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From knowledge acquisition to competency development: reflections on the educational reform of the diagnostics practical course

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Abstract: Diagnostics practical teaching serves as a core link in cultivating medical students' clinical skills and clinical thinking. The traditional diagnostics practical teaching features a rigid teaching model that emphasizes knowledge indoctrination while neglecting competency cultivation, which can hardly meet the competency-based requirements for modern medical talent training. Guided by the competency-based medical education concept centered on clinical thinking cultivation, this study optimizes the practical teaching system from four dimensions: teaching objectives, teaching methods, evaluation system, and technological empowerment. It innovates the traditional demonstration and imitation teaching mode, implements task-based situational teaching and whole-process diversified assessment, and carries out smart teaching by integrating virtual simulation and artificial intelligence technology. This reform effectively improves students' clinical operational capabilities and diagnostic thinking levels. Combined with teaching practice, this paper systematically sorts out the practical paths of competency-based teaching and analyzes practical dilemmas including the construction of dual-qualified teaching staff, the development of digital resources, and the formalization risk of evaluation reform, providing practical references for optimizing diagnostics practical teaching and cultivating high-quality clinical medical talents.

Keywords: Diagnostics; practical teaching; competency-based education; teaching reform

1 Introduction

Diagnostics serves as a core bridging course connecting basic medicine and clinical medicine. Its practical teaching constitutes a key link for medical students to master fundamental clinical skills such as inquiry, physical examination, and auxiliary examination interpretation, as well as to initiate preliminary clinical thinking, which provides fundamental support for the cultivation of clinical talents. At present, diagnostics practical teaching has long adopted the traditional mode of "teacher demonstration and student imitation". Teaching and assessment mainly focus on knowledge memorization and standardized operational replication, resulting in prominent problems of prioritizing form over thinking and mechanical repetition over practical application. The disconnection between teaching content and real clinical scenarios hinders the cultivation of students' clinical critical thinking and comprehensive practical abilities, making it difficult to adapt to the talent training requirements of modern medical education [1]. With the continuous advancement of the New Medical Science construction, the internationalization of medical education, and the rapid popularization of intelligent teaching technology, certain achievements have been made in the content restructuring and methodological

innovation of diagnostics practical teaching. Combined with the actual teaching practice, this paper systematically explores the implementation paths and practical challenges of transforming diagnostics practical teaching from knowledge transmission to competency orientation, summarizes curriculum reform experience, and provides references for the high-quality and sustainable optimization of the course.

2 Connotation of diagnostics practical teaching from the perspective of competency-based education

Competency-Based Medical Education (CBME) is oriented toward the cultivation of core clinical competencies for professional practice and abandons the curriculum-coverage-oriented teaching logic, focusing on the practical competency requirements of patient care. Compared with traditional teaching, CBME delivers reforms in multiple dimensions: teaching objectives shift from knowledge acquisition to knowledge application, learning paths transform from rigid indoctrination modes to flexible adaptive learning, and the evaluation system evolves from summative assessment to criterion-referenced formative evaluation. It provides core theoretical support for the reform of diagnostics practical teaching and promotes the pedagogical focus from completing teaching tasks to cultivating clinical diagnosis and treatment competencies [2].

3 Practical paths of diagnostics practical teaching from the perspective of competency-based education

3.1 Teaching objectives: centering on the cultivation of clinical thinking competency

Clinical thinking ability is the core essence of the reform of diagnostics practical teaching. From the perspective of competency-based education, the teaching objectives of diagnostics practical courses have shifted from "knowledge memorization and operational imitation" to the cultivation of clinical thinking ability. Traditional teaching objectives only require students to "master operations and repeat knowledge", which commonly results in the phenomenon of "skilled operation without independent thinking". In contrast, the reformed teaching objectives focus on guiding students to form a complete thinking chain including information collection, physical sign interpretation, diagnostic reasoning, and decision-making reflection in real and simulated clinical scenarios, so as to realize the organic integration of knowledge, skills and thinking [3]. Teaching is no longer terminated by "completing experimental tasks", but oriented toward students' ability to conduct independent and standardized clinical reasoning. Therefore, teaching objectives should be specific, observable, and measurable, and aligned with the evaluation system. In this way, every inquiry, physical examination and result interpretation can serve as the carrier for clinical thinking training and assessment, and ultimately achieve the training orientation of guiding operational practice with clinical thinking and satisfying clinical demands with comprehensive competency.

3.2 Teaching methods: from demonstration and imitation to task-based scenario teaching

The traditional demonstration and imitation teaching mode fails to stimulate students' initiative in active thinking and problem analysis. Currently, multiple integrated teaching strategies have been validated in diagnostics practical teaching. Outcome-based Education applied to diagnostics practical teaching can improve students' operational assessment performance and comprehensive quality [4]. The combination of the BOPPPS model and flipped classroom has achieved positive outcomes in practical diagnostics teaching [5]. Additionally, the modified Peyton teaching method combined with online-offline blended teaching can standardize operational procedures, deepen students' understanding, and strengthen knowledge memory, thereby effectively improving medical students' clinical practical skills [6]. A common feature of these innovative teaching models is embedding learning in specific tasks and scenarios, enabling students to build professional competencies through continuous cycles of practice and feedback, rather than passively accepting demonstrative teaching.

