

The Development of a Modified PDCA Management Model for Enhancing Curriculum Management Effectiveness in Sports Injury Rehabilitation Training for Non-Physical Education Students at Hubei Engineering University

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Abstract

This article aimed to (1) identify key components and indicators of the modified PDCA management model for curriculum management; (2) analyze problems and needs in sports injury rehabilitation training; (3) design and validate a modified PDCA management model; and (4) examine the impact of improving curriculum management and practical performance. A mixed-methods design was implemented across four sequential phases. Phase 1 involved expert interviews with five specialists to identify the model's core components and indicators. Phase 2 employed a survey of 390 students and 27 teachers/administrators to assess management problems and needs using a five-point Likert scale, with priority areas determined through the Modified Priority Needs Index (PNI). Phase 3 refined the model through expert validation with ten reviewers. Phase 4 evaluated its applicability and effectiveness using pre- and post-tests with 27 participants, supplemented by expert interviews. Data were analyzed using mean, standard deviation, modified PNI, and paired-sample t-tests, with all research instruments verified through Item-Objective Congruence and pilot testing. The findings revealed that (1) the modified PDCA model consists of four components and twelve indicators; (2) needs assessments indicated substantial gaps between current and expected performance, especially in optimizing teaching methods (PNI = 0.57) and improving content design (PNI = 0.54); (3) the final model integrated four components, twelve indicators, and thirty-six specific strategies; and (4) implementation

produced a statistically significant improvement in curriculum management outcomes ($t = 3.42$, $p < 0.05$), and experts affirmed the model's practicality and feasibility for curriculum enhancement in applied training contexts. The model provides a systematic and generalizable governance framework, offering guidance for institutional practices and policy-making.

Keywords: Modified PDCA Management Model; Curriculum Management Effectiveness; Sports Injury Rehabilitation Training; Non-Physical Education Students

Introduction

Recent educational reform initiatives in Chinese higher education emphasize strengthening curriculum governance to enhance teaching quality, student safety, and institutional accountability. Within this context, physical education reforms have increasingly highlighted not only physical training outcomes but also curriculum management effectiveness. However, a review by Zhang (2012) indicates that university physical education courses remain predominantly skill-oriented and lack systematic supervision and evaluation mechanisms for curriculum management. Consequently, non-physical education students are more susceptible to sports-related injuries, while the effectiveness of teachers' curriculum management practices is difficult to assess in a structured and objective manner. These findings suggest that existing practices insufficiently address curriculum-level governance in sports injury rehabilitation training.

With the establishment of Healthy China 2030 as a national strategy, universities are required to align curriculum management with broader policy goals related to health promotion and injury prevention by Tan et al. (2017). This policy shift underscores the need for an integrated management approach that connects curriculum planning, implementation, supervision, and continuous reform. Nevertheless, although prior studies have emphasized the importance of systematic curriculum management, few have proposed an operational framework that effectively links these processes into a coherent and assessable governance cycle. This reveals a clear research gap in developing and validating a structured model to enhance curriculum management effectiveness in sports injury rehabilitation training for non-physical education students.

In educational governance research, the PDCA cycle has been widely recognized as an effective mechanism for ensuring continuous improvement, accountability, and systematic feedback across organizational processes. Wang and Chen (2025) demonstrate that a PDCA-driven governance framework can align curriculum processes with institutional objectives by strengthening transparency, quality assurance, and evidence-based decision-making. Building on

this rationale, the present study applies a modified PDCA management model to the context of sports injury rehabilitation training, integrating curriculum planning, implementation, supervision and monitoring, and curriculum evaluation into a closed-loop management system. By doing so, this study seeks to provide an adaptive and evidence-supported model for improving curriculum management effectiveness, bridging institutional policy requirements with classroom practice and supporting sustainable improvement in higher education.

Research Objectives

1. To identify the key components and indicators of a modified PDCA management model for enhancing curriculum management effectiveness in sports injury rehabilitation training.
2. To prioritize curriculum improvement strategies using the Priority Needs Index (PNI) based on the problems and needs of non-physical education students in sports injury rehabilitation training.
3. To design and validate a PDCA management model that includes key components and specific indicators for improving course management effectiveness.
4. To examine the impact of modified PDCA management model on improving curriculum management effectiveness among teachers and educational administrators.

