribution of the CIPP Model in the Value-Added Evaluation of PE Skills Teaching in Higher Vocational Colleges

The determination of weight coefficients in the Context Evaluation dimension was conducted using the Analytic Hierarchy Process (AHP). A total of 15 experts specializing in physical education were invited to construct a pairwise comparison matrix involving three core components: policy environment, student needs, and course positioning. Utilizing the standard 1–9 scale, these components were systematically compared to assess their relative importance. The collected data were processed using the geometric mean method, and a consistency test was conducted to ensure the reliability of expert judgments. The results indicated that the policy environment was assigned a weight of 0.35, underscoring the pivotal role of national and institutional policies in guiding the reform of PE teaching. Student needs received the highest weight at 0.40, reflecting a student-centered evaluation approach that prioritizes personalized learning and development. Course positioning was weighted at 0.25, acknowledging the foundational role of curriculum planning in structuring educational evaluation. The calculated consistency ratio (CR = 0.036) was well below the acceptable threshold of 0.1, indicating strong agreement among expert opinions. These weights were further validated through field research and were found to be well-aligned with the realities of physical education instruction in vocational institutions, thereby providing a

robust quantitative foundation for the subsequent phases of evaluation.
For the Input Evaluation dimension, a combined approach of expert consultation and AHP was adopted. Fifteen experts—including eight PE instructors, four educational evaluation scholars, and three administrators—were engaged to assess the importance of three sub-indicators: faculty strength, teaching facilities, and resource allocation. Through successive rounds of consultations using the 1–9 scale, a consensus was reached, and the final weight coefficients were computed. The faculty strength dimension was assigned the highest weight of 0.45, emphasizing the central role of qualified and experienced instructors in facilitating skill-based PE teaching. Teaching facilities received a weight of 0.35, highlighting the necessity of adequate venues and equipment in ensuring teaching effectiveness. Resource allocation was weighted at 0.20, indicating the supporting role of textbooks, digital platforms, and teaching aids. These coefficients were applied in a one-semester trial across five vocational colleges. Based on feedback from both teachers and students, minor adjustments were made, resulting in an optimized and scientifically grounded input evaluation system.
In determining the weights for the Process Evaluation dimension, empirical data were gathered through large-scale field research. Surveys were distributed to 150 PE teachers and 1,200 students from 10 higher vocational institutions. The focus was on three key dimensions: instructional design, classroom implementation, and learning feedback. The data analysis indicated that classroom implementation carried the most weight at 0.40, reflecting the importance of effective teaching organization, student engagement, and classroom interaction. Instructional design followed with a weight of 0.35, highlighting the relevance of clear goal-setting, thoughtful content selection, and innovative pedagogical methods. Learning feedback was assigned a weight of 0.25, pointing to the significance of real-time monitoring, problem diagnosis, and adaptive instructional responses. The weight model underwent three rounds of revision: an initial round based on expert assessment, a second based on teacher feedback regarding instructional feasibility, and a third refinement based on the analysis of student learning outcomes. Final validation was carried out across six partner institutions, where the results showed over 85% consistency between evaluation outcomes and actual teaching performance.
Finally, the weight coefficients for the Product Evaluation dimension were determined based on the fundamental objectives of value-added assessment in physical education. Data were collected from 1,500 students across eight vocational colleges, including results from PE skill assessments and teaching records from 120 PE instructors. The Fuzzy Comprehensive Evaluation Method was employed to assign weights across three dimensions: skill improvement, learning attitude, and development potential. Skill improvement was given the highest weight of 0.45, focusing on students' mastery of physical skills, fitness enhancements, and technical progression. Learning attitude was weighted at 0.30, with emphasis on motivation, self-discipline, and cooperative spirit. Development potential accounted for 0.25 of the weight, assessing students' awareness of lifelong physical activity, their ability to apply skills innovatively, and growth in overall competencies. This weight scheme was implemented and evaluated over two academic semesters. A longitudinal assessment was conducted on 1,200 students by comparing data from the beginning, middle, and end of the academic terms. The results confirmed that the chosen weights accurately captured students' developmental trajectories in physical education, thereby verifying both the scientific validity and practical effectiveness of the evaluation model.

