Research on Construction of Quality Assurance System for Online-Offline Blended Teaching in Higher Education Based on PDCA Cycle Theory

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Abstract: Higher education faces critical challenges in blended teaching quality assurance, including absent standards, weak monitoring, and ineffective improvement mechanisms. This study employs PDCA cycle theory to construct a systematic quality assurance framework. The coupling mechanism between PDCA cycle and blended teaching is first analyzed, followed by a thorough examination of current quality assurance dilemmas and their root causes. Based on these findings, a quality assurance system is designed following the four PDCA phases: the Plan phase establishes objectives and standard systems; teaching implementation processes are standardized in the Do phase; multiple monitoring and evaluation mechanisms are built during the Check phase; and continuous improvement and optimization are implemented in the Act phase. Four dimensions of implementation strategies are proposed to ensure effective system deployment: organizational support, technical infrastructure, culture development, and institutional improvement. This research provides both theoretical framework and operational pathways for blended teaching quality management in universities, holding significant value for advancing teaching model innovation and enhancing educational quality.

Keywords: PDCA Cycle Theory; Online-offline Blended Teaching; Quality Assurance System; Higher Education

1. Introduction

Against the backdrop of digital transformation, online-offline blended teaching has become an inevitable trend in higher education reform. Particularly in the post-pandemic era, blended teaching has transformed from an emergency measure to a normalized teaching model, posing entirely new challenges to traditional teaching quality assurance systems. However, universities currently still face prominent issues in blended teaching quality assurance, including absence of standard systems, weak process monitoring, and insufficient motivation for continuous improvement, which severely constrain the high-quality development of blended teaching. How to construct a scientific and effective quality assurance system to ensure deep integration of online and offline teaching while achieving continuous quality improvement has become a critical issue urgently requiring resolution in university teaching management. As a mature quality management theory, the PDCA cycle's closed-loop management model of Plan-Do-Check-Act highly aligns with the systematic requirements of blended teaching quality assurance, providing theoretical support and methodological guidance for solving current dilemmas. Based on blended teaching practice, this study deeply analyzes the practical difficulties faced by quality assurance, employs PDCA cycle theory to construct a quality assurance system covering the entire teaching process, and proposes implementation strategies from four dimensions of organization, technology, culture, and institution, aiming to provide theoretical reference and practical guidance for quality enhancement of blended teaching in higher education.

2. Analysis of the Coupling Mechanism between PDCA Cycle Theory and Online-Offline Blended Teaching in Higher Education

2.1 Connotation Characteristics and Operating Mechanism of PDCA Cycle Theory

As the cornerstone of modern quality management, the core essence of PDCA cycle theory lies in deconstructing complex management processes into four interconnected and interdependent stages—Plan, Do, Check, and Act—forming a closed-loop management

system [1]. The Plan stage emphasizes the scientific nature of goal setting and rationality of resource allocation; the Do stage focuses on standardized operations and process control; the Check stage highlights the comprehensiveness of data collection and objectivity of evaluation analysis; while the Act stage concentrates on experience summarization and standard consolidation. These four stages are interlocked, constituting a complete chain of quality management. In actual operation, the PDCA cycle is not a simple linear cycle but presents dynamic evolutionary characteristics of spiral ascent. Upon completing each cycle period, the quality level achieves a new leap based on the original foundation, with unresolved problems and newly discovered challenges automatically entering the next cycle, driving continuous refinement of management levels [2]. This repetitive cycling process embodies systematic thinking in quality management, integrating seemingly scattered management elements into an organic whole. Through information feedback and dynamic adjustment mechanisms, the management system maintains sensitivity and adaptability to environmental changes. Particularly in the field of teaching quality management in higher education, the dynamic characteristics of the PDCA cycle align well with the complexity of educational processes and the variability of teaching environments, providing theoretical foundation and methodological guidance for constructing highly adaptive and responsive quality assurance systems.