Literature Review

Curriculum Management Effectiveness

Curriculum management effectiveness refers to the systematic coordination of curriculum planning, implementation, monitoring, and evaluation to ensure educational quality and institutional accountability. Ornstein and Hunkins (2017) emphasize that effective curriculum management depends on the alignment of objectives, instructional processes, and assessment mechanisms. From a governance perspective, Samuel and Farrer (2025) note that structured management models enhance transparency and stakeholder participation by embedding continuous improvement within curriculum operations. These studies highlight that curriculum effectiveness is shaped not only by teaching content but also by coherent management structures.

Sports Injury Rehabilitation

Research on sports injury rehabilitation has primarily focused on recovery processes and injury prevention outcomes. Black et al. (2021) demonstrate that structured rehabilitation protocols can reduce injury risk and improve functional outcomes among student populations. While these

findings support the educational value of rehabilitation training, limited attention has been given to how such training is systematically managed, monitored, or evaluated within university curricula, particularly for non-physical education students.

PDCA Management Model

The PDCA model is widely applied in higher education to support quality assurance and continuous improvement. Samuel and Farrer (2025) argue that PDCA-based governance strengthens accountability by integrating goal setting, implementation, monitoring, and feedback into a closed-loop management process. Similarly, Yan et al. (2025) report that PDCA-oriented quality assurance systems facilitate data-driven curriculum adjustment. However, existing applications largely focus on general academic programs, with limited attention to practice-oriented curricula requiring close integration of teaching, supervision, and evaluation.

Research gap: although prior studies have addressed curriculum management effectiveness, sports injury rehabilitation training, and PDCA-based governance, these strands remain insufficiently integrated. Few studies examine how a PDCA-based framework can enhance curriculum management effectiveness in sports injury rehabilitation training for non-physical education students. This study addresses this gap by developing and validating a modified PDCA management model tailored to this context.

Conceptual Framework

The conceptual framework integrates three key elements—curriculum guidelines, stakeholder needs, and PDCA-based governance—to establish a modified PDCA management model for sports injury rehabilitation.

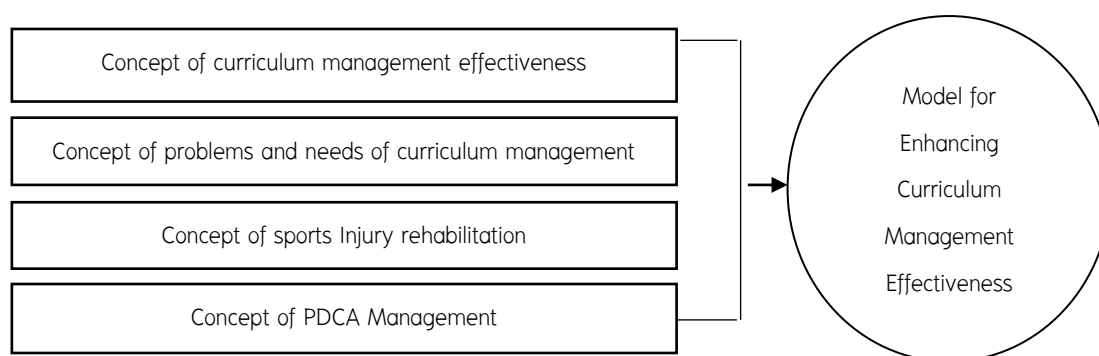


Figure 1 Conceptual framework

Research Methodology

This study adopted a sequential exploratory mixed-methods design, in which qualitative expert interviews were first used to construct the modified PDCA framework, followed by quantitative surveys and pre-post tests to validate the model and examine its effectiveness.

Phase 1: Identify key components and indicators of modified PDCA management model

Population and Sample

Five experts—two curriculum administrators, two physical education teachers, and one sports rehabilitation specialist—were purposively selected to ensure disciplinary diversity and practical insight into curriculum governance. Guest et al. (2006) stated that five participants are generally sufficient to reach data saturation in qualitative research.