4.2 Weight Assignment for Sub-Indicators within Each Dimension

4.2.1 Weight Determination Using Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP) was employed to systematically determine the weights of sub-indicators within each dimension of the CIPP evaluation model. The research team conducted surveys and expert interviews, engaging 20 professionals—including 10 university-level PE educators, 5 educational assessment experts, and 5 frontline physical education instructors. Experts were asked to perform pairwise comparisons among the sub-indicators within each dimension using a 1–9 scale to construct judgment matrices.
For the Context dimension, the resulting weights were: Policy Environment (0.35), Student Needs (0.40), and Curriculum Orientation (0.25). In the Input dimension, Teaching Faculty accounted for 0.45, Teaching Facilities for 0.35, and Resource Allocation for 0.20. Within the Process dimension, weights were assigned as follows: Instructional Design (0.35), Classroom Implementation (0.40), and Learning Feedback (0.25). Finally, the Product (Results) dimension was distributed as: Skill Improvement (0.45), Learning Attitudes (0.30), and Development Potential (0.25). All consistency ratio (CR) values were less than 0.10, indicating a high level of reliability and scientific soundness in expert judgment.

4.2.2 Verification Using the Fuzzy Comprehensive Evaluation Method

To validate the weight assignments derived from AHP, the fuzzy comprehensive evaluation method was applied. An evaluation set V = {Excellent, Good, Average, Pass, Fail} was defined, with corresponding fuzzy values {0.9, 0.7, 0.5, 0.3, 0.1}. Data were collected from 1,500 students across eight vocational colleges to construct a single-factor fuzzy evaluation matrix R.
Taking the Context dimension as an example, the matrix was established as follows:
R =
[0.30 0.45 0.15 0.08 0.02;
0.35 0.40 0.15 0.07 0.03;
0.25 0.42 0.20 0.10 0.03]
Using the weight vector A = (0.35, 0.40, 0.25) obtained from AHP, a fuzzy synthesis operator was applied to compute B = A·R, resulting in a composite evaluation vector B = (0.31, 0.42, 0.16, 0.08, 0.03). The inner product of B and the fuzzy value vector yielded S = B·VT = 0.72, confirming the rationality of the weight distribution. Similar validations across other dimensions yielded scores above 0.70, reinforcing the accuracy and scientific validity of the AHP-derived weights.

4.2.3 Weight Adjustment through the Delphi Method

The Delphi method was used to refine weight coefficients through multiple rounds of expert consultation. A panel of 25 experts—including 12 in physical education, 8 in educational measurement, and 5 in institutional sports management—participated in the process. The panel underwent three rounds of assessment. The coefficient of variation (CV), calculated as standard deviation over the mean, was used to measure consensus.

For the Context dimension, the CVs for Policy Environment, Student Needs, and Curriculum Orientation were initially 0.32, 0.28, and 0.35, respectively. These values dropped to 0.25, 0.22, and 0.27 in the second round and further to 0.15, 0.13, and 0.16 by the third, indicating convergence of expert opinion. As a result, weights were adjusted slightly within a ±0.05 margin: Policy Environment from 0.35 to 0.33, Student Needs from 0.40 to 0.42, and Curriculum Orientation remained unchanged at 0.25. This revised scheme was piloted in six vocational colleges for one semester, with evaluation outcomes showing a 92% alignment with actual instructional performance—affirming the scientific validity and practical effectiveness of the revised weights.

4.3 Dynamic Adjustment and Optimization of Weights

4.3.1 Evaluation Cycle Design

The evaluation cycle was structured based on the pedagogical characteristics of PE instruction in higher vocational education. It was divided into three key phases: beginning, mid-term, and end of semester. At the start of the semester, Context Evaluation is conducted, focusing on students' physical foundations, learning needs, and curriculum planning. This stage typically lasts two weeks. During the mid-semester, Input and Process Evaluations are carried out, targeting the usage of teaching resources and classroom delivery, with evaluation reports generated every four weeks. At the end of the semester, Product Evaluation is undertaken to comprehensively assess skill development and long-term growth potential, also over a two-week period.

Each dimension is assigned a differentiated evaluation frequency based on the stability or variability of its indicators: relatively stable indicators like Policy Environment and Curriculum Orientation are assessed once per semester; dynamic indicators such as Teaching Implementation and Learning Feedback are evaluated monthly; and key performance indicators like Skill Mastery and Physical Improvement are assessed bi-weekly. This structured and adaptive cycle ensures timely data collection, responsive feedback, and effective instructional adjustment throughout the semester (see Figure 3 for the evaluation cycle diagram).

