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APPLICATION OF A PAD CLASS INTEGRATED WITH CBL TEACHING MODEL IN CULTIVATING TCM CLINICAL THINKING IN CHINESE MATERIA MEDICA

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Abstract: This study tackles the challenge of cultivating clinical thinking in *Chinese Materia Medica* education by integrating the Presentation-Assimilation-Discussion (PAD) Class model with Case-Based Learning (CBL). A teaching framework was structured around the "Lecture–Self-study–Reflection–Discussion–Evaluation" pathway, incorporating CBL cases distinguished by their typicality, authenticity, progressive complexity, and heuristic value. The alternating-class PAD approach was implemented to strengthen students' capacity to connect TCM theory, diagnosis, formulation, and herb application in clinical reasoning. A multifaceted evaluation system integrating process and outcome assessments was established, complemented by a TCM teaching clinic as a secondary learning platform to bridge theoretical knowledge and practical application. The model significantly enhanced student engagement and proficiency in syndrome differentiation and treatment. Future initiatives will prioritize the optimization of case libraries, advancement of teacher training, and exploration of AI-supported personalized learning pathways to inform innovative reforms in TCM curriculum design.
Keywords: TCM clinical thinking; PAD class; Case-Based Learning (CBL); *Chinese Materia Medica* instruction; Instructional reform

1 INTRODUCTION

Higher education in Traditional Chinese Medicine (TCM) carries the critical mission of cultivating professionals with solid theoretical foundations and exceptional clinical competence. As a cornerstone of the TCM curriculum, the *Chinese Materia Medica* course plays a pivotal role in shaping students' understanding of herbal properties, therapeutic efficacy, and clinical application. However, traditional instructor-centered teaching methods often prove inadequate in guiding students to apply abstract pharmacological theories to complex clinical scenarios, resulting in significant gaps in clinical thinking [1].

In response to this challenge, medical education has been shifting towards student-centered approaches that emphasize active learning, clinical reasoning, and problem-solving skills [2]. The Presentation-Assimilation-Discussion (PAD) class model facilitates systematic knowledge acquisition through its structured phases of concise lecturing, self-directed assimilation, and interactive discussion [3]. Complementarily, Case-Based Learning (CBL) employs authentic clinical scenarios to deepen analytical and decision-making abilities [4]. The integration of these two pedagogical strategies presents a promising approach to overcoming the limitations of conventional *Chinese Materia Medica* instruction by bridging knowledge delivery with cognitive development.

This study, therefore, focuses on the integration of the PAD class model and CBL within *Chinese Materia Medica* education. Through a systematic design encompassing case development, classroom implementation, and evaluative feedback, the research aims to enhance students' ability to apply knowledge and strengthen their dialectical thinking in clinical practice.

2 CURRENT STATE OF TCM CLINICAL THINKING CULTIVATION

TCM clinical thinking is a unique cognitive model shaped by China's distinctive cultural context and ancient philosophical traditions. It permeates the entire process of TCM theory construction, clinical syndrome differentiation, and treatment [5]. Its cultivation is rooted in the clinical practice sequence of "four diagnostic methods-syndrome differentiation-treatment determination-therapy implementation" [6]. This process encompasses key steps such as collecting diagnostic information, analyzing pathogenesis, and formulating treatment plans based on pattern differentiation. This cognitive process is essential for translating theoretical knowledge into practical clinical competence among TCM practitioners. However, a significant theory-practice gap persists in current *Chinese Materia Medica* education, which hinders students' ability to apply knowledge effectively [7].

Key challenges include a limited ability to identify core symptoms, which frequently results in unsystematic clinical analysis. A common difficulty is the failure to grasp both the primary symptoms and the underlying pathogenesis during syndrome differentiation. Even when familiar with herbal properties and functions, students often struggle to accurately match herbs to specific syndromes. This reveals a weak integration of TCM theory, diagnostic methods, formula design,

and herb application. These difficulties originate from a lack of systematic curriculum integration, leading to fragmented knowledge that impedes the development of applied clinical thinking. Furthermore, teaching and assessment mechanisms in *Chinese Materia Medica* courses often remain misaligned with the goal of cultivating clinical thinking. The prevailing evaluation system overemphasizes the memorization of herbal properties, while neglecting the effective assessment of syndrome differentiation skills and clinical reasoning. This misalignment diminishes the emphasis that both instructors and students place on clinical thinking skills.