Research Instrument

A semi-structured interview of qualitative research guide covering curriculum and management improvement was validated by two educational administration experts.

Data Collection

Face-to-face interviews were conducted with each session lasting 45–60 minutes. With informed consent, all interviews were audio-recorded and later transcribed for analysis.

Data Analysis

Following the content analysis approach described by Hsieh and Shannon (2005), interview transcripts were systematically coded to identify high-frequency terms, recurring themes, and shared viewpoints.

Phase 2: Analyze the problems and needs of curriculum management in sports injury rehabilitation training

Population and Sample

The study involved 14,456 non-physical education students and 1,200 faculty and administrators at Hubei Engineering University. Using Taro Yamane's formula (1967), a stratified random sample of 390 students was selected to ensure proportional representation across academic years and departments. Due to the limited number of faculty specializing in sports rehabilitation, all 23 physical education teachers and 4 administrators were included.

Research Instrument

A questionnaire was developed based on the twelve indicators identified in Objective 1 to assess curriculum management effectiveness. The instrument consisted of 60 items rated on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Parallel versions were administered to teachers/administrators and students, using identical indicators to capture management needs and perceived implementation performance. Content validity was confirmed by five experts (IOC = 0.99), and internal consistency reliability was acceptable (Cronbach's α = 0.81–0.84). Owing to the limited sample size, the questionnaire was used as an evaluative tool for curriculum management rather than a standardized psychometric scale.

Data Collection

Teacher and student questionnaires were administered in class under researcher supervision. Participants were briefly informed of the study purpose, confidentiality principles, and completion instructions before responding independently.

Data Analysis

Data were analyzed using descriptive statistics (mean, standard deviation) and the Priority Needs Index (PNI). Items with PNI > 0.30 were classified as high-priority for course improvement. Given the limited sample size ($n = 27$), the instrument was applied for evaluative purposes rather than scale validation.

Phase 3: Design and validate a modified PDCA management model

Population and Sample

10 experts were purposively selected to participate in a focus group discussion: 4 PE teachers, 2 specialists in sports rehabilitation or physiology, and 4 education administrators. According to Krueger and Casey (2014), a focus group of this size ensures both diversity and depth of discussion while maintaining manageability.

Research Instrument

A structured focus group guide was prepared, introducing the draft PDCA model and evaluation questions for each component. The protocol was reviewed by two senior administrators for clarity and relevance.

Data Collection

The focus group lasted 60 minutes, followed by a 45-minute open discussion. Participants were provided with the draft model and agenda in advance to informed feedback.

Data Analysis

Transcripts were analyzed by frequency of agreement and thematic coding of expert suggestions. Model revisions were made based on shared consensus.

Phase 4: Examine the impact of improving curriculum management and practical performance

Population and Sample

Consistent with the sample of teachers and administrators in the questionnaire, all 27 people participated in the curriculum management training based on the improved PDCA model.

The same five experts from Phase 1 were invited to assess the model's applicability and feasibility.

Research Instrument

Two instruments were used: 1) A training program incorporating pre- and post-tests to assess participants' changes in PDCA-related knowledge and self-evaluated curriculum management competence (5-point Likert scale). 2) Semi-structured expert interviews, reviewed by two educational-administration specialists, to evaluate the model's applicability and feasibility through qualitative feedback.

Data Collection

The two-week program included pre-tests administered before training and post-tests conducted immediately afterward. Individual expert interviews (30–45 minutes) were conducted.

Data Analysis

Questionnaire scores were analyzed using dependent samples t-tests in SPSS, with significance set at $p < 0.05$. Content analysis was used on the expert interview data to extract evaluative judgments regarding the model's applicability, feasibility, and recommendations.

Research Results

1. Identify the key components and indicators of a modified PDCA management model for enhancing curriculum management effectiveness

Expert interviews identified four components and twelve indicators forming the foundation of the modified PDCA model for curriculum governance. Thematic synthesis revealed that effective curriculum management requires systematic alignment across planning, implementation, monitoring, and evaluation to ensure continuous improvement.

