

Exploring the PBL Teaching Model in Clinical Medicine Based on Core Competencies

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Abstract: The education reform oriented toward core competencies has placed new demands on the cultivation of clinical medical talents. Based on an analysis of the connotation of core competencies, this paper examines the application of core competencies in clinical medical education from the perspectives of professional competence, cognition, interpersonal skills, scientific innovation, personal development, and social dimensions. By constructing a new PBL teaching model with six core competencies as training objectives—"mastery of medical knowledge and application of clinical skills, clinical thinking and decision-making abilities, communication and teamwork, scientific research and innovation capabilities, self-regulation and lifelong learning, as well as professional ethics and humanistic care"—this study explores the deep integration of the core competencies concept into the entire process of PBL teaching in clinical medicine. It aims to provide an effective pathway for cultivating outstanding clinical medical talents that meet the demands of the new era.

Keywords: Core competencies; Clinical medicine; PBL teaching model

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1. Introduction

Against the backdrop of the deepening Healthy China strategy and the rapid development of medical technology, society's demand for clinical medical talents has shifted from merely mastering professional knowledge and skills to possessing comprehensive qualities that enable them to solve complex health problems, adapt to advancements in medicine, and adhere to professional ethics. In the field of medical education, cultivating clinical doctors with core competencies has become a critical task of education reform. Core competencies, as a widely adopted target framework for addressing the challenges of the 21st century, emphasize the cultivation of students' essential character and key abilities. This framework has become a focal point of global education research and an important direction for practical implementation. Enhancing the quality of talent cultivation based on core competencies is directly related to a nation's future development and

competitiveness^[1]. However, traditional teaching models focus primarily on knowledge transmission, leading to practical dilemmas in medical education, such as the disconnection between knowledge acquisition and ability development, the conflict between standardized training and personalized development, and the imbalance between clinical skills and humanistic literacy^[2]. These issues result in deficiencies in cultivating students' comprehensive abilities. The PBL teaching model, which is problem-oriented, student-centered, and conducted in the form of group discussions, aligns highly with the philosophy of core competencies cultivation due to its characteristics of active inquiry, collaborative learning, and practical relevance^[3-4]. This model brings new ideas and methods to medical education. This paper aims to deeply explore the PBL teaching model in clinical medicine based on core competencies, with the hope of providing theoretical support and reference for medical education.

2. The Connotation of core competencies and their application dimensions in clinical medical education

2.1. The connotation of core competencies

In 2003, the Organisation for Economic Co-operation and Development (OECD) first explicitly proposed the concept of “core competencies” in a research report, defining it as a combination of key abilities and essential character traits. It emphasizes the critical knowledge, skills, and attitudes required for individuals to adapt to future society, encompassing dimensions such as cognitive skills, interpersonal skills, and self-regulation abilities. In September 2016, China released the overarching framework of Chinese Student Development Core Competencies, which positions the cultivation of “well-rounded individuals” at its core. The framework divides core competencies into three aspects: cultural foundation, autonomous development, and social participation. These are comprehensively manifested through six core competencies: humanistic grounding, scientific spirit, learning capacity, healthy living, sense of responsibility, and practical innovation^[5-6]. Some scholars, contextualizing the concept within the era, emphasize that core competencies represent advanced abilities and humanistic capacities needed to adapt to the information age and knowledge-based society, address complex problems, and navigate unpredictable situations^[7]. There is also a stronger emphasis on the value orientation of fostering virtue and nurturing talents^[8]. In summary, core competencies refer to the comprehensive embodiment of key abilities, essential character traits, and values that individuals need to adapt to lifelong development and societal demands in an era of informatization and globalization. In the context of medical education, core competencies extend beyond professional knowledge and clinical skills. They place greater emphasis on cultivating critical thinking, communication, and collaboration, humanistic care, and lifelong learning abilities among medical students, which are crucial for training high-quality medical talents capable of adapting to future healthcare environments.

