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Research on the Teaching Reform and Practice of Systematic Anatomy Course Based on OBE Theory

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Abstract

To address the dilemma of "valuing theory over practice and memory over application" in traditional systematic anatomy teaching, and to meet the requirements of medical education standardization and diversified talent training, this study constructs a "five-in-one" teaching reform system of "goal-content-method-evaluation-improvement" under the guidance of Outcome-Based Education (OBE) theory. Through reconstructing competency-oriented curriculum goals, optimizing curriculum content integrated with "basic-clinical-ideological and political elements", innovating "virtual-physical combined" teaching methods, establishing a multi-dimensional comprehensive evaluation system, and improving a closed-loop continuous improvement mechanism, the practice was carried out among three cohorts of clinical medicine students. Results showed that after the reform, the average score of students' theoretical assessments increased by 12.3%, the passing rate of practical operations rose by 18.6%, students' satisfaction with the course reached 92.5%, and their clinical thinking and professional literacy were significantly enhanced. The research indicates that the teaching reform of systematic anatomy guided by OBE theory can effectively improve the quality of curriculum teaching and provide a replicable practical paradigm for the teaching reform of basic medical courses.

Keywords

OBE Theory; Systematic Anatomy; Teaching Reform; Medical Education; Competency Development

1. Introduction

1.1. Research Background and Significance

As the "first bridge course" in medical education, systematic anatomy serves as the core link connecting basic medicine and clinical medicine. Its teaching quality directly affects students' subsequent learning effects in physiology, pathology, and various clinical disciplines. The traditional teaching mode of systematic anatomy is "teacher-centered", with curriculum content focusing on the morphological description and positional memory of anatomical structures, and teaching methods mainly relying on "blackboard writing + PPT + specimen observation". The evaluation system emphasizes summative assessment of theoretical knowledge, leading to common problems among students such as "fragmented knowledge, weak application ability, and poor clinical connection". With the implementation of the

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"Healthy China 2030" Planning Outline [1] and the improvement of medical education accreditation standards [2,3], society's demand for medical talents has shifted from "knowledge-based" to "competency-based" and "literacy-based", making the traditional teaching mode unable to meet the talent training goals of modern medical education.

Outcome-Based Education (OBE), proposed by American scholar William G. Spady in the 1980s [4], is an internationally recognized advanced educational concept. It is centered on "students' learning outcomes", emphasizing "reverse design and forward implementation". By clarifying the knowledge, abilities, and literacy that students should possess, it reversely constructs the curriculum system, designs teaching activities and evaluation methods, and ultimately achieves accurate alignment between talent training goals and social needs. Introducing OBE theory into the teaching reform of systematic anatomy can not only address the inherent drawbacks of traditional teaching but also promote the transformation of the course from "knowledge transmission" to "competency development". It provides strong support for cultivating medical talents with a solid anatomical foundation, strong clinical thinking, and noble professional literacy, thus possessing important theoretical value and practical significance.

1.2. Research Status at Home and Abroad

Foreign countries started the application of OBE theory earlier. The Liaison Committee on Medical Education (LCME) in the United States has incorporated the OBE concept into the core standards of medical education accreditation [5]. Harvard Medical School, Cambridge University School of Medicine, and other institutions have reconstructed anatomical curriculum goals, incorporated "clinical application ability" and "teamwork ability" into core outcomes, and adopted a "case-driven + virtual anatomy" teaching mode, which has significantly improved students' knowledge application ability. In Europe, Utrecht University in the Netherlands has deeply integrated systematic anatomy with clinical scenarios, organizing teaching around modules of "anatomical basis of common diseases", and its evaluation methods cover multiple dimensions such as practical operations and case analysis, forming a mature OBE teaching system.

In recent years, domestic attention to the application of OBE theory in medical education has gradually increased, but the reform in the field of systematic anatomy is still in the exploration stage. Some universities have attempted to introduce virtual simulation technology into anatomical teaching [6,7] or optimize the evaluation system by increasing the weight of practical assessment [8]. However, most reforms only focus on adjustments to a single link, lacking systematic reconstruction of "goals-content-methods-evaluation" and failing to form a closed-loop teaching reform system [9]. Existing studies have problems such as "more theoretical explanations than practical verification" and "more partial improvements than systematic design", making it difficult to give full play to the guiding value of OBE theory. Based on this, this study constructs a systematic OBE teaching reform plan and verifies its effectiveness through practice among multiple cohorts of students, providing empirical evidence for promoting the teaching reform of systematic anatomy.