3.3 Evaluation system: from summative assessment to competency-based evidence evaluation

Evaluation acts as the "baton" of competency-based teaching. If the evaluation system still focuses on knowledge repetition and standardized operational performance, competency-oriented teaching objectives cannot be effectively implemented. The Objective Structured Clinical Examination (OSCE) and Mini-Clinical Evaluation Exercise (Mini-CEX) serve as core assessment tools for competency-based evaluation. OSCE comprehensively evaluates students' clinical competencies through multi-station standardized examinations [7], while Mini-CEX enables teachers to directly observe students' diagnosis and treatment behaviors in real clinical scenarios and provide immediate, structured feedback [8]. It is worth noting that the core of evaluation reform is to objectively reflect students' comprehensive competency level, rather than merely enriching assessment forms.

3.4 Technology empowerment: integrated teaching of virtual simulation and artificial intelligence

Virtual simulation technology breaks the resource constraints of traditional practical training and serves as an important tool to resolve the dilemmas of conventional teaching. For instance, in the teaching of four major puncture techniques in internal medicine, physical mannequins are limited in quantity. Repeated use leaves marks at puncture sites, which tends to make students neglect localization training. Virtual simulation systems can reconstruct the complete operational procedure and allow students to practice repeatedly before and after class. Combined with hands-on operation on physical mannequins, it improves the mastery of practical skills. Existing studies have verified that micro-lessons combined with virtual simulation can boost students' academic performance and learning interest in diagnostics teaching [9]. Other research indicates that the training program integrating AI-powered virtual standardized patients (VSP) and traditional standardized patients can more significantly enhance students' clinical reasoning ability, core competencies and OSCE scores. The benefits are especially prominent for students with weak foundations, while teachers' time spent on assessment and feedback can be reduced [10].

4 Practical challenges of competency-based teaching

4.1 Bottlenecks in the construction of dual-qualified teachers

The transformation of teaching paradigms has placed higher demands on teachers. Teachers engaged in diagnostics practical teaching are required not only to possess solid theoretical foundations in laboratory medicine and diagnostics, but also to accumulate rich clinical experience and innovative teaching capabilities. However, practical diagnostics teaching in most domestic medical colleges is undertaken by frontline clinical teachers. Although such teachers have solid practical experience, they are burdened with heavy clinical workloads, resulting in limited time and energy devoted to teaching. Moreover, lacking systematic training in pedagogical methods, they show deficiencies in teaching design, student situation analysis, and competency-oriented guidance. To promote the effective implementation of teaching reform in diagnostics practical courses, it is vital to build a high-quality dual-qualified teaching team with proficient clinical competence and professional teaching skills and bridge the mismatch in teachers' comprehensive capabilities [11].

4.2 Contradiction between quality and quantity of digital teaching resources

Despite the growing abundance of virtual simulation and artificial intelligence teaching resources, the development of high-quality teaching resources still faces challenges such as high investment costs, long development cycles, and slow content updates. Some medical colleges exhibit a phenomenon of "emphasizing construction while neglecting application" in virtual laboratories, with insufficient system interactivity and delayed update of case databases, which fail to meet students' personalized learning needs [12]. Furthermore, the reliability and validity of intelligent evaluation systems remain to be verified. In particular, the technical maturity of automated assessment for complex competencies, including clinical thinking and doctor-patient communication, is insufficient to completely replace teacher evaluation.

4.3 Risks of formalization in evaluation reform

The promotion and implementation of innovative evaluation models such as OSCE and Mini-CEX face considerable practical obstacles. The application of Mini-CEX requires substantial teacher time for on-site observation and immediate feedback, making it difficult to achieve regular implementation in medical institutions with imbalanced teacher-student ratios. Some teachers understand formative evaluation merely as "increasing assessment frequency" and fail to give full play to its core function of feedback and teaching improvement. In addition, subjective discrepancies exist in the evaluation criteria adopted by different teachers, leading to insufficient scoring consistency and standardization as well as potential evaluation deviations. Regular standardized training and scoring standard calibration sessions are therefore required to further refine the evaluation system.

5 Conclusion

Against the background of Emerging Medical Science construction, the transformation of diagnostics practical teaching from knowledge transmission to competency orientation conforms to the policy orientation of medical education reform, complies with the laws of medical talent cultivation, and adapts to the practical demands of clinical posts. Integrating the concept of competency-based medical education into daily teaching and systematically optimizing teaching objectives, teaching methods, evaluation systems and digital support systems can improve the instructional design of experimental courses and effectively enhance the quality of diagnostics practical teaching. This reform effectively consolidates students' clinical skills, clinical thinking and professional literacy, laying a solid foundation for cultivating high-quality and applied clinical medical talents in the new era.

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Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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