2.2. Application dimensions of core competencies in clinical medical education

2.2.1. Professional competence dimension (Mastery of medical knowledge and application of clinical skills)

Medical knowledge and clinical skills form the foundational core competence of medical students. This encompasses a broad range of basic medical knowledge, such as anatomy, physiology, and pathology, which serves as the cornerstone for understanding normal physiological functions and disease mechanisms. Clinical diagnosis and treatment skills are equally critical, including medical history taking, physical examination,

diagnostic methods, and treatment techniques. Proficiency in fundamental clinical operations, such as punctures and suturing, enables the delivery of higher-quality medical services to patients and represents a vital aspect of medical students' practical abilities.

2.2.2. Cognitive dimension (Clinical thinking and decision-making skills)

Clinical thinking and decision-making skills are essential competencies for medical students when addressing complex clinical issues. These skills require students to employ critical thinking to analyze, synthesize, and evaluate clinical information. For instance, when dealing with a patient presenting with chest pain, medical students must comprehensively consider various potential causes, such as angina, myocardial infarction, or pneumothorax. By analyzing the patient's symptoms, signs, and examination results, they can eliminate confounding factors and arrive at an accurate diagnosis. Developing a reasonable diagnosis and treatment plan not only involves disease identification but also requires consideration of the patient's individual circumstances, such as age, physical condition, and financial situation.

2.2.3. Interpersonal dimension (Communication, collaboration, and teamwork)

In medical practice, effective communication, collaboration, and teamwork are crucial for ensuring the quality of healthcare services. On one hand, medical students need to communicate effectively with patients and their families to understand the patient's condition, needs, and psychological state, while also explaining treatment plans and precautions to enhance patient compliance. On the other hand, collaboration with members of the healthcare team, including physicians, nurses, and pharmacists, is equally important. By leveraging their respective strengths within the team, they can work together to provide comprehensive medical care to patients.

2.2.4. Scientific innovation dimension (Scientific research and innovation capability)

The capability for scientific research and innovation is primarily reflected in two aspects: First, medical students should be proficient in data collection, statistical analysis, literature retrieval, and other essential skills when participating in clinical research. They should be able to integrate existing research findings through systematic evaluation methods to form scientific argumentation processes. Second, they should demonstrate innovative thinking in clinical operations or process optimization. For example, in addressing issues such as poor medication adherence among elderly patients, they should develop innovative medication management solutions, fostering an innovative mindset to explore the unknown and solve clinical challenges.

2.2.5. Personal development dimension (Self-regulation and lifelong learning ability)

The ability to engage in self-reflection, update knowledge, and adapt to the evolving field of medicine is a core competency for medical students. Emotional and behavioral regulation in high-pressure scenarios is crucial. For instance, in high-stress situations such as emergency rescues or doctor-patient conflicts, they must quickly adjust their mindset to maintain professional judgment. Additionally, proactive efforts to continuously update their knowledge systems are essential. This includes regularly reading authoritative journals, participating in annual academic conferences or online seminars, and promptly applying the latest diagnostic and treatment guidelines to case discussions, ensuring their knowledge remains aligned with advancements in medicine.

2.2.6. Social dimension (Professional ethics and humanistic care)

Professional ethics and humanistic care reflect the core values of medical students. Upholding professional

ethics requires adherence to medical ethical principles, respect for patients' rights and dignity, and protection of patient privacy. Humanistic care embodies the compassion and respect medical students show toward patients, focusing not only on disease treatment but also on patients' physical and mental well-being and quality of life. A sense of social responsibility enables medical students to recognize their role and obligations in safeguarding public health, actively participate in public health activities, and contribute to society by providing health services.

3. Theoretical foundation and framework of the core competency-based PBL teaching model in clinical medical education

3.1. Theoretical foundation

The Problem-Based Learning (PBL) teaching model is primarily grounded in constructivist theory and pragmatist theory. Constructivist theory posits that learning is an active process where students construct knowledge through interacting with their environment based on prior knowledge and experiences ^[9]. In PBL, students integrate existing medical knowledge with new problem scenarios by solving real clinical cases, thereby deepening their understanding and application of knowledge. For example, when analyzing treatment plans for diabetic patients, students must draw on multidisciplinary knowledge such as endocrinology and pharmacology, and through group discussions and self-directed inquiry, develop a comprehensive understanding of diabetes management. Pragmatist theory emphasizes the integration of learning and practice ^[10]. PBL immerses students in authentic clinical scenarios, enabling them to enhance practical skills and problem-solving abilities through hands-on experience. For instance, when managing simulated emergency cases, students must make rapid decisions and implement appropriate first aid measures, thereby translating theoretical knowledge into practical operational skills.