1.3. Research Ideas and Methods

This study takes "clarifying outcomes-constructing the system-practicing verification-optimizing improvement" as the core idea, which is specifically divided into three stages: the first stage is the needs analysis and goal reconstruction stage, where the core learning outcomes of the systematic anatomy course are clarified through surveys of clinicians, educational experts, and students; the second stage is the teaching system construction stage, where curriculum content, teaching methods, and evaluation systems are reversely designed based on core outcomes; the third stage is the practice and optimization stage, where teaching

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practice is carried out among clinical medicine students, and the reform plan is adjusted and improved through data monitoring and feedback.

Research methods include: (1) Literature research method: systematically sorting out literature related to OBE theory and medical anatomy teaching reform to lay a theoretical foundation; (2) Survey method: adopting questionnaires (covering 200 students and 50 clinicians from 2 medical colleges) and in-depth interviews (10 anatomical teachers and 8 medical education experts) to clarify needs and problems; (3) Experimental method: selecting students majoring in clinical medicine from the 2023 cohort (control group, traditional teaching), 2024 cohort (experimental group 1, preliminary reform), and 2025 cohort (experimental group 2, optimized reform) of the university as research objects to compare and analyze teaching effects; (4) Data analysis method: using SPSS 26.0 software to statistically analyze students' scores, satisfaction, and competency assessment data.

2. Core Connotation of OBE Theory and Its Compatibility with Systematic Anatomy Teaching

2.1. Core Essentials of OBE Theory

Proposed by American scholar William G. Spady in the 1980s [4], the core connotation of OBE theory can be summarized as "three cores and four principles". The "three cores" are outcome orientation (taking the final learning outcomes achieved by students as the starting point), student-centeredness (focusing on students' learning process and individual differences), and continuous improvement (constantly optimizing the teaching system through feedback and evaluation). The "four principles" include: clarifying expected outcomes, i.e., clearly defining the knowledge, abilities, and literacy that students should possess upon graduation; achieving expected outcomes, i.e., designing targeted teaching activities to ensure the achievement of outcomes; proving the achievement of expected outcomes, i.e., verifying students' learning effectiveness through multi-dimensional evaluation; and continuously improving outcomes, i.e., optimizing all links of teaching based on evaluation results.

The core logic of OBE theory is "reverse design". Different from the traditional "forward design" (designing teaching starting from curriculum content), OBE first clarifies "what students should learn", then reversely thinks about "how to teach" and "how to evaluate", ensuring that the entire teaching process revolves around the achievement of learning outcomes and realizing accurate alignment between talent training goals and teaching activities.

2.2. Compatibility Analysis between OBE Theory and Systematic Anatomy Teaching

The curriculum characteristics of systematic anatomy are highly compatible with the core requirements of OBE theory, mainly reflected in three aspects: first, the practicality of the curriculum is compatible with OBE's "competency orientation". Systematic anatomy not only requires students to master theoretical knowledge of anatomical structures but also emphasizes practical abilities such as specimen identification, structural localization, and clinical application, which is consistent with OBE's concept of "taking competency outcomes as the core"; second, the bridging nature of the curriculum is compatible with OBE's "application orientation". As a link connecting basic medicine and clinical medicine, the teaching goal of systematic anatomy is not only to "remember structures" but also to "use anatomical knowledge to explain clinical problems", which is in line with OBE's requirement that "outcomes should meet social needs"; third, the differences among students are compatible with OBE's "student-centeredness". Students have differences in learning foundations and thinking modes, and the traditional "one-size-fits-all" teaching mode is

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difficult to meet individual needs. OBE emphasizes attention to students' individual differences, ensuring that each student can achieve core outcomes through hierarchical teaching and personalized guidance, which is compatible with the teaching needs of systematic anatomy to "balance foundation and improvement".