Table 1 The guidelines of modified PDCA management model of expert interviews (n=5)

Component	Indicator	Representative Quotation
Curriculum Planning	Defining goals outcomes	“Alignment with student needs professional standards.”
	Designing content structure	“Balancing theoretical with practical application.”
	Setting evaluation criteria	“Establishing measurable criteria linked to objectives.”
Curriculum	Managing teaching activities	“Organizing lessons supports the intended goals.”
Implementation	Applying instructional strategies	“Using interactive and problem-based teaching.”
	Providing support services	“Ensuring sufficient facilities, learning resources.”
Curriculum	Monitoring performance outcomes	“Measuring instructional impact on student outcomes.”
Supervision Monitoring	Conducting internal supervision	“Regular reviews to identify weaknesses.”
	Collecting feedback	“Gathering opinions from teachers and students.”
Curriculum Evaluation	Assessing alignment	“Checking consistency between planned goals, teaching content, and actual learning results.”
	Measuring effectiveness	“Whether achieve intended learning outcomes.”
	Continuous improvement	“Embedding systematic feedback-driven processes.”

Table 1 shows that the effectiveness of curriculum management depends on the functional connections between these stages. Planning indicators emphasize goal alignment, content structure, and assessment clarity. Implementation indicators focus on instructional organization, teaching strategies, and resource support. Monitoring indicators emphasize performance monitoring, internal review, and feedback collection, while assessment indicators emphasize outcome consistency and feedback-driven improvement. These elements collectively realize the logic of PDCA for continuous curriculum improvement and accountability.

2 . Prioritize curriculum improvement strategies based on the problems and needs of non-physical education students in sports injury rehabilitation training

Building on the framework established in Objective 1, a structured questionnaire was used to examine the current problems and needs in curriculum management for sports injury rehabilitation among non-physical-education students. The instrument measured twelve indicators of the modified PDCA model through five-point Likert-scale items.

The survey results from teachers, administrators, and students revealed gaps between problems and needs, identifying priority areas for improvement using the revised PNI index. To illustrate the findings clearly, only strategies with PNI values above the mean were presented. Within each of the twelve indicators, three strategies exceeded the average PNI, yielding thirty-six key strategies for enhancement. The following sections present descriptive results across the

three stakeholder groups, organized by twelve indicators and thirty-six strategies, with charts illustrating current status, expectations, and priority needs.