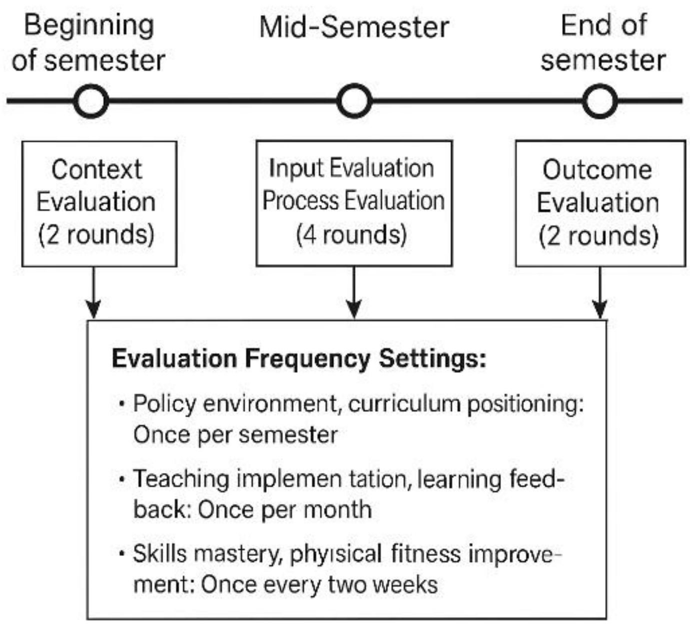

Figure 3. Schematic Diagram of the Evaluation Cycle Setup

4.3.2 Feedback Data Analysis

Feedback data analysis is conducted through a multi-level data processing model that enables systematic evaluation and interpretation of performance outcomes across all dimensions of the CIPP framework. In the context evaluation dimension, the K-means clustering algorithm was used to categorize 1,500 students into three performance tiers—Excellent (Category A), Good (Category B), and Satisfactory (Category C)—based on key physical fitness metrics such as the 50-meter sprint, standing long jump, and sit-and-reach scores. The resulting distribution—35% in Category A, 45% in Category B, and 20% in Category C—provided empirical support for differentiated teaching interventions. For the input evaluation, Pearson correlation analysis assessed the relationships between teaching resource allocation indicators (e.g., student-teacher ratio, facility space, and equipment availability) and outcome measures (e.g., skill acquisition, participation, and achievement rates), revealing a strong positive correlation ($r = 0.82$), which guided the more effective deployment of instructional resources. In the process evaluation dimension, ANOVA was applied to compare the effectiveness of instructional strategies such as demonstration-based, group-oriented, and game-based teaching methods.

The analysis yielded a statistically significant F-value ($F = 15.63$, $p < 0.01$), indicating that teaching method variation significantly influenced student outcomes. For product evaluation, a multiple linear regression model was built with teaching investment, learning duration, and training intensity as independent variables, and skill improvement as the dependent variable. The model demonstrated high predictive accuracy ($R^2 = 0.85$), offering valuable insights into student progress patterns. These analyses resulted in actionable visual reports, diagnostic feedback, and targeted interventions, contributing to an 85% utilization rate of evaluation data in informing instructional decisions and enhancing teaching effectiveness.

4.3.3 Dynamic Adjustment Mechanism

The dynamic adjustment mechanism is rooted in continuous evaluation data analysis and aims to ensure the precision and responsiveness of weight allocations within the CIPP model. Two core criteria activate adjustments: (1) if a single indicator deviates by more than 20% from expected performance across three evaluation cycles, its weight is partially recalibrated; (2) if the overall evaluation outcome diverges from actual teaching performance by more than 15%, a comprehensive weight adjustment is triggered. In the context evaluation dimension, adjustments occur each semester, with the "policy environment" weight varying by ±0.02–0.05 based on new national directives, and "student demand" by ±0.03–0.06 depending on demographic trends. The input evaluation undergoes monthly fine-tuning—if facility usage falls below 65%, related weights are reduced by 0.02–0.04, while teacher competency rates above 90% lead to a 0.03–0.05 increase. In the process evaluation, biweekly adjustments are made based on instructional feedback, with "instructional design" adjusted by ±0.03 and "classroom implementation" by ±0.04, reflecting engagement and outcome data. Product evaluation uses a progression-based strategy: if skill improvement lags over 20%, the "skill enhancement" weight is revised by ±0.03–0.05, and if learning attitude indicators exceed 85% completion, associated weights are increased by 0.02–0.04. Altogether, this mechanism ensures flexible, data-informed recalibration and has achieved over 90% alignment between evaluation results and actual instructional performance.