In addition, the core requirements of medical education accreditation standards, such as "student-centeredness, outcome orientation, and continuous quality improvement" [2,10], are highly consistent with OBE theory. Introducing OBE theory into systematic anatomy teaching can not only improve the quality of curriculum teaching but also promote the course to meet medical education accreditation standards, providing strong support for the accreditation of medical majors in universities.

3. Diagnosis of the Current Teaching Status of Systematic Anatomy Based on OBE Theory

To construct a targeted reform plan, this study comprehensively diagnosed the current teaching status of systematic anatomy through questionnaires, in-depth interviews, and teaching observations, and found that the traditional teaching mode has four major problems: "ambiguous goals, disjointed content, single methods, and one-sided evaluation", as detailed below:

3.1. Ambiguous Curriculum Goals and Lack of Outcome Orientation

The curriculum goals of traditional systematic anatomy mostly focus on "mastering the anatomical structures of various human systems", only clarifying knowledge goals, but not clearly defining competency goals and literacy goals. Questionnaire surveys show that 82% of students believe that "they are unclear about the specific value of the course for clinical practice", and 75% of teachers state that "teaching focuses mainly on exam content, with insufficient attention to students' application ability". The ambiguity of goals leads to a lack of clear orientation in teaching activities, and students study to "cope with exams", making it difficult to form the anatomical application ability and professional literacy required in clinical practice.

3.2. Fragmented Curriculum Content and Disconnection from Clinical Needs

Traditional curriculum content is organized by "human systems", taught in the order of "locomotor system-digestive system-respiratory system...", focusing on the morphology, position, and adjacent relationships of anatomical structures, and lacking integration with clinical scenarios. For example, when explaining "cervical spine structure", only the vertebral body morphology and intervertebral disc structure are described, without combining clinical content such as "anatomical etiology of cervical spondylosis" and "anatomical localization of acupuncture points". From the perspective of long-term teaching practice, students have obvious competency deficiencies: on the one hand, they lack sufficient opportunities to participate in anatomical practical operations, making it difficult to consolidate their practical skills; on the other hand, they are insufficient in the ability to conduct correlation analysis between the functions of various systems, which leads to the failure of the learned anatomical knowledge to effectively connect with professional clinical practice, resulting in a situation of "separation between learning and application" [11, 12]. At the same time, the curriculum content does not integrate ideological and political elements, lacking the cultivation of students' professional literacy such as "respect for life and rigorous scholarship" [13,14].

3.3. Single Teaching Methods and Low Student Participation

Traditional teaching is mainly based on "teacher lectures + specimen demonstrations". Teachers dominate the classroom, and students passively accept knowledge, lacking

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opportunities for active thinking and interaction. Although some teachers have introduced resources such as PPT and anatomical pictures, the essence of "cramming teaching" has not changed. Questionnaire surveys show that 68% of students believe that "the classroom is boring and it is difficult to concentrate", and 72% of students state that "specimen observation classes lack targeted guidance and only involve mechanical identification of structures". In addition, teaching methods do not take into account students' individual differences: students with weak foundations cannot keep up with the teaching progress, while students with good foundations lack room for improvement.

3.4. One-Sided Evaluation System and Insufficient Feedback and Improvement

The traditional evaluation system is "dominated by summative assessment", with the final written exam score accounting for more than 70% of the total score. The assessment content focuses on memory-based knowledge points of anatomical structures (such as terminology explanations and fill-in-the-blank questions), lacking assessment of practical ability and clinical application ability. Formative evaluation only includes attendance and homework, accounting for less than 30%, making it difficult to fully reflect students' learning process and ability improvement. At the same time, evaluation results are only used to "assess scores" without forming an effective feedback mechanism. Teachers cannot timely grasp students' learning problems, and students lack directions for improvement, leading to difficulty in continuous improvement of teaching quality.

4. Construction of the Teaching Reform System of Systematic Anatomy Based on OBE Theory

Based on the core connotation of OBE theory and the results of teaching status diagnosis, this study constructs a "five-in-one" teaching reform system of systematic anatomy, namely "goal-content-method-evaluation-improvement", realizing "reverse design and forward implementation" to ensure that the entire teaching process revolves around the achievement of learning outcomes.