3 IMPLEMENTATION OF THE INTEGRATED PAD CLASS AND CBL TEACHING MODEL IN INSTRUCTION

As a university-level flagship course at Jining Medical University, the *Chinese Materia Medica* curriculum has been continuously refined by the teaching team to stimulate and enhance students' clinical thinking in Traditional Chinese Medicine (TCM). Building on prior educational reforms, including mind mapping training and the implementation of the Presentation-Assimilation-Discussion (PAD) Class model [8-9], this study integrates the PAD Class with Case-Based Learning (CBL) to establish an innovative teaching model. The primary objective of this model is to systematically strengthen students' dialectical thinking and clinical practice skills.The PAD Class structures instructional time into three distinct phases: teacher presentation, student assimilation, and group discussion, thereby emphasizing active participation and independent thinking. Conversely, CBL employs authentic clinical cases as a foundational vehicle to guide students in analyzing and resolving practical problems, thereby fostering applied competence and critical reasoning skills. Integrating these two pedagogical strategies creates a synergistic model that leverages their respective strengths, ultimately aiming to improve overall teaching effectiveness.

3.1 Development of CBL Cases Based on TCM Clinical Thinking

High-quality cases are fundamental to the successful implementation of Case-Based Learning (CBL), and their design must be closely aligned with the core objective of cultivating clinical thinking in Traditional Chinese Medicine (TCM) [10]. The development of these cases should adhere to several key principles: typicality, authenticity, progressive complexity, and heuristic value [11].

A typical case should illustrate common clinical patterns or core herbal applications, allowing students to master fundamental principles of diagnosis and treatment through specific examples. For instance, a case involving a wind-cold common cold treated with Ephedra Decoction(Mahuang Tang) should clearly delineate Ephedra's medicinal properties, compatibility rules, and clinical precautions, emphasizing its acrid-warm nature and exterior-releasing function while stating contraindications explicitly. The principle of authenticity necessitates that case materials are derived from real clinical records or proven cases of experienced TCM practitioners, ensuring credible diagnostic scenarios, information from the four diagnostic methods, and treatment processes without fictionalization. Progressive complexity requires a structured design that advances from simple to complex, beginning with single syndrome patterns and core herb-pair analysis, then gradually introducing complex pathogenesis and differential diagnosis of similar syndromes to align with students' cognitive development. Finally, heuristic value emphasizes the incorporation of explorable questions, such as unexpected therapeutic outcomes, to stimulate critical thinking and encourage reflection on diagnostic accuracy, the rationale for herb selection, and dosage logic, thereby fostering clinical decision-making and reflective skills.

Cases should follow a structured framework: Case Summary-Syndrome Differentiation Analysis- Herb Selection Decision-Discussion Points [12]. The Case Summary provides essential information obtained through the four diagnostic methods (e.g., patient details, chief complaint, current symptoms, tongue, and pulse characteristics), presented concisely to facilitate preliminary syndrome differentiation. Syndrome Differentiation Analysis guides students in extracting core pathogenesis from clinical symptoms using TCM theory to establish a pattern diagnosis. As the core step, Herb Selection Decision requires students to prescribe key herbs based on the diagnosis, considering the herbs' properties, efficacy, channel tropism, and compatibility contraindications, while justifying their selections. Discussion Points, pre-designed by the instructor, may focus on herb-syndrome correspondence, comparisons of similar herbs, potential risks, or comparisons with classic medical cases to steer discussions toward achieving the learning objectives.

3.2 Organic Integration of PAD Class and CBL: An Instructional Pathway of "Lecture–Assimilation–Reflection–Discussion–Evaluation"

The efficacy of integrating the Presentation-Assimilation-Discussion (PAD) class model with Case-Based Learning (CBL) hinges on a coherent instructional design and its consistent implementation [13]. This study operationalized an instructional process structured around "teacher's concise lecture, student assimilation and reflection, case discussion, and summary evaluation." Specifically, an alternating-class PAD format was adopted, wherein the complete learning cycle spanned two consecutive class sessions to ensure adequate time for knowledge internalization.

3.2.1 Teacher's concise lecture

During the first session of the two-class cycle, the instructor delivers a concise lecture limited to approximately 20 minutes, focusing on core concepts such as the classification, properties, channel tropism, and fundamental efficacy of exterior-releasing medicinals. The primary objective is to establish a foundational knowledge framework while elucidating key concepts and clarifying common points of confusion, deliberately avoiding comprehensive coverage.

Subsequently, clearly defined self-directed learning and case analysis tasks are assigned to guide the subsequent learning phase.

3.2.2 Student self-directed learning and group discussion

Following the teacher's concise lecture in the first session, students engage in self-directed learning during the remaining in-class time and after class. This involves utilizing the Chaoxing platform to access resources such as instructional videos and excerpts of clinical experiences from renowned practitioners. Working in small groups, they conduct preliminary discussions on the assigned CBL cases and complete individual PAD (Presentation-Assimilation-Discussion) assignments. To prepare for subsequent in-depth classroom discussions, students are required to complete consolidation tests on the platform within a stipulated timeframe and submit a written summary of their preliminary case analysis. This summary must include the key points of syndrome differentiation and the rationale for herb selection .