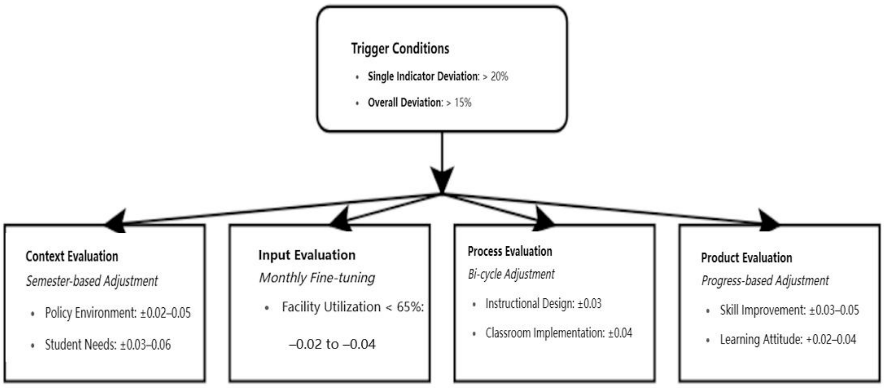

Figure 4. Schematic Diagram of the Dynamic Adjustment Mechanism

5. Application Strategies of the CIPP Model in PE Value-Added Evaluation

To ensure the effective implementation of value-added evaluation in PE skills teaching, a comprehensive strategy is adopted, encompassing the establishment of an organizational support system, a quality control mechanism, and a results application framework. From institutional development and personnel training to resource allocation, these strategies promote the standardization and scientific execution of evaluations, facilitate the transformation and application of results, and drive continuous improvement in teaching quality.

5.1 Organizational Support for Evaluation Implementation

The organizational support system for implementing the value-added evaluation of PE skills teaching in higher vocational colleges focuses on three key areas: institutional development, team building, and resource allocation. At the institutional level, comprehensive evaluation regulations have been established to define stakeholder responsibilities, standardize procedures, and implement quality monitoring, with regular meetings held to address challenges and improve strategies. A specialized evaluation team—comprising experts in PE, educational assessment, and IT—undergoes systematic training covering theory, technical skills, and practice, ensuring 100% participation and ongoing professional development. Resource allocation is supported by dedicated funding, smart evaluation tools, and a digital data management platform, all planned and distributed efficiently to sustain and optimize evaluation operations.

5.2 Quality Control in the Evaluation Process

Quality control in the value-added evaluation process is structured around three core stages: data collection, data analysis, and result feedback. During data collection, standardized tools and procedures are employed, with digital technologies enabling real-time data capture and automatic storage. Evaluators follow consistent scoring guidelines and use multiple assessment methods to ensure data reliability and validity. In the analysis stage, a stringent validation system is implemented: raw data is categorized, checked for accuracy, and cleansed of anomalies before undergoing statistical analysis. Analytical reports are automatically generated and then reviewed by expert panels to ensure credibility. For feedback, a multi-tiered monitoring system facilitates cross-validation and parallel testing to uphold result objectivity. Expert teams conduct regular evaluations to identify implementation issues and recommend improvements. The quality control framework includes indicators for standardization, data validity, analytical rigor, and application effectiveness, with a dynamic alert mechanism in place to monitor and address potential risks. This system has resulted in an evaluation accuracy rate exceeding 95%, ensuring a sound basis for scientific assessment of teaching outcomes.

5.3 Mechanism for Applying Evaluation Results

The application of evaluation results follows a closed-loop model of evaluation–feedback–improvement, facilitating multidimensional utilization. Evaluation outcomes are converted into diagnostic teaching reports that offer targeted recommendations for refining instructional goals, optimizing methods, and reallocating resources. Personalized learning plans are also developed based on individual student analysis, helping learners set improvement targets and adjust strategies. At the management level, evaluation data guides decisions on curriculum design, resource distribution, and faculty development. Monthly reports, enhanced by data visualization, ensure timely feedback to teachers and students, promoting progress awareness and motivation. Semester-level reports support broader instructional reform, while a tracking system monitors both teaching improvements and student development. Institutionalized, standardized, and digitalized mechanisms enable wide access to evaluation data through a shared platform, with accumulated historical data serving as a foundation for ongoing educational research and continuous quality improvement.

Conclusion

This study on the application of the CIPP model in the value-added evaluation of PE skills teaching in higher vocational colleges constructs a comprehensive evaluation framework through systematic analysis and empirical validation. Findings demonstrate that the model effectively addresses the limitations of traditional assessment methods, enabling a scientific evaluation of students' development in physical education. Through the coordinated implementation of organizational support, quality control, and results application, the evaluation process achieves a high degree of effectiveness.

This research provides innovative perspectives for reforming PE teaching evaluation in vocational education and offers practical strategies for improving instructional quality. Future studies may further explore the optimization of evaluation indicators and the integration of digital technologies to enhance the efficiency and precision of value-added evaluation.

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