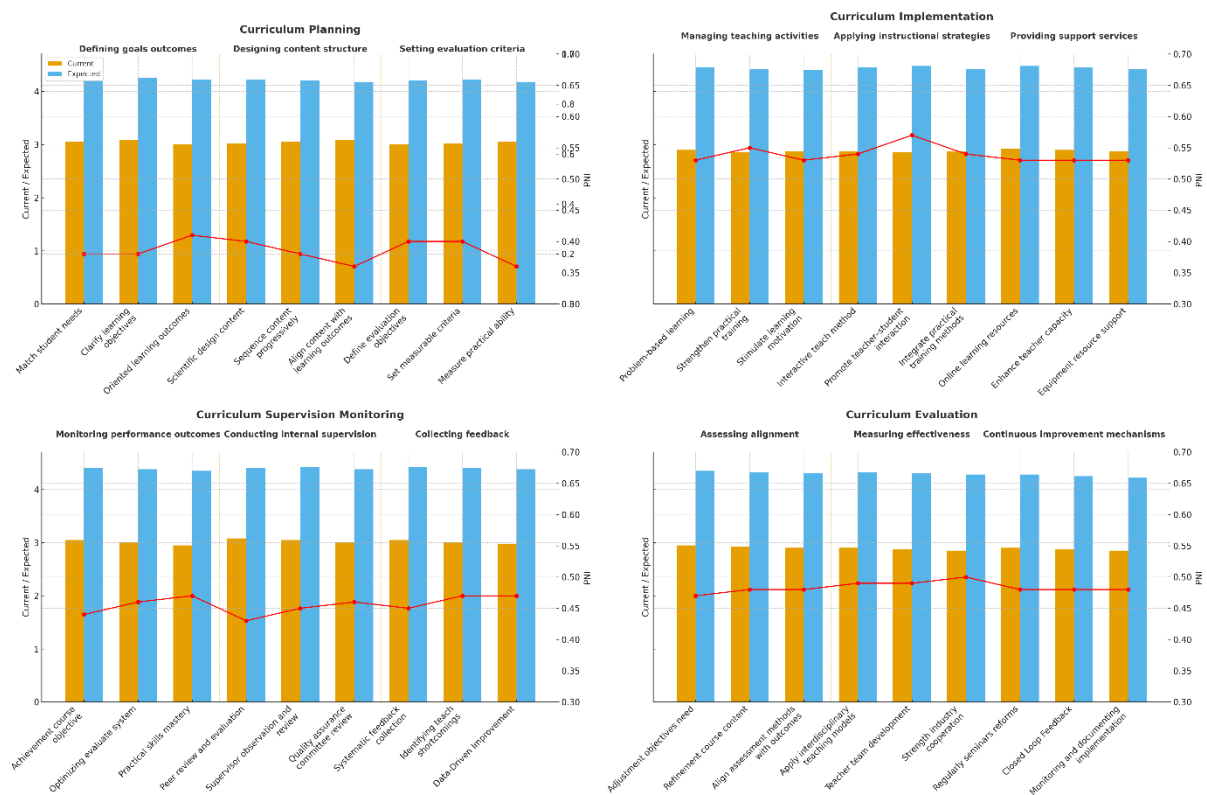


Figure 2 The results of the questionnaire survey of teachers and administrators

As shown in Figure 2, teachers reported clear gaps between current and expected conditions ($PNI = 0.36\text{--}0.55$). The highest priorities were in curriculum implementation, particularly strengthening practical training ($PNI = 0.55$), promoting problem-based learning ($PNI = 0.53$), and enhancing teacher-student interaction ($PNI = 0.57$). Teachers also highlighted needs for resource support and improved evaluation systems.