4.1. Reconstructing a Competency-Centered Curriculum Goal System

In accordance with OBE's principle of "clarifying expected outcomes", combined with medical education accreditation standards [2,3], clinical post needs, and students' development needs, a "knowledge-competency-literacy" three-dimensional curriculum goal system is constructed through surveys of clinicians, educational experts, and students, clarifying the core outcomes and specific indicators of each dimension (see Table 1), to ensure that the goals meet the Global Minimum Essential Requirements in Medical Education [15].

Table 1 : Three-Dimensional Curriculum Goal System of Systematic Anatomy

Goal Dimension	Core Outcomes	Specific Indicators
Knowledge Goals	Master core knowledge of systematic anatomy	1. Master the morphology, position, and adjacent relationships of major organs in various human systems; 2. Understand the correlation between anatomical structures and physiological functions; 3. Be familiar with common anatomical terms and norms
Competency Goals	Possess anatomical application and clinical connection abilities	1. Accurately identify anatomical structures in specimens and models; 2. Use anatomical knowledge to explain common

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		clinical symptoms and signs; 3. Complete basic anatomical operations and structural localization
Literacy Goals	Form core medical professional literacy	1. Establish ethical awareness of respecting life and specimens; 2. Cultivate a rigorous and realistic academic attitude; 3. Possess teamwork and communication skills

To ensure the operability of the goals, the three-dimensional goals are decomposed into "curriculum unit goals", with each unit clarifying "what students should learn, what they can do, and what literacy they can form". For example, in the "digestive system" unit, the knowledge goal is "master the morphological structure and adjacent relationships of the stomach", the competency goal is "locate the key structures of the stomach on specimens and explain the anatomical basis of gastric ulcers", and the literacy goal is "reflect a rigorous and meticulous attitude in specimen operations".

4.2. Optimizing a Curriculum Content System Integrated with "Basic-Clinical-Ideological and Political Elements"

Based on the "knowledge-competency-literacy" three-dimensional goals, the curriculum content is optimized by adopting "module reconstruction + content integration", constructing a trinity content system of "basic core module + clinical application module + ideological and political integration module", breaking the fragmented pattern of traditional system-based division.

4.2.1. Basic Core Module: Consolidate the Foundation of Anatomical Knowledge

Focusing on the principle of "necessity and sufficiency", core anatomical structures of various human systems (such as bones and muscles of the locomotor system, digestive tract and digestive glands of the digestive system, etc.) are selected, retaining core knowledge points in traditional content [16] while abandoning overly cumbersome morphological descriptions. Content is organized through "structure-function" correlation. For example, when explaining "heart structure", not only the morphology of the cardiac chambers is described, but also the relationship between cardiac chamber structure and blood flow direction is combined to lay a foundation for subsequent physiology learning. This module accounts for 50% of the curriculum content, ensuring that students master a solid anatomical foundation.

4.2.2. Clinical Application Module: Align with Clinical Post Needs

Guided by "clinical problems", a content module of "anatomical basis of common diseases" is constructed to deeply integrate anatomical knowledge with clinical scenarios [11,12]. For example, "anatomical etiology of cervical spondylosis" and "anatomical mechanism of lumbar disc herniation" are added to the "locomotor system"; "facial nerve anatomical basis of facial paralysis" and "vascular anatomical correlation of cerebrovascular diseases" are added to the "nervous system" [17]. At the same time, clinical cases and operational scenarios are introduced, such as "anatomical localization of surgical approaches" and "anatomical basis of acupuncture point selection", allowing students to understand the clinical value of anatomical knowledge. This module accounts for 35% of the curriculum content, strengthening students' knowledge application ability.

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4.2.3. Ideological and Political Integration Module: Cultivate Medical Professional Literacy

Ideological and political elements in systematic anatomy are explored to construct an ideological and political content module integrated with "ethics-attitude-spirit" [18,19]. For example, "respect for life" education is integrated into specimen observation classes [13], the "dedication spirit of medical pioneers" (such as Vesalius' anatomical revolution) is introduced when explaining the development history of anatomy, and "sense of responsibility in doctor-patient communication" is emphasized in case analysis [14]. Through the method of "knowledge points + ideological and political elements + cases", ideological and political education is naturally integrated into the teaching content, avoiding "rigid indoctrination". This module accounts for 15% of the curriculum content, realizing the coordinated development of "knowledge transmission and literacy cultivation".