3.2.3 In-depth CBL case discussion

In the second class, 15 minutes are allocated for detailed CBL case discussions in groups of 5–7. The teacher begins by reiterating the core questions and objectives. Each group analyzes issues such as "how to select exterior-releasing medicinals for a patient with wind-cold exterior syndrome and internal dampness obstruction," engaging in advanced syndrome differentiation and treatment decision-making. A group leader facilitates discussions while a recorder organizes key points. The instructor circulates to guide reasoning through questioning, offering timely hints without providing direct answers. Finally, representatives from each group present their analytical processes and conclusions .

3.2.4 Summary and evaluation

The teacher concludes with a systematic review of the case discussions, summarizing core knowledge points and addressing common questions. Using the case as an example, the teacher explicates how the principle of "identifying pathogenesis through syndrome differentiation and determining treatment based on pathogenesis" guides herb selection. The entire learning activity is evaluated, and feedback is provided based on formative assessment records (Figure 1).

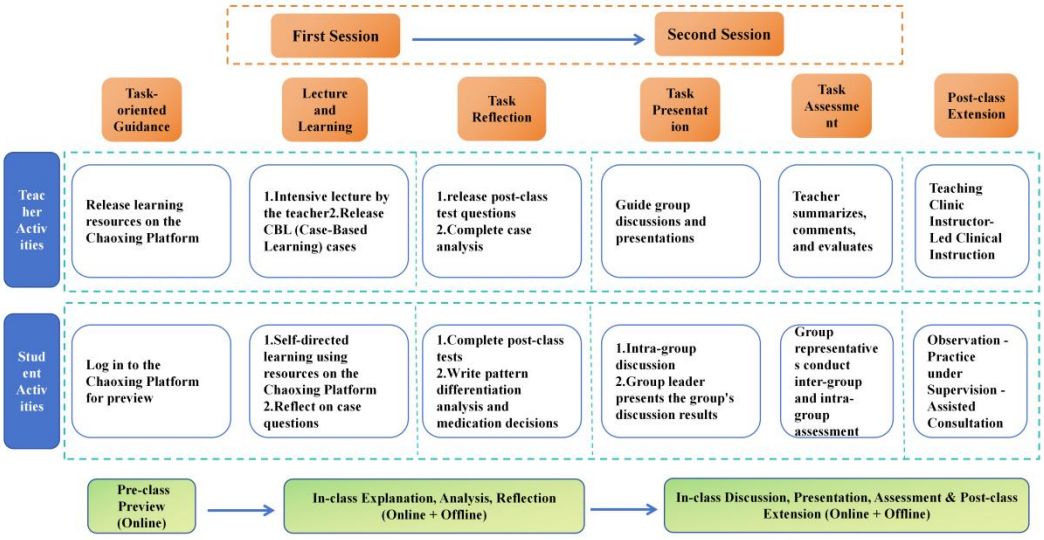

Figure 1 Pathway of Integrated PAD Class and CBL Instructional Practice

3.3 Development of an Integrated Process and Outcome Teaching Evaluation System

Teaching evaluation is a critical component for measuring instructional effectiveness, providing feedback on pedagogical issues, and guiding educational reform. To address the limitations of traditional models—which overrely on final examinations and fail to dynamically capture the development of students' clinical thinking and practical abilities—this study established a dual-dimensional evaluation system integrating process and outcome assessment.

In process-oriented assessment, the emphasis shifts from rote memorization of discrete facts to evaluating higher-order competencies, including TCM clinical thinking, teamwork, and logical expression. The operational approach incorporates two key elements: first, the use of a structured classroom observation scale to record and score critical behaviors during case discussions, such as the logical coherence of syndrome differentiation, the analytical depth in assessing herb-syndrome correspondence, and the effectiveness of responses to challenges [14]; and second, the implementation of a multi-source evaluation mechanism during group presentations, which involves both instructors and student representatives to assess the internal logic of prescription decisions, the appropriateness of herb selection, and the accuracy of professional expression [15]. This integrated approach ensures that evaluation results more accurately reflect students' comprehensive literacy and developmental potential.

In outcome-oriented assessment, periodic quizzes and final examinations remain the primary forms of evaluation, but their emphasis shifts from the recall of discrete facts to assessing comprehension and applied skills. Specifically, this involves increasing the proportional weight of subjective questions grounded in case analysis. Furthermore, simulated

clinical tasks are designed to require students to independently execute a complete clinical thinking process. This process begins with collecting diagnostic data through the four examinations, continues with conducting syndrome differentiation, and culminates in establishing treatment principles and selecting appropriate formulas and herbs. This approach provides a comprehensive evaluation of students' ability to translate theoretical knowledge of *Chinese Materia Medica* into clinical practice.

