# Teaching Reform and Exploration of Neurology Courses Centered on Cultivating Clinical Thinking

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**Abstract:** Neurology is a highly specialized, logically rigorous and practice-oriented discipline. Clinical thinking serves as the core competency for medical students engaged in neurological diagnosis and treatment. Traditional neurology teaching is hampered by rigid teaching modes, disconnection between theory and practice, and simplistic assessment systems, which lead to deficient clinical thinking and poor post adaptability among students. In accordance with the requirements of the New Medical Education initiative, this paper analyzes the current dilemmas in cultivating students' clinical thinking based on the status quo of neurology teaching. A multi-dimensional teaching reform system centered on clinical thinking is constructed from four aspects: curriculum content restructuring, teaching method innovation, practical teaching system improvement and assessment mechanism reform. Meanwhile, existing challenges in reform implementation and corresponding optimization strategies are discussed. This study aims to break the limitations of traditional lecture-based teaching, transform talent training from knowledge imparting to competency development, and provide references for cultivating high-quality applied clinical talents in neurology.

***Keywords*:** Neurology; Clinical thinking; Curriculum reform; Teaching practice; Talent cultivation

## 1. Introduction

As a core branch of clinical medicine, neurology focuses on the etiology, pathogenesis, diagnosis and treatment of neurological diseases. It features a sophisticated knowledge system and high requirements for logical reasoning, thus imposing strict demands on medical students' clinical thinking ability[1]. Clinical thinking refers to the core capability of physicians to integrate medical theories and clinical experience for condition analysis, differential diagnosis, definitive diagnosis and treatment decision-making, and it lays a solid foundation for clinical practice in neurology[2]. At present, most medical colleges and universities still adopt conventional teaching modes for neurology courses, which attach excessive importance to theoretical memorization and knowledge indoctrination while neglecting thinking training and practical application. Consequently, although students have a good command of theoretical knowledge, they are weak in clinical reasoning, case analysis and individualized treatment decision-making, and struggle to adapt to clinical posts after graduation[3]. Therefore, carrying out targeted neurology curriculum reform focusing on clinical thinking training is an inevitable choice to improve teaching quality, foster high-caliber neurological talents and meet the requirements of clinical post competency.

## 2. Dilemmas in Cultivating Clinical Thinking in Neurology Teaching

### 2.1 Rigid Teaching Modes and Formalized Thinking Training

Current neurology teaching is predominantly based on one-way instruction combining theoretical lectures and case demonstrations. Teaching activities follow the fixed framework of textbooks, presenting knowledge in the order of etiology, pathology, clinical manifestations, diagnosis and treatment. Students passively receive standardized knowledge with insufficient opportunities for active thinking, reasoning and critical discussion[4]. Such teaching practices prioritize the integrity of knowledge systems but ignore the cultivation of clinical logic. When explaining diseases, teachers usually directly present typical symptoms, imaging manifestations and standardized diagnosis and treatment protocols, without guiding students to simulate real clinical scenarios and conduct full-process reasoning including symptom screening, differential diagnosis and etiological analysis. Students merely memorize typical disease characteristics for examinations, and fail to establish the complete clinical thinking chain of symptom–sign–lesion–etiology. When confronted with atypical cases or cases complicated by comorbidities, they are incapable of effective differential diagnosis, making clinical thinking training purely formalistic.

### 2.2 Disconnection between Theory and Practice and Insufficient Scenarios for Thinking Application

The disconnection between pre-clinical and clinical teaching constitutes a major obstacle to the development of students' clinical thinking. Despite systematic learning of basic disciplines such as neuroanatomy, neurophysiology and neuropathology, students find it difficult to combine foundational knowledge with clinical scenarios and translate theories into clinical practice[5]. For instance, though they can recite anatomical structures of the nervous system proficiently, they fail to correlate clinical symptoms such as limb weakness and sensory disturbance with neural pathways so as to accurately locate lesions and identify causes. Furthermore, clinical clerkship and internship are restricted by patient privacy protection, limited high-quality cases and heavy clinical workloads. Students rarely get chances to conduct independent medical inquiry, physical examination and case analysis in real clinical settings. The lack of practical training scenarios results in a persistent gap between theory and practice, and hinders the formation of sound clinical thinking[6].