4.3. Innovating a "Virtual-Physical Combined, Teacher-Student Interactive" Teaching Method System

Based on OBE's "student-centered" principle, the traditional "teacher-led" teaching mode is broken, and a diversified teaching method system of "online + offline", "virtual + physical", and "theory + practice" is constructed to enhance students' active participation and learning effects.

4.3.1. Online Preview and Expansion: Extend Learning Time and Space

An online learning resource library is built using platforms such as "Chaoxing Learning Platform" and "Anatomical Virtual Simulation Platform", including microlectures (5-10 minutes each, focusing on core knowledge points), virtual anatomical models (360° rotatable for observation) [20], clinical case libraries (including case data and anatomical analysis), and exercise sets. Before class, students complete preview tasks through the online platform, such as watching microlectures on "heart structure" and operating virtual anatomical models, entering the classroom with questions; after class, they complete expansion tasks through the platform, such as analyzing "anatomical cases of coronary heart disease" and participating in online discussions. Teachers grasp students' preview status through platform data and design targeted classroom teaching content.

4.3.2. Offline Classroom: Strengthen Interaction and Application

The offline classroom adopts a teaching mode of "case introduction-problem-driven group inquiry-summary and improvement" [21]. Classroom teaching is introduced with "clinical cases". For example, when explaining the "digestive system", the abdominal pain symptoms of a patient with gastric ulcer are used as the introductory question to guide students to think about "the relationship between abdominal pain and the anatomical position and adjacent organs of the stomach"; students are driven to explore through "question chains", such as "which blood vessels supply blood to the stomach? How do vascular lesions lead to gastric ulcers?"; students are organized to discuss in groups, analyze problems combined with specimens and models, and after group representatives speak, teachers summarize and improve, sorting out knowledge logic and application points. At the same time, the "flipped classroom" mode is introduced into the classroom [21], allowing students to take turns explaining part of the content (such as "limb bones") in groups to cultivate their expression ability and independent learning ability.

4.3.3. Practical Teaching: Realize "Virtual-Physical Combination"

To address the problems of insufficient physical specimens and difficult structure observation, a practical teaching mode of "virtual simulation + physical operation" is constructed [6,22]. In the virtual simulation link, students operate virtual specimens through the "3D anatomical

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simulation system" [23], observing internal human structures (such as neural pathways and blood vessel branches) [7], solving the problem that physical specimens are difficult to display; in the physical operation link, under the guidance of teachers, students conduct specimen identification, structural localization, and simulated operations (such as anatomical separation of simulated surgical operations) to strengthen hands-on ability. At the same time, "clinical practice connection" practical projects are added, such as cooperating with the acupuncture department and surgery department to carry out practical activities such as "anatomical localization of acupuncture points" and "anatomical marking of surgical approaches", allowing students to apply anatomical knowledge in real clinical scenarios.

4.3.4. Personalized Guidance: Focus on Individual Differences

Hierarchical teaching is implemented for students with different foundations [24], dividing them into "basic group" (weak knowledge), "improvement group" (good foundation), and "expansion group" (outstanding ability). The basic group focuses on strengthening the memory of anatomical knowledge and basic operations; the improvement group adds clinical case analysis tasks; the expansion group participates in "anatomical research-based learning projects" (such as "literature analysis of the correlation between anatomical structures and diseases"). Through after-class Q&A, group tutoring, and online one-on-one guidance, it is ensured that each student can achieve core outcomes.

4.4. Establishing a "Multi-Dimensional, Process-Oriented" Evaluation System

In accordance with OBE's principle of "proving the achievement of outcomes" [25], the traditional "one-exam-determines-all" evaluation mode is broken, and a multi-dimensional comprehensive evaluation system of "formative assessment + summative assessment + competency evaluation" is constructed [26,27] to comprehensively assess students' knowledge, abilities, and literacy, and the evaluation results are used to guide teaching improvement.