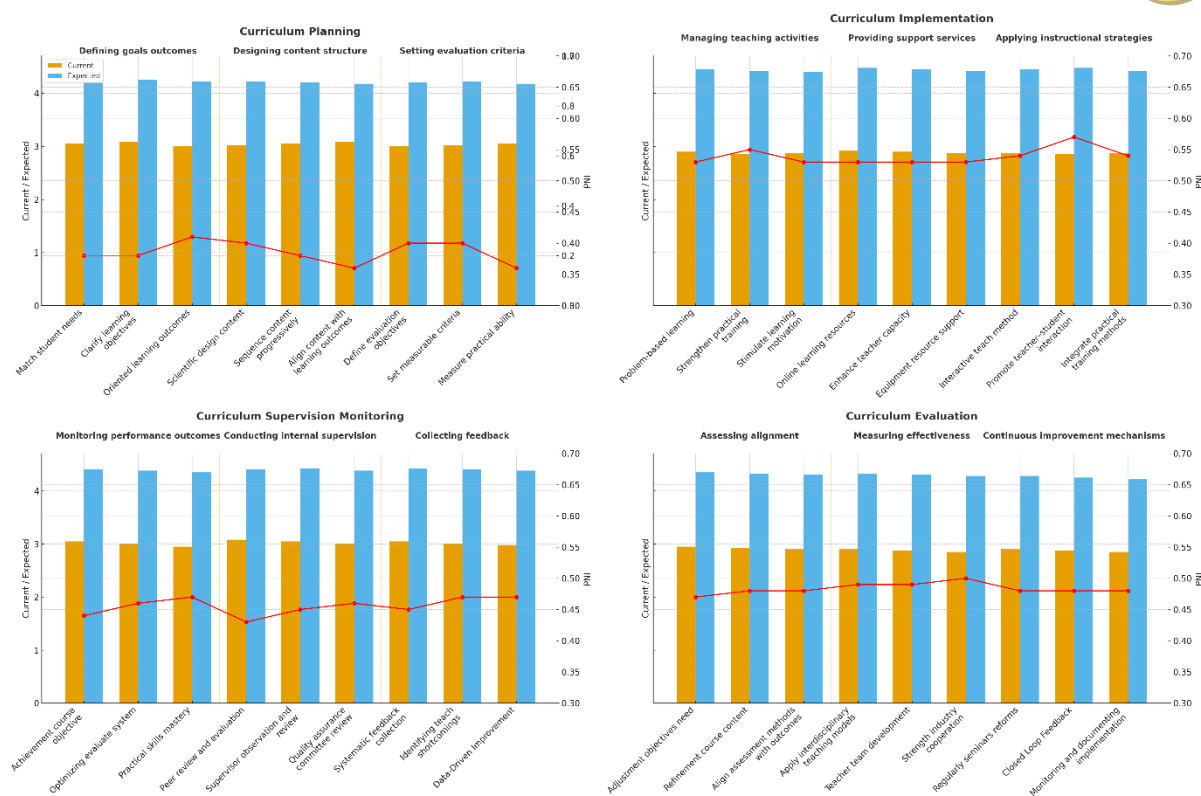


Figure 3 The results of the questionnaire survey of students

As shown in Figure 3, students expressed similar concerns, with PNI values ranging from 0.36 to 0.57. They emphasized the importance of practical training, interactive learning, and sufficient online and equipment resources. Students also valued assessment alignment and continuous feedback.

Both groups consistently recognized significant improvement needs in implementation and evaluation, though teachers focused more on instructional quality and goal alignment, while students prioritized practice and support. Together, their perspectives reaffirm the importance of refining the modified PDCA model to integrate governance priorities with learner-centered development.

3. Design and validate a PDCA management model for improving course management effectiveness

The modified PDCA management model integrates four interrelated components, twelve indicators, and thirty-six strategies, forming a continuous cycle of planning, implementation, supervision, and evaluation. The overall framework is shown in Figure 4.

Compared with traditional PDCA applications, this modified model extends the cycle to the curriculum governance level by embedding stakeholder participation, policy alignment, and continuous quality assurance mechanisms to enhance curriculum management effectiveness.

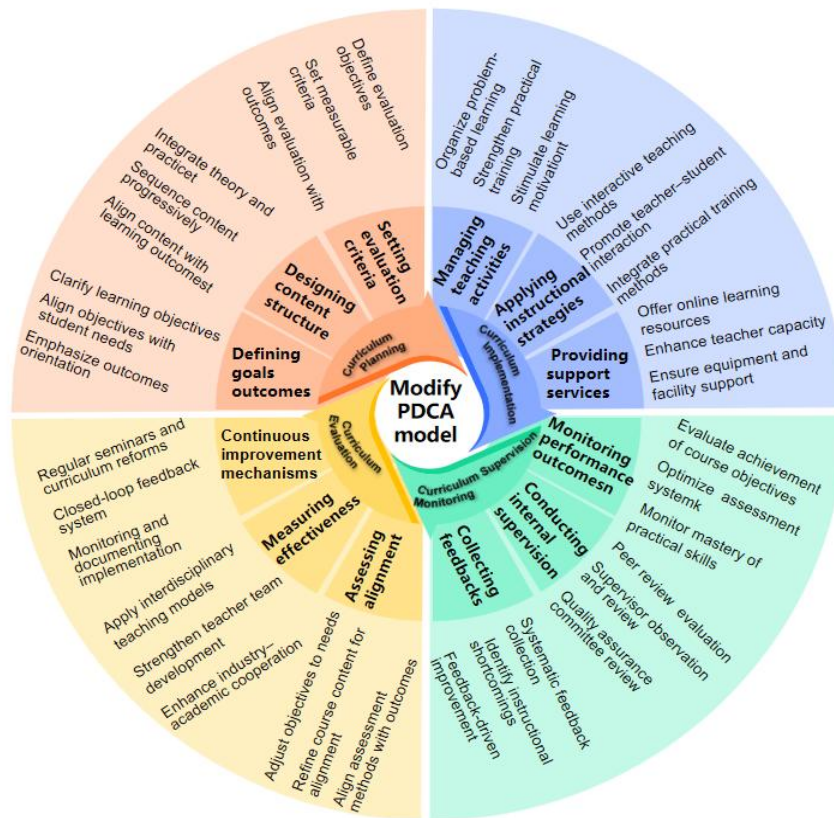


Figure 4 Modified PDCA management model for enhancing curriculum management effectiveness