### 2.3 Simplistic Assessment System and Inadequate Evaluation of Clinical Thinking

The existing assessment system mainly relies on closed-book theoretical examinations, which focus on basic knowledge including diagnostic criteria, characteristic signs and medication specifications, and primarily test students' ability of knowledge memorization and recall[7]. There is a lack of systematic and quantifiable evaluation indicators and methods for core clinical thinking skills, such as comprehensive analysis of symptoms and signs, reasoning for differential diagnosis, formulation of individualized treatment plans and case-based critical thinking. The single assessment orientation leads to the misconception that students only learn content to be examined. Students tend to concentrate on rote memorization rather than systematic training of clinical thinking, resulting in the common problem of being proficient in theories but incompetent in clinical diagnosis, treatment and case analysis. This mode not only fails to motivate students to take the initiative to develop clinical thinking, but also cannot objectively evaluate their clinical potential.

## 3. Reform Approaches for Neurology Courses Centered on Clinical Thinking

### 3.1 Restructure Curriculum Content to Build a Thinking-Oriented Knowledge System

To address fragmented knowledge and the bias toward theories over thinking training in traditional curricula, the integrated curriculum content is restructured following clinical diagnostic logic, so as to integrate knowledge teaching and thinking cultivation in depth. Disciplinary barriers between pre-clinical and clinical disciplines are broken down to establish an integrated teaching module covering basic medicine– clinical medicine–research advances. Abandoning the chapter-based teaching mode of textbooks, teaching content is organized around core clinical symptoms including dizziness, numbness of limbs and disturbance of consciousness. Basic theories of neuroanatomy, pathology and pharmacology are integrated with clinical diagnosis and treatment, and teaching is arranged in line with the clinical workflow of symptom analysis–lesion localization–etiological classification–diagnosis and treatment, helping students develop systematic associative thinking for neurological diseases[8]. In addition, special sessions on clinical thinking methodologies are added to the curriculum, highlighting the core logic of localization and etiological diagnosis in neurology. Typical cases are analyzed to teach practical thinking approaches including backward reasoning, exclusion-based differential diagnosis and symptom clustering. Combined with special lectures, case interpretation and simulated reasoning, these activities help students master core clinical thinking skills[9,10]. Furthermore, cutting-edge research achievements and controversial clinical issues are incorporated into teaching content, including new neuroimaging techniques and updated treatment regimens for rare neurological diseases. Debates on contentious topics such as the timing of thrombolytic therapy for stroke are carried out through literature review, group discussion and expert comments. These measures break the constraints of standardized knowledge and foster students' critical thinking and innovative ability in clinical decision-making.

### 3.2 Innovate Teaching Modes to Establish Diversified Platforms for Thinking Training

To resolve the problems of one-way teaching and insufficient practical scenarios, multiple teaching methods are integrated to build an all-round and immersive training system for clinical thinking. A flipped teaching mode combining Problem-Based Learning (PBL) and Case-Based Learning (CBL) is implemented to form a closed-loop teaching system of pre-class exploration–in-class discussion–post-class reflection. Before class, complete clinical cases and progressive question chains are released via intelligent teaching platforms. Students work in groups to retrieve literature, sort out diagnostic logic and draw preliminary conclusions independently. Classroom activities focus on group presentations, interactive Q&A and comments on reasoning flaws, centering on symptom differentiation, lesion localization and treatment decision-making. This approach drives students to think actively and construct complete clinical thinking chains[11]. Virtual simulation technology is introduced to make up for the shortage of clinical practical opportunities. A dedicated virtual simulation platform for

neurology is built, with a library of standardized virtual patients, simulated wards and auxiliary examination systems covering the whole process of medical inquiry, physical examination, imaging interpretation and treatment decision-making. Students can repeatedly practice specialized physical examination and case reasoning in a risk-free and repeatable virtual environment to consolidate their clinical thinking, which effectively addresses the shortage of clinical cases and practical opportunities[12]. Bedside teaching combined with Multi-Disciplinary Team (MDT) case discussion is also conducted. Selected typical cases are used for bedside inquiry and physical examination, with teachers explaining diagnostic logic in real time. Meanwhile, interdisciplinary case discussions are held with departments of radiology, laboratory medicine and rehabilitation. Such practices break the limitations of single-discipline diagnosis, cultivate students' systematic thinking for overall patient assessment and comprehensive decision-making, and conform to the real clinical working mode[13].