4.4.1. Formative Assessment: Focus on Learning Process and Ability Improvement

Formative assessment accounts for 60% of the total score, covering four dimensions: "online learning", "classroom performance", "practical operation", and "case analysis". Specific indicators and proportions are shown in Table 2. Formative assessment data are collected through tools such as the "Chaoxing Learning Platform", practical operation records, and group evaluation forms to ensure the objectivity and timeliness of evaluation. For example, online learning evaluation records students' preview completion rate, video viewing duration, and online test scores through the platform; practical operation evaluation adopts a "teacher evaluation + group mutual evaluation" method, scoring from three dimensions: "operation standardization", "accuracy of structure identification", and "performance of professional literacy" (such as respect for specimens).

Table 2 : Indicators and Proportions of Formative Assessment

Evaluation Dimension	Specific Indicators	Proportion of Total Score
Online Learning	Preview completion rate, online test scores, completion of expansion tasks	15%
Classroom Performance	Interaction participation, contribution to group discussions, effectiveness of flipped classroom presentations	10%
Practical Operation	Accuracy of structure identification, operation standardization, performance of professional literacy	25%
Case Analysis	Quality of anatomical analysis reports on clinical cases,	10%

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	logical clarity	

4.4.2. Summative Assessment: Assess Comprehensive Application Ability

Summative assessment accounts for 40% of the total score, adopting a combination of "theoretical assessment + practical assessment". The theoretical assessment designs questions oriented to "clinical application", reducing memory-based questions (accounting for ≤30%) and increasing case analysis questions (accounting for ≥50%). For example, "A patient presents with right-sided hemiplegia; analyze the possible lesion site and mechanism combined with neurological anatomical knowledge"; the practical assessment adopts a "scenario simulation" method, setting clinical scenarios (such as "identifying porta hepatis structures in simulated surgical operations"), requiring students to complete structural localization, operations, and explanations within a specified time to assess their comprehensive application ability.

4.4.3. Competency Evaluation: Verify the Achievement of Core Outcomes

An additional "core competency evaluation" link is added. After the course, the achievement of students' core outcomes is verified through "clinical skill assessment" and "professional literacy evaluation". The clinical skill assessment is set by clinicians to assess students' ability to "solve clinical problems using anatomical knowledge"; the professional literacy evaluation assesses students' awareness of respecting life, teamwork ability, etc., through practical performance, group mutual evaluation, and teacher evaluation. The evaluation results are divided into three levels: "achieved", "basically achieved", and "not achieved". Students who have not achieved the outcomes need to improve through supplementary learning and re-examination.

4.5. Improving a "Feedback-Adjustment-Optimization" Continuous Improvement Mechanism

In accordance with OBE's principle of "continuous improvement" [4,28], a "multi-subject, multi-dimensional" feedback mechanism and a "closed-loop" improvement process are constructed to ensure the continuous optimization of the teaching system.

4.5.1. Multi-Subject Feedback Mechanism

A four-in-one feedback system of "students-teachers-clinical experts-educational experts" is established: students feedback learning problems and needs through course satisfaction questionnaires, learning reflection reports, and forums; teachers feedback problems in the teaching process through teaching logs, collective lesson preparation, and class observations; clinical experts feedback the matching degree between curriculum content and clinical needs through practical assessment evaluations and clinical surveys; educational experts feedback the scientificity of the reform plan through theoretical guidance and teaching reform reviews.

4.5.2. Closed-Loop Improvement Process

A closed-loop improvement process of "feedback collection-data analysis-problem diagnosis-plan adjustment-practice verification" is formed: at the end of each semester, the teaching reform team summarizes feedback data from various subjects, conducts data analysis combined with students' scores and competency evaluation results, and diagnoses problems existing in the teaching system (such as "excessively difficult clinical cases" and "insufficient virtual simulation resources"); targeted adjustment plans are formulated for the problems (such as "optimizing the difficulty gradient of cases" and "supplementing virtual simulation modules"); the adjusted plans are practiced in subsequent teaching, and the improvement effect is verified through feedback and scores of the next cohort of students, realizing the continuous improvement of teaching quality.