3.2. Overall framework

3.2.1. Problem design

Problem design is a critical component of the PBL teaching model. The selection of clinically representative cases forms the basis of problem design. These cases should be typical, instructive, and moderately complex, covering multiple disciplinary knowledge points and clinical skills. For example, a case of a hemiplegic patient after cerebral infarction not only involves diagnosis and treatment in neurology but also requires the formulation of rehabilitation plans in rehabilitation medicine and nursing care considerations. Problem design should revolve around such cases, guiding students to delve deeper into critical thinking with questions such as: "How to recognize early signs of cerebral infarction?" "What are the treatment principles and methods for cerebral infarction?" "How to develop a personalized rehabilitation plan for a hemiplegic patient?"

3.3.2. Group collaboration

Group collaboration is a key organizational form in PBL (Problem-Based Learning) teaching. Group discussions among students facilitate knowledge sharing and the exchange of ideas. Typically, each group consists of 5–8 students who collaborate by dividing tasks and working together to solve problems. For example, in the PBL teaching at the Reproductive Medicine Center of the Second Xiangya Hospital of Central South University, students enhanced their teamwork skills through group collaboration ^[11]. Within the group, tasks can be assigned based on students' strengths and interests, such as searching literature, organizing materials, and delivering

presentations. During discussions, students are encouraged to actively express their viewpoints, listen to others' opinions, and collaboratively explore solutions.

3.3.3. Outcome presentation and reflection

The presentation of solutions by each group is a critical component of PBL teaching. By showcasing their learning outcomes, students not only improve their presentation skills but also receive feedback and suggestions from teachers and other groups. Teacher-guided reflection is a key step in helping students deepen their understanding of knowledge and enhance their abilities. In the PBL teaching at Shandong Provincial Third Hospital, teachers provided instructional feedback and conducted theoretical knowledge tests through inter-group scoring comparisons, which deepened students' understanding of gynecological clinical cases^[12]. Additionally, teachers can guide students to reflect on the strengths and weaknesses of their problem-solving process, helping them summarize experiences and improve learning outcomes. For instance, questions such as "Which pieces of information played a critical role in the diagnostic process?" or "Is there room for improvement in the treatment plan?" can be discussed.

4. Design of a core competency-based PBL teaching model in clinical medicine

4.1. Case design

Taking "COPD with Respiratory Failure" as an example, a three-stage PBL case was designed to guide students' in-depth thinking and problem-solving by gradually revealing the patient's condition and related information.

4.1.1. First stage: The patient is admitted with chest pain and difficulty breathing

Students are required to analyze possible causes. This stage primarily guides students to apply their existing knowledge of respiratory diseases to conduct a preliminary analysis and judgment of the patient's symptoms. Students need to consider various potential conditions, such as COPD, asthma, pneumothorax, and pulmonary embolism, and collect more information through medical history inquiries and physical examinations.

4.1.2. Second stage: Provide auxiliary examination results to guide students in formulating diagnosis and treatment plans

In this stage, based on the information collected in the first stage and newly provided auxiliary examination results (such as blood gas analysis and chest CT), students further clarify the diagnosis and develop corresponding treatment plans. They need to comprehensively evaluate the advantages and disadvantages of various treatment methods, such as oxygen therapy, mechanical ventilation, and medication, to select the optimal treatment plan for the patient.

4.1.3. Third stage: Simulate changes in the patient's condition to assess students' emergency response capabilities

This stage sets up a scenario where the patient's condition suddenly deteriorates, such as the occurrence of complications like arrhythmia or heart failure, to evaluate students' ability to handle emergencies and the flexibility of their clinical thinking. Students must quickly analyze the reasons for the changes in the patient's condition, adjust the treatment plan, and take effective emergency measures.