### 3.3 Improve Practical Teaching System to Promote the Clinical Application of Clinical Thinking

In accordance with clinical post requirements, practical teaching links are optimized to strengthen practical training and realize the transformation from clinical thinking to clinical competency. The duration of clinical clerkship is extended, and one-on-one tutoring is adopted to standardize students' medical inquiry, physical examination and case summary, eliminating the phenomenon of focusing on observation rather than hands-on practice. Specialized thinking training modules are set up during internship. Students are required to independently manage 3 to 5 patients with different neurological diseases and participate in the full clinical workflow including admission assessment, treatment formulation and follow-up evaluation. Tutors conduct regular reviews to correct logical defects in students' reasoning and reinforce practical clinical thinking[14,15]. A training platform combining a case library and skill workshops is established. A large collection of typical, difficult and rare neurological cases with complete clinical data and interpretation of key thinking points is provided for students' autonomous learning and reasoning. Special workshops on neurological physical examination and localization diagnosis are launched, adopting model operation, role-playing and case deduction to consolidate students' operational skills and diagnostic thinking[16,17]. In addition, doctor-patient communication, medical humanities and ethical thinking are integrated into the training system. Scenario simulation, case discussion and bedside demonstration are applied to cultivate students' empathy and humanistic literacy, forming a comprehensive clinical thinking framework that integrates diagnostic logic, medical humanity and professional ethics[18].

### 3.4 Reform Assessment Mechanism to Establish a Scientific Evaluation System

The single summative assessment is replaced by a comprehensive evaluation system combining formative assessment and summative assessment to fully quantify students' clinical thinking ability. Formative assessment accounts for 50% of the total score, covering classroom performance in discussions, case analysis reports, virtual simulation operation and practical performance during clerkship and internship. It mainly evaluates students' independent thinking, logical reasoning and practical application capabilities. Summative assessment takes up the other 50% and adopts the Objective Structured Clinical Examination (OSCE) mode. Multiple examination stations are set to assess skills including medical inquiry, physical examination, differential diagnosis and treatment decision-making for comprehensive evaluation of clinical competency[19]. The content and form of assessments are optimized by increasing the proportion of case analysis and situational reasoning questions. Atypical cases and cases with complicated comorbidities are adopted to examine the flexibility and accuracy of students' clinical thinking[20,21]. A multi-subject evaluation system is established, including teacher evaluation, self-evaluation, peer group evaluation and standardized patient evaluation, to ensure objectivity and fairness. The assessment system gives full play to its guiding, motivating and improving functions, encouraging students to strengthen clinical thinking training voluntarily[22].

## 4. Challenges and Optimization Strategies for Teaching Reform

Several deficiencies and challenges remain in the implementation of this teaching reform. Firstly, virtual simulation teaching resources cannot be updated in a timely manner to keep pace with emerging clinical technologies and new cases, and the maintenance and iteration of such resources require sustained financial and technical investment. Secondly, some teachers are constrained by traditional teaching concepts and lack proficiency in applying innovative teaching modes such as PBL, CBL and MDT, and their competency in thinking-oriented teaching needs to be improved. Thirdly, the current case library is dominated by common and typical diseases, with insufficient reserves of difficult and rare cases, leading to limited diversity and representativeness of teaching cases. Targeted strategies are proposed for further reform. First, increase investment in teaching resource construction. Artificial intelligence-assisted diagnostic teaching systems are introduced to continuously update virtual simulation resources and enrich the library of difficult and rare cases, so as to expand the breadth and depth of clinical thinking training. Second, establish a regular teacher training mechanism. Specialized training

on innovative teaching methods and clinical thinking-oriented teaching is organized, and communication platforms are built to comprehensively upgrade teachers' teaching capabilities. Third, deepen university-hospital cooperation to integrate high-quality clinical cases and teaching staff from affiliated hospitals. A talent cultivation model integrating teaching, clinical practice and scientific research is constructed to continuously optimize the training system for clinical thinking.

## 5. Conclusion

Clinical thinking is a core component of post competency for neurological practitioners and a key bridge connecting theoretical knowledge and clinical practice. The limitations of traditional neurology teaching result in inadequate clinical thinking and poor post adaptability among students. Restructuring thinking-oriented curriculum content, innovating diversified teaching modes, improving practical teaching systems and establishing scientific comprehensive assessment mechanisms can effectively break the barriers of conventional teaching and fundamentally shift the teaching focus from knowledge memorization to competency cultivation. This teaching reform can consolidate students' theoretical foundation, refine their clinical logical thinking, and enhance their clinical diagnosis and treatment capabilities as well as humanistic literacy. It provides solid support for cultivating high-quality applied clinical talents in neurology and offers valuable references for curriculum reform in other clinical medicine disciplines.

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