By constructing this multidimensional evaluation system, teaching assessment no longer serves merely as a scoring tool but becomes a supportive mechanism for continuously fostering student development, ultimately advancing the goal of cultivating TCM clinical thinking and professional competence.

4 EMPHASIZING COMPLEMENTARY LEARNING PLATFORMS

While the integrated teaching model of PAD Class and CBL effectively trains students' abilities in syndrome differentiation analysis and medication decision-making within simulated scenarios, its activities remain confined to the classroom. To address the critical shortcoming of students lacking opportunities to fully temper their TCM thinking in real, complex, and dynamic clinical settings, we have introduced the TCM teaching clinic as an indispensable complementary learning platform.

Building upon the traditional master-apprentice education model, the TCM teaching clinic establishes a progressive instructional pathway of "observing the master in clinic - simulated patient diagnosis - collaborative assisted diagnosis" [16]. Within the teaching clinic, learning is student-centered. Students are required to independently complete the entire process—from patient reception and history-taking through the comprehensive application of the four diagnostic methods, to analyzing pathogenesis, performing syndrome differentiation, and ultimately prescribing medication. The instructor assumes the roles of guide and safety guarantor, whose primary responsibilities are to observe, guide, ensure medical safety, and provide immediate analysis, correction, and explanatory feedback after the student completes the consultation. This step-by-step clinical practice model, grounded in real patient cases, is a crucial link enabling students to transform knowledge acquired in the classroom into stable clinical thinking and proficiency in syndrome differentiation and treatment.

5 REFLECTIONS ON TEACHING PRACTICE

The teaching model integrating the PAD Class with CBL has demonstrated multifaceted impacts. Through clear pre-class self-directed learning and case analysis tasks, students' initiative is more effectively stimulated, leading to active participation in group discussions and in-depth exchanges on key points of syndrome differentiation and the rationale for herb selection. When analyzing medical cases, students are required to comprehensively apply knowledge of herbal properties, efficacy, and channel tropism, conducting integrated analyses based on clinical manifestations. This effectively facilitates the transition of students' knowledge of *Chinese Materia Medica* from rote memorization to flexible application, thereby enhancing their clinical practical ability. The model's subtle cultivation of students'TCM clinical thinking is particularly important. By analyzing cases, students gradually master the complete process of syndrome differentiation and treatment—from collecting information through the four diagnostic methods and analyzing pathogenesis to determining treatment principles and selecting/formulating prescriptions—forming a thinking pattern centered on "formula–syndrome–pathogenesis–herb," which enables them to preliminarily develop the ability to prescribe medicines based on syndrome differentiation .

The successful implementation of this model places higher demands on the transformation and capabilities of the teacher's role. Teachers are required to shift from being mere knowledge transmitters to becoming guides and organizers of the learning process. Effectively managing discussion pacing in class, prompting deep thinking through key questions, and providing timely guidance without excessive intervention all pose greater challenges to teachers' abilities. The adaptability differences among student groups cannot be ignored. Students with weaker foundational knowledge or those accustomed to passive learning may struggle in case discussions, leading to low participation, which could potentially result in a polarization of learning outcomes over time. Designing more tiered cases and providing personalized learning support are urgent challenges to address. With the rapid development of AI technology, precise construction of personalized learning profiles through AI-based monitoring of learning conditions, integrating data from unit tests and case analyses, allows teachers to push targeted reinforcement tasks to students based on AI-analyzed learning data, enabling precise teaching intervention. This may represent an important direction for deepening teaching reform.

6 CONCLUSION

The integration of the PAD Class and CBL, through its structured classroom design of "concise lecture, assimilation, and discussion" and the organic incorporation of authentic cases, effectively stimulates students' learning initiative and enhances both their depth of understanding of *Chinese Materia Medica* knowledge and their clinical application abilities. Through the case analysis process, students gradually construct TCM clinical thinking centered on syndrome differentiation and treatment, thereby addressing the deficiencies of traditional teaching methods in cultivating cognitive skills .

To continuously improve teaching effectiveness, future efforts should focus on key areas such as case library development, enhancement of teacher and student capabilities, and optimization of evaluation mechanisms. Specific

tasks include establishing a hierarchical and comprehensive case resource system, implementing specialized training to improve teachers' instructional facilitation skills, and refining a multifaceted evaluation scheme that integrates process and developmental assessments to promote the model's routine and efficient operation. The further development of teaching clinics should be actively promoted, positioning them as a bridge connecting the classroom with clinical practice. Additionally, introducing digital technologies to integrate real outpatient cases and build a reusable, traceable digital case library can significantly supplement classroom case resources, providing students with readily accessible materials for extended learning.

The integrated PAD Class and CBL teaching model offers a promising practical pathway for reforming *Chinese Materia Medica* instruction. Its successful experience also holds reference value and potential for adoption in teaching innovations within other TCM-related courses.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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