2.2 Essential Attributes and Quality Elements of Online-Offline Blended Teaching

Online-offline blended teaching is essentially a new educational form that transcends the spatiotemporal boundaries of traditional teaching. Its core lies in achieving deep integration of virtual and physical spaces, organic fusion of digital and traditional teaching resources, and flexible switching between synchronous teaching and asynchronous learning [3]. This teaching model exhibits distinct characteristics of hybridity, interactivity, and personalization, retaining the emotional communication advantages and immediate feedback mechanisms of face-to-face teaching while fully leveraging the resource richness and learning flexibility of online teaching. From the dimension of quality composition, blended teaching quality encompasses multiple levels including the adaptability of instructional design, richness of teaching resources, continuity of teaching processes, effectiveness of teacher-student interaction, and achievement of learning outcomes. These elements interact with each other, collectively determining the overall quality level of blended teaching. Regarding the identification of key control points in quality assurance, seamless connection between online and offline teaching activities, comprehensive collection and analysis of learning data, adaptive adjustment of teaching content, stable operation of technology platforms, and scientific construction of evaluation systems constitute the core nodes of quality control [4]. These control points are distributed across different stages of the entire teaching process, including frontend instructional design optimization, midstream teaching implementation monitoring, and backend teaching effect evaluation, forming a quality control network covering the entire teaching lifecycle, laying a solid foundation for achieving continuous improvement in blended teaching quality.

2.3 Analysis of Compatibility between PDCA Theory and Blended Teaching Quality Assurance

PDCA cycle theory and quality assurance systems for online-offline blended teaching in higher education demonstrate high internal unity and logical consistency in fundamental concepts and practical approaches [5]. From the goal-oriented dimension, the planning-first principle emphasized by PDCA cycle naturally resonates with the clarity of objectives pursued by blended teaching quality assurance. Both take clear quality objectives as the logical starting point for action, achieving precise positioning of quality management through goal decomposition and indicator refinement [6]. At the process management level, the phased advancement mechanism of PDCA cycle perfectly matches the complex process characteristics of blended teaching, capable of incorporating multiple teaching segments such as online preview, classroom interaction, and offline consolidation into a unified management framework. Through standardized process design and normalized operational guidelines, it ensures consistent implementation of quality standards across different teaching scenarios [7]. The dynamic nature and complexity of blended teaching

models determine that quality assurance cannot be achieved overnight, while the continuous improvement concept embedded in PDCA cycle provides methodological support for solving this challenge. Through cyclical iteration, problems are continuously discovered, analyzed, and resolved, enabling the quality assurance system to be continuously optimized and upgraded in practice. This spiral improvement path both conforms to the gradual characteristics of educational laws and adapts to the rapid iteration needs of technological development and teaching innovation, enabling the blended teaching quality assurance system to achieve steady improvement in dynamic balance, truly reaching the expected goals of quality management.

3. Analysis of Practical Dilemmas and Causes in Quality Assurance of Online-Offline Blended Teaching in Higher Education

3.1 Absence and Ambiguity of Quality Standard Systems

The primary dilemma facing quality assurance of online-offline blended teaching in higher education lies in structural defects and content ambiguity of standard systems [8]. Universities often act independently when formulating blended teaching evaluation standards, lacking unified top-level design and normative guidance, resulting in the same course presenting entirely different quality judgment criteria in different departments or even under different teachers. This fragmentation of standards seriously undermines the credibility and comparability of quality evaluation. Existing quality indicator systems mostly follow traditional classroom teaching evaluation frameworks, lacking refined quantitative standards for elements unique to blended teaching such as online resource quality, asynchronous learning effects, and cross-platform interaction frequency. The extensive nature of indicator settings makes quality evaluation superficial, failing to truly reflect the actual effects of blended teaching. More problematic is the apparent binary separation between online and offline teaching standards—online teaching is often simplified to statistics of resource quantity and click rates, while offline teaching excessively relies on traditional attendance rates and exam scores. These two standard systems lack mechanisms for organic integration, unable to form scientific judgments about the overall quality of blended teaching. This absence and ambiguity of standard systems stem from insufficient understanding of the essence of blended teaching and lagging updates in quality management concepts, causing quality assurance work to lack clear directional guidance and reliable evaluation criteria, severely restricting systematic improvement of blended teaching quality.

3.2 Weakness and Failure of Process Monitoring Mechanisms

The weakness of blended teaching process monitoring is concentrated in the limitations of coverage and superficiality of monitoring depth. Traditional teaching inspection and supervision models appear inadequate when facing decentralized and asynchronous online learning scenarios [9]. Key teaching segments such as students' autonomous learning processes, group collaborative discussions, and personalized learning path selections remain outside the monitoring scope, creating numerous management vacuums. The construction of data collection systems severely lags behind the development speed of blended teaching. While existing platforms can record basic login information and resource access records, they lack effective capability to capture deep learning behavior data such as thinking processes, knowledge construction paths, and cognitive load changes. Moreover, data analysis mostly remains at simple descriptive statistics, lacking predictive and diagnostic analytical capabilities, causing quality problems to often only be exposed during final assessments, missing the optimal timing for process intervention. The breakage and delay of feedback chains further exacerbate monitoring failures—teachers cannot timely learn about students' learning difficulties and changing needs, students' opinions and suggestions are diluted or shelved in layer-by-layer transmission, and information asymmetry between management departments and frontline teaching is prevalent. This systematic deficiency in monitoring mechanisms stems from the dual lag of technical means and management concepts, as well as institutional design gaps caused by insufficient understanding of blended teaching complexity, resulting in functional paralysis of the quality assurance system at the most critical process control stage.