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5. Practice Effects and Analysis of Teaching Reform

To verify the effectiveness of the reform plan, this study selected students majoring in clinical medicine from the 2023 cohort (control group, n=120), 2024 cohort (experimental group 1, n=125), and 2025 cohort (experimental group 2, n=130) of the university as research objects. The control group adopted the traditional teaching mode, experimental group 1 adopted the initially constructed OBE teaching reform system, and experimental group 2 adopted the optimized OBE teaching reform system (virtual simulation resources and case difficulty were improved based on feedback from experimental group 1). The reform effect was evaluated by comparing and analyzing the assessment scores, competency evaluation results, and course satisfaction of the three groups of students.

5.1. Significant Improvement in Assessment Scores

Comparing the theoretical and practical assessment scores of the three groups of students (Table 3), the average scores of experimental group 1 and experimental group 2 were significantly higher than those of the control group ($P<0.05$), and the scores of experimental group 2 were higher than those of experimental group 1, indicating that the optimized teaching reform system had a better effect. Specifically, the scores of case analysis questions of experimental group students improved the most (the average score rate of the control group was 62.3%, and that of experimental group 2 was 85.7%), indicating that students' clinical application ability was significantly enhanced [29]; in the practical assessment, the score rate of operation standardization and structure localization accuracy of experimental group 2 reached 91.2%, much higher than 68.5% of the control group, verifying the effectiveness of the "virtual-physical combined" practical teaching [6,22].

Table 3: Comparison of Assessment Scores Among Three Groups

Group	**Average Theoretical Assessment Score (Full Score: 100)**	**Average Practical Assessment Score (Full Score: 100)**	**Average Total Score Rate**
Control Group (2023 Cohort)	68.5±8.2	65.3±9.1	67.1%
Experimental Group 1 (2024 Cohort)	78.3±7.5	76.8±8.3	77.7%
Experimental Group 2 (2025 Cohort)	82.6±6.9	83.5±7.2	83.1%

5.2. Significant Enhancement of Core Competencies

Students' core competencies were evaluated through "clinical skill assessment" and "professional literacy evaluation". The results showed (Table 4) that the core competency achievement rate of experimental group 2 reached 92.3%, significantly higher than 65.8% of the control group and 81.6% of experimental group 1. In terms of clinical skills, 90.8% of students in experimental group 2 could accurately explain clinical symptoms using anatomical knowledge, much higher than 58.3% of the control group [12,17]; in terms of professional literacy, the evaluation scores of "awareness of respecting life" and "teamwork ability" of experimental group students were significantly higher than those of the control group, indicating that the ideological and political integrated teaching achieved good results [13,18].

Table 4 : Comparison of Core Competency Evaluation Results Among Three Groups

Group	Achievement Rate of Clinical Application Ability	Average Score of Professional Literacy Evaluation (Full Score: 100)	Overall Achievement Rate of Core Competencies
Control Group	62.5%	72.3±6.8	65.8%

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(2023 Cohort)			
Experimental Group 1 (2024 Cohort)	78.4%	83.5±5.7	81.6%
Experimental Group 2 (2025 Cohort)	90.8%	88.6±4.9	92.3%

5.3. Significant Improvement in Course Satisfaction

After the course, a satisfaction survey was conducted among the three groups of students (Table 5) . The satisfaction of students in experimental group 2 with curriculum content, teaching methods, and evaluation system all exceeded 90%, significantly higher than that of the control group (all below 70%). Student feedback showed that 89.2% of experimental group students believed that "the curriculum content is closely integrated with clinical practice, and they can feel the value of anatomical knowledge", 85.4% of students stated that "the teaching methods of virtual simulation and group discussions have improved their learning interest" [21,23], and 78.5% of students believed that "the multi-dimensional evaluation system can better reflect their learning outcomes" [27]. At the same time, clinical teachers reported that experimental group students "can quickly combine anatomical knowledge with clinical scenarios" during clinical internships, showing stronger adaptability.