In the Curriculum Planning phase, the model defines clear learning goals, aligns objectives with student needs, and emphasizes outcomes orientation. It integrates theory with practice, organizes content progressively, and ensures alignment between content and outcomes. Evaluation standards are established by defining objectives, setting measurable criteria, and linking evaluation to expected outcomes.

The Curriculum Implementation phase focuses on applying plans through problem-based and practice-oriented teaching, stimulating learning motivation, and promoting teacher-student interaction. It further integrates practical methods, enhances teacher capacity, and provides online resources, equipment, and facility support to ensure effective delivery.

The Curriculum Supervision and Monitoring phase ensures quality control through evaluating course objectives, optimizing assessment systems, and monitoring practical skill

mastery. Internal supervision is conducted via peer review, observation, and committee evaluation, while systematic feedback is collected to identify shortcomings and drive improvement.

Finally, the Curriculum Evaluation phase assesses alignment among objectives, content, and outcomes, refines teaching and assessment methods, and promotes interdisciplinary collaboration, faculty development, and industry–academic cooperation. Continuous improvement is maintained through regular seminars, curriculum reforms, feedback loops, and documentation of implementation outcomes.

4. Examine the impact of modified PDCA management model on improving curriculum management effectiveness among teachers and educational administrators

4.1 Quantitative verification of model effectiveness

A PDCA-based training program was implemented to examine its impact on curriculum management effectiveness among teachers and educational administrators. Participants completed pre- and post-training assessments using a curriculum management competence questionnaire. Dependent-sample t-tests were conducted to compare mean scores.

Table 2 Results of the dependent samples t-test comparing pre-test and post-test scores on Curriculum Management Effectiveness after the modified PDCA management model training (n = 27)

Indicator	Variable	$\bar{X}$	S.D.	t-value	Sig.
Curriculum Management	Pre-test	3.09	0.48	15.764	0.000
Effectiveness after the modified PDCA management model	Post-test	4.30	0.41		

As shown in Table 2, participants' curriculum management competence increased significantly from 3.09 (SD = 0.48) to 4.30 (SD = 0.41) ($t = 15.764$, $p < 0.001$). The effect size was large (Cohen's $d = 2.72$), indicating a substantial practical impact of the modified PDCA management model on curriculum management competence.

4.2 Qualitative analysis of the applicability and feasibility of the modified PDCA management model

Experts unanimously agreed that the model is highly applicable and feasible, with a clear structure that aligns with existing curriculum governance practices. They also pointed out that the key to translating this model from management theory into practical actionable steps for teachers lies in ensuring teacher development and institutional coordination.

Overall, the interviews affirmed that the model effectively bridges educational theory and management practice, offering a realistic and adaptable tool for enhancing curriculum governance in higher education.

Discussions

1. Interpretation of modified PDCA management model guidelines

The identification of four components and twelve indicators suggests that curriculum management effectiveness can be structured as a governance process rather than fragmented instructional practices. This explains why the PDCA logic is appropriate at the curriculum level: its cyclical structure mirrors administrative decision-making by linking objectives, implementation, monitoring, and evaluation within a single framework. Consistent with Bobrytska et al. (2023) findings indicate that clearly defined indicators enhance accountability by translating governance principles into operational actions.

2. Significance of needs-based prioritization

The needs assessment revealed significant gaps in content design, teaching practice, and learning support—issues frequently noted in educational administration. Incorporating stakeholder input and needs-based analysis enhances reform legitimacy and aligns policy objectives with institutional capacity. Applying the modified PNI provided administrators with a data-driven approach for prioritizing resource allocation and targeted improvements.