3.3 Insufficiency and Obstacles in Continuous

Improvement Motivation

The insufficient internal motivation for continuous improvement in blended teaching quality has become a deep-seated obstacle restricting the effective operation of quality assurance systems. Some teachers view blended teaching as an emergency measure or formal requirement, lacking internal drive for active exploration and self-innovation. They habitually apply traditional teaching thinking to new teaching scenarios, adopting passive response or simple repair strategies for quality problems rather than fundamentally reflecting on and reconstructing teaching models [10]. The incentive and constraint mechanisms at the institutional level show obvious structural imbalance—there lacks reasonable value recognition and reward mechanisms between input and output in teaching improvement. The extra efforts teachers invest in blended teaching innovation are difficult to fully reflect in professional title evaluation and performance assessment, while accountability mechanisms for teaching quality problems are relatively loose, resulting in improvement behaviors lacking dual drives of positive incentives and negative constraints. Structural shortages and uneven distribution of resource allocation further weaken improvement capabilities. Investment in key areas such as technology platform upgrades, teacher training, and teaching research is obviously insufficient, with resource allocation mostly favoring hardware construction while neglecting soft capability enhancement. Teachers often face practical difficulties such as lack of technological tools, absence of professional support, and exhaustion of time and energy when implementing improvement measures. This lack of improvement motivation formed by multiple overlapping factors reflects deep-level problems in universities' transformation to blended teaching, including unclear strategic positioning, insufficient determination for change, and lack of systematic thinking, urgently requiring breakthroughs from multiple dimensions including concept reshaping, mechanism innovation, and resource reorganization.

4. Construction of Blended Teaching Quality Assurance System Based on PDCA Cycle

To address the complexity challenges of quality assurance in online-offline blended teaching models, this study introduces the PDCA cycle management concept as the core framework for constructing a blended teaching quality assurance system. Through the cyclical repetition of four stages—Plan, Do, Check, and Act—the PDCA cycle forms a dynamic, continuously improving quality management closed loop that can effectively adapt to the dynamic and complex characteristics of blended teaching environments. By organically integrating various elements of quality management, this system achieves comprehensive coverage from top-level design to specific implementation, from process monitoring to continuous improvement, providing scientific methodological guidance for systematic improvement of blended teaching quality. The specific architecture is shown in Figure 1.

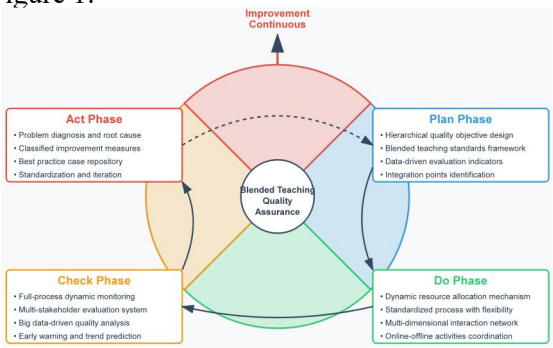

Figure 1. Blended Teaching Quality Assurance System Based on PDCA Cycle

4.1 Plan Stage: Quality Objective Setting and Standard System Construction

As the initial stage of the PDCA cycle, the Plan stage's core lies in laying a solid foundation for blended teaching quality assurance through systematic top-level design. The construction of the quality objective system must follow the principle of hierarchical progression, starting from macro-level overall talent cultivation objectives, progressively refining to meso-level course teaching objectives and micro-level knowledge point mastery objectives, forming a vertically integrated and horizontally coordinated objective network structure. Based on this, the formulation of quality standard frameworks should fully consider the differentiated characteristics and integration points of online and offline teaching, focusing on dimensions such as teaching content appropriateness, teaching method innovation, learning process autonomy, and teaching effect achievement. This must both reflect the unique advantages of blended teaching and accommodate the personalized needs of different

disciplines and majors. The establishment of evaluation indicator systems needs to break through the limitations of traditional single-mode evaluation, introducing quantitative indicators such as learning engagement, interaction participation rate, resource utilization rate, and capability improvement degree, combined with big data analysis technology to precisely characterize learning behavior trajectories, achieving comprehensive dynamic assessment of teaching quality. This data-driven indicator system not only objectively reflects actual teaching conditions but also provides reliable basis for subsequent quality monitoring and continuous improvement, ensuring the entire quality assurance system operates orderly on a scientific and standardized track.