4.2. Implementation process

4.2.1. Problem-oriented learning

Problem-oriented learning serves as the starting point of PBL implementation, where students raise questions based on clinical cases. In a case of “COPD complicated by respiratory failure”, students may propose questions such as: “How to differentiate COPD from other respiratory diseases?” “What are the types and diagnostic criteria for respiratory failure?” These questions reflect students’ critical thinking and uncertainties regarding the case, thereby guiding subsequent learning and discussions. Students are encouraged to identify core competency challenges embedded in the case and conduct literature retrieval with a competency-aware approach.

4.2.2. Self-directed inquiry and group discussion

This phase constitutes the core of PBL, where students integrate knowledge from disciplines such as physiology and pathology through literature review and discussions. During group discussions, students share their findings and collaboratively explore solutions. Key components include: Structured Facilitation: Instructors employ questioning techniques (e.g., “What is the patient’s primary concern at this moment?”; “What evidence supports your diagnosis?”; “How would you handle the situation if the patient refuses treatment?”) to guide students in analyzing information, evaluating evidence, weighing pros and cons, and considering patient values. Role-Playing and Simulation: Students assume roles as patients, family members, or healthcare professionals from different specialties to simulate communication scenarios and multidisciplinary consultations, enabling firsthand experience and reflection on communication dynamics. Ethical and Humanistic Reflection: Dedicated sessions are held to discuss ethical dilemmas and psychosocial needs in the case, encouraging perspective-taking and empathy. Knowledge Integration and Application: Emphasis is placed on immediately applying newly acquired knowledge to interpret case phenomena, revise hypotheses, and formulate or adjust management plans.

4.2.3. Teacher guidance and feedback

Teachers play a crucial role in ensuring the smooth progression of PBL by timely intervening and correcting deviations. During discussions, instructors transition from “knowledge providers” to “learning facilitators” and “competency guides”, skilled in questioning, active listening, and providing feedback. They foster a safe and open discussion environment, introduce perspectives related to humanism, ethics, and communication when appropriate, and closely monitor student progress to offer guidance and suggestions. During presentations, students are expected to not only report medical conclusions but also elaborate on their decision-making processes, communication strategies, ethical considerations, and encountered challenges, engaging in team-based reflection. After student presentations, instructors provide objective evaluations and constructive feedback, acknowledging strengths while identifying areas for improvement and offering specific recommendations for growth.

4.3. Effectiveness evaluation

4.3.1. Formative evaluation

Formative evaluation includes student self-assessment (reflecting on the learning process and competency development), peer assessment (focusing on communication, collaboration, and contribution), and teacher evaluation (comprehensive performance and competency development). It serves as a crucial method for holistically assessing students’ learning processes and ability development. In clinical medicine PBL teaching, adopting a multi-dimensional evaluation system allows student self-assessment to help learners reflect on

their progress and identify their strengths and weaknesses. Peer assessment promotes communication and learning among students, fostering critical thinking and evaluation skills. Teacher evaluation provides objective, professional feedback on student performance and offers targeted guidance.

4.3.2. Summative evaluation

Summative evaluation employs standardized patient tests (assessing communication skills and humanistic care) to evaluate students' clinical skills, serving as an important means to examine learning outcomes. Standardized patient tests simulate real clinical scenarios, examining students' abilities in medical history taking, physical examination, diagnosis, and treatment, thereby comprehensively assessing their clinical practice proficiency.

5. Conclusion and outlook

Constructing and implementing a core competency-based PBL teaching model in clinical medicine is a key exploration in deepening medical education reform and enhancing the quality of talent cultivation. By integrating the concept of core competencies with PBL teaching methods, this model can effectively develop medical students' comprehensive abilities and lay a solid foundation for their future professional development. Although many challenges exist in its implementation, with the evolution of educational concepts and the advancement of teaching practices, this model is poised to play an even greater role in cultivating high-quality medical talents. Medical educators should actively explore, innovate courageously, and continuously refine the core competency-based PBL teaching model to promote the sustained improvement of medical education quality. In the future, this model must be continuously refined through practice, reflection, and improvement, and its application should be expanded both broadly and deeply to lay a solid foundation for cultivating outstanding medical talents who possess both moral integrity and professional excellence.

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Disclosure statement

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