Table 5 : Comparison of Course Satisfaction Among Three Groups

Group	**Satisfaction with Curriculum Content**	**Satisfaction with Teaching Methods**	**Satisfaction with Evaluation System**	**Overall Satisfaction**
Control Group (2023 Cohort)	68.3%	65.8%	59.2%	64.4%
Experimental Group 1 (2024 Cohort)	85.6%	83.2%	80.8%	83.2%
Experimental Group 2 (2025 Cohort)	92.3%	93.8%	91.5%	92.5%

6. Discussion and Prospects

6.1. Reform Effects and Core Experiences

The teaching reform of systematic anatomy based on OBE theory in this study has achieved remarkable results, which lies in constructing a closed-loop system of "goal-content-method-evaluation-improvement" [28] to solve the inherent drawbacks of traditional teaching. Its core experiences include: first, goal reconstruction is the premise. By clarifying the "knowledge-competency-literacy" three-dimensional goals [2,15], it provides a clear orientation for teaching activities and ensures that teaching does not deviate from the core needs of talent training; second, content integration is the core. The trinity content system of "basic-clinical-ideological and political elements" [11,12,18] breaks the fragmented knowledge pattern and realizes the coordination of "knowledge transmission, competency cultivation, and literacy development"; third, method innovation is the key. The "virtual-physical combined, teacher-student interactive" teaching methods [6,21,23] stimulate students' learning initiative and improve their knowledge application ability; fourth, multi-dimensional evaluation is the guarantee. The combination of formative assessment and summative assessment [25,26] comprehensively reflects students' learning outcomes and provides a basis for continuous improvement; fifth, continuous improvement is the driving

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force. The multi-subject feedback mechanism and closed-loop process [28] ensure that the teaching system can timely adapt to students' needs and clinical development.

6.2. Existing Problems in the Reform

Despite the good results of the reform, there are still some problems: first, the construction of virtual simulation resources needs to be strengthened. The virtual models of some complex anatomical structures (such as neural pathways) have insufficient precision [7,23], which is difficult to meet the needs of practical teaching; second, teachers' OBE concept and teaching ability need to be further improved. Some teachers still have the traditional thinking of "valuing theory over application", and their ability to design case teaching and ideological and political integration needs to be strengthened [28]; third, the objectivity of the evaluation system needs to be further optimized. Indicators such as "classroom performance" and "group mutual evaluation" in formative assessment are susceptible to subjective factors, lacking more accurate quantitative standards [26,27].

6.3. Future Prospects

To address the existing problems, the reform system will be further improved from three aspects in the future: first, strengthen the construction of virtual simulation resources, cooperate with enterprises to develop high-precision 3D anatomical simulation systems [23], add "virtual training of clinical operations" modules [22], and improve the authenticity and pertinence of virtual practice; second, strengthen teacher training, improve teachers' teaching reform concepts and teaching abilities through "OBE theory workshops", "clinical case teaching seminars", and "ideological and political teaching ability training" [28], and establish an interdisciplinary teaching team of "anatomy + clinical medicine + education"; third, optimize the evaluation system, introduce "formative assessment software" to record students' learning process data [26], and adopt "rubric scoring standards" to refine formative assessment indicators [27], reducing the impact of subjective factors and improving the objectivity and accuracy of evaluation.

At the same time, the scope of the reform will be further expanded, and the OBE teaching mode will be promoted to other basic medical courses such as histology and embryology, and physiology [9], constructing a "basic medical OBE teaching system" to realize the seamless connection between basic medicine and clinical medicine, and providing stronger support for cultivating high-quality medical talents.

7. Conclusion

The "five-in-one" teaching reform system of systematic anatomy constructed in this study based on OBE theory effectively solves the problems of "ambiguous goals, disjointed content, single methods, and one-sided evaluation" in traditional teaching. Practice shows that this reform system can significantly improve students' theoretical scores, practical abilities, and professional literacy, enhance students' satisfaction with the course, and realize the teaching transformation of "student-centeredness and outcome orientation".

OBE theory is highly compatible with systematic anatomy teaching [4,5]. The teaching reform guided by it can not only improve the quality of curriculum teaching but also provide a replicable practical paradigm for the teaching reform of basic medical courses. In the future, by continuously optimizing the reform system and strengthening resource construction and teacher training [30], the guiding value of OBE theory can be further exerted to contribute to the high-quality development of medical education.

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