4.2 Do Stage: Standardized Operation of Teaching Implementation Process

The Do stage carries the critical mission of transforming quality planning into teaching practice, with its standardized operation directly determining the effectiveness of blended teaching quality assurance. Teaching resource allocation needs to break down traditional barriers between online and offline separation, establishing dynamic deployment mechanisms to achieve cross-temporal and spatial circulation and sharing of quality resources. Through precise matching based on teaching content characteristics and student learning needs, it forms a synergistic effect where the broad coverage advantages of online resources complement the deep interaction characteristics of offline resources. The standardized process design of teaching activities is not mechanical program replication but, while ensuring basic teaching norms, reserves sufficient innovation space for teachers. By clarifying quality control points and key operational requirements for each teaching segment, it constructs a process system where flexibility and standardization coexist. As a core element of blended teaching, teacher-student interaction needs to break through spatiotemporal limitations to construct a three-dimensional interaction network, using intelligent tools to achieve organic combination of synchronous and asynchronous interaction. By setting parameters such as interaction frequency thresholds, response time requirements, and feedback quality standards, it ensures the timeliness, pertinence, and depth of interaction. This multi-dimensional coordinated advancement implementation mechanism not only ensures orderly development of the teaching process but also validates and optimizes quality standards set in the Plan stage at the practical level, providing rich process data support for subsequent quality testing, embodying the connecting role of the execution stage in the PDCA cycle.

4.3 Check Stage: Diversified Quality Monitoring and Evaluation Mechanism

The Check stage constitutes a key feedback node in the PDCA cycle, achieving precise control of teaching quality through systematic monitoring and evaluation mechanisms. The construction of dynamic monitoring systems needs to overcome the lag disadvantages of traditional summative evaluation by embedding multiple monitoring nodes throughout the teaching process, collecting real-time student learning behavior data, teacher teaching trajectory information, and platform operation status parameters, forming a three-dimensional monitoring network covering pre-class preview, in-class participation, and post-class consolidation. The multi-stakeholder evaluation mechanism breaks through the limitations of single evaluation perspectives, incorporating multiple stakeholders including student self-evaluation, peer evaluation, teacher evaluation, supervision assessment, and enterprise feedback into the evaluation system. Different evaluation stakeholders make independent judgments based on their respective perspectives and standards, achieving scientific integration of evaluation results through weight distribution and algorithm optimization. Data-driven quality analysis models, leveraging big data mining and machine learning technologies, conduct deep mining and correlation analysis of massive teaching data, identifying key factors affecting teaching quality and their action paths, establishing quality early warning mechanisms and trend prediction models, achieving a paradigm shift from experiential judgment to data-driven decision-making. This multi-dimensional, comprehensive monitoring and evaluation system not only timely discovers problems and deviations in the teaching process but also provides precise data support and decision-making basis for improvement measures in the Act stage, ensuring the quality assurance system continuously optimizes and upgrades through cyclical iteration.

4.4 Act Stage: Continuous Improvement and Optimization Enhancement Path

As the closing node of the PDCA cycle and the new starting point for spiral ascent, the Act stage bears the important function of transforming problems discovered through quality monitoring into systematic improvement drivers. Problem diagnosis and attribution analysis need to transcend superficial simple attribution, constructing multi-factor interaction models to deeply analyze the deep mechanisms behind teaching quality deviations, distinguishing between systematic and incidental problems, structural contradictions and operational errors, laying the foundation for precise policy implementation. The formulation of improvement measures must follow classification and grading principles, adopting differentiated intervention strategies for problems of different levels and types, including both optimization adjustments to hard elements such as instructional design, resource allocation, and technical support, as well as continuous improvement of soft factors such as teacher capability enhancement and student learning habit cultivation. By establishing timetables, roadmaps, and responsibility matrices for improvement measure implementation, it ensures all measures take root. Experience summarization and standardized promotion reflect the knowledge management function of the PDCA cycle. Through refining and sublimating successful experiences and deeply reflecting on failure lessons, it forms a replicable and scalable best practice case library, solidifying verified effective practices into new quality standards and operational norms, integrating them into the Plan stage of the next cycle, achieving iterative upgrading and continuous evolution of the quality assurance system, driving blended teaching quality to continuously leap to new heights through dynamic cycling.