3. Governance implications and practical constraints

Expert validation indicates that the modified PDCA model functions as a governance-oriented improvement mechanism by integrating stakeholder feedback and shared evaluation criteria. Unlike traditional PDCA applications focused on process control, this model strengthens coordination between teaching and management units. Similar governance-oriented applications of PDCA in higher education have been reported by Chigbu and Makapela (2025), although the present findings also highlight constraints related to faculty capacity and institutional support.

Despite the relatively small sample size and the absence of a control group, this study employed a mixed-methods design combining quantitative and qualitative evidence to enhance the robustness of interpretation. Nevertheless, these methodological constraints should be considered when generalizing the findings, and future studies are encouraged to adopt larger samples and comparative designs to further validate the modified PDCA management model.

New Knowledge from Research

This study constructs a governance-oriented closed-loop PDCA framework for curriculum management, which integrates policy coordination, stakeholder coordination, and data-driven oversight, providing a scalable solution for practice-oriented curricula.

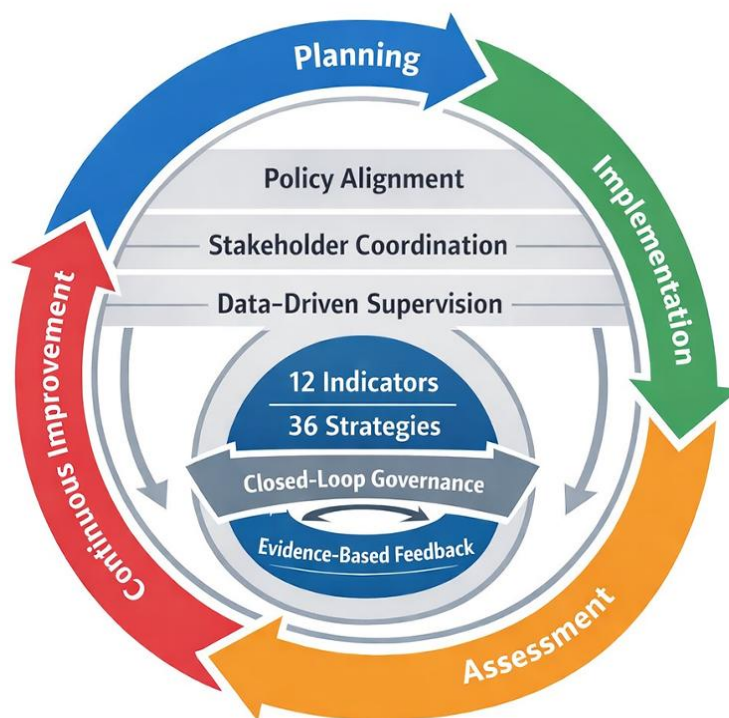


Figure 5 Governance-Oriented PDCA framework for curriculum management

Conclusion

This study develops and validates a governance-oriented PDCA model for curriculum management in sports injury rehabilitation training for non-physical education students. The model, comprising four components, twelve indicators, and thirty-six strategies, addresses key gaps in teaching methods and curriculum design. Implementation produced statistically significant improvements in curriculum management competence among teachers and educational administrators ($p < 0.05$). The findings provide institutions with a practical framework for aligning curriculum planning, implementation, and continuous improvement, and highlight the importance of governance-based approaches in strengthening practice-oriented curricula in higher education.

Suggestions

1. Suggestions for utilization of research results

Institutions should strengthen curriculum governance by establishing a dedicated committee to oversee planning, implementation, supervision, and evaluation, while aligning curriculum objectives and assessment with national policies such as Healthy China 2030. Periodic audits can support policy alignment and continuous improvement. To enhance theory–practice integration, universities should embed case-based and simulation-based learning, develop partnerships with medical and rehabilitation institutions, and systematically incorporate practitioner feedback to refine curriculum content.

2. Suggestions for future research

Future studies should validate the modified PDCA model across multiple institutions and contexts using quasi-experimental designs to enhance generalizability. Longitudinal research is needed to assess the sustainability of curriculum management improvements and their impact on student outcomes, including injury prevention knowledge and practical skills.

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