5. Implementation Strategies and Guarantee Mechanisms for the Quality Assurance System

5.1 Organizational Guarantee: Establishing Collaborative and Coordinated Management Mechanisms

As the fundamental support for effective operation of the quality assurance system, organizational guarantee needs to break the rigid constraints of traditional hierarchical management models, constructing flat, networked organizational structures to achieve horizontal integration and vertical coordination among academic affairs departments, information centers, quality monitoring departments, and various teaching units. The allocation of responsibilities and authorities should follow the principle of matching rights with responsibilities, granting each entity sufficient autonomy while clarifying their quality responsibility boundaries, avoiding buck-passing or management vacuums caused by functional overlap. The establishment of coordination mechanisms needs to transcend simple administrative instruction transmission, forming a collaborative pattern of shared objectives, shared resources, and shared risks through establishing cross-departmental quality assurance committees, regular consultation systems, and information sharing platforms, ensuring seamless connection and efficient operation of each PDCA stage at the organizational level, providing a solid organizational foundation for continuous improvement of blended teaching quality.

5.2 Technical Guarantee: Constructing Intelligent Support Platforms

Technical guarantee constitutes the core engine for digital transformation of the blended teaching quality assurance system, with the key being achieving deep coupling between technological empowerment and teaching needs. The functional improvement of teaching platforms should not be limited to simple function stacking but requires modular design based on quality management needs at each PDCA cycle stage, achieving organic integration of functions such as resource management, teaching interaction, and learning analysis. The introduction of data analysis technology needs to break through the limitations of traditional descriptive statistics, using machine learning algorithms for predictive and diagnostic analysis of teaching behavior data, uncovering hidden quality problems and predicting development trends. Intelligent quality monitoring tools, by constructing AI-based anomaly detection models and early warning systems, achieve automatic identification and real-time warning of teaching quality deviations, transforming post-event remediation into pre-event prevention and

in-process intervention, ensuring efficient operation of the PDCA cycle and precise achievement of quality objectives from the technical level.

5.3 Cultural Guarantee: Creating a Quality-Oriented Teaching Culture

As the soft power support of the quality assurance system, cultural guarantee's core value lies in internalizing quality pursuit into collective consensus and conscious action. The cultivation of quality awareness needs to transcend traditional didactic indoctrination, using multiple pathways such as establishing quality case libraries, conducting quality salons, and implementing quality mentorship systems to transform teachers from passive execution of quality standards to active pursuit of teaching excellence. The creation of an innovative atmosphere requires breaking solidified thinking patterns, encouraging teachers to innovate teaching methods and explore technology applications within the PDCA framework, establishing error tolerance and correction mechanisms to stimulate reform vitality. The construction of continuous improvement culture needs to integrate PDCA concepts throughout the entire daily teaching management process, forming a cultural ecology where everyone focuses on quality, quality is reflected everywhere, and quality is improved constantly through institutionalized reflection mechanisms, normalized experience sharing, and systematic improvement actions, transforming quality assurance from external constraints to internal drivers, providing deep cultural support for high-quality development of blended teaching.

5.4 Institutional Guarantee: Improving the Incentive and Constraint System

Institutional guarantee provides fundamental assurance for the long-term operation of the quality assurance system through organic combination of rigid constraints and flexible incentives. The improvement of evaluation and assessment systems needs to break through traditional single and summative evaluation models, constructing comprehensive evaluation systems that combine process evaluation with outcome evaluation, quantitative indicators with qualitative indicators, incorporating PDCA cycle execution into teacher performance assessment. The innovative design of incentive mechanisms should avoid egalitarian tendencies, establishing differentiated incentive systems based on quality contribution, stimulating teachers' internal motivation to participate in quality improvement through special incentives such as teaching quality awards and excellent case awards. The implementation of accountability mechanisms needs to clarify quality responsibility subjects and accountability procedures, implementing classified and graded handling of quality incidents, avoiding both formalism caused by generalized accountability and management failure caused by virtual accountability, ensuring responsibilities and measures are in place at each PDCA cycle stage through rigid institutional execution, driving blended teaching quality assurance from institutional design to practical implementation.

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