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Research on the Construction of Open Management System for Teaching Laboratories in Local Universities and Colleges Under the Background of New Medical Sciences

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Abstract: ***In the era of the "New Medical Sciences" initiative, the cultivation of medical talents aims to foster high-quality medical students with profound theoretical knowledge, excellent practical skills, and a commitment to clinical services, further enhancing their clinical reasoning ability and practical innovation capacity. Cultivating college students with innovative capabilities is one of the core objectives for multi-level and high-standard talent development in medical universities under the New Medical Sciences framework. This paper systematically analyzes the main challenges encountered in exploring the cultivation of college students' innovative abilities through the opening of teaching laboratories in local universities. It proposes a four-level closed-loop governance mechanism of "University-Management-Teacher-Student" and synergistically advances structural reforms on both the supply and demand sides. By improving the governance capacity and operational efficiency of laboratory opening from multiple dimensions, this study strengthens the cultivation of students' practical abilities and innovative literacy, thereby providing a theoretical basis and practical path for nurturing compound medical innovative talents under the background of New Medical Sciences.***

Keywords: New Medical Sciences, management of university teaching laboratories, college students, cultivation of innovative abilities.

1. Introduction

The conference on the Ministry of Education's "Six Excellence and One Top-Tier Program 2.0" formulated specific development plans for New Engineering, New Medical Sciences, New Agriculture, and New Liberal Arts, defining the overall goal of comprehensively accelerating the construction of high-quality undergraduate education and improving talent training capacity [1]. Meanwhile, centering on the Healthy China Strategy, efforts are made to deepen the integration of medical education and clinical practice, aiming to cultivate talents with outstanding medical innovation capabilities, further shape a "New Medical Sciences" education system with Chinese characteristics, and continuously strengthen teaching reforms targeting the development of post competency [2]. Under the background of "New Medical Sciences", laboratories are required to transform from traditional teaching demonstrations to comprehensive, interdisciplinary experimental teaching characterized by "student-led and project-driven" approaches. Priority is given to supporting students in independently carrying out innovative projects derived from cutting-edge scientific research or actual industrial needs. By deepening the integration of industry and education as well as the integration of science and education, medical students' scientific research thinking, practical skills, and independent exploration spirit are strengthened, thereby nurturing compound innovative talents capable of addressing future health challenges for the development of New Medical Sciences. Therefore, the opening of university teaching laboratories has become a key initiative for cultivating the innovative capabilities of undergraduate medical students [3]. At present, some local universities still generally face problems such as low degree of opening of teaching laboratories and uneven opening standards. Instead of playing a corresponding role in promoting the cultivation of college students' innovative abilities, these issues—including insufficient faculty resources, shortage of funding investment, low quality of students, and inadequate research venues—have formed bottlenecks restricting the development of students' innovative potential. As a result, the inherent innovation incubation function of laboratories has not been fully realized, making it difficult to meet the urgent demand for cultivating compound innovative talents under the background of "New Medical Sciences". Based on this, this paper will analyze the difficulties faced by the opening of teaching laboratories in local universities, explore practical paths consistent with the training mode of innovative medical talents under the background of New Medical Sciences, significantly improve the quality of laboratory opening and the efficiency of resource utilization, strengthen the cultivation of medical students' practical abilities and innovative literacy, and provide strong support for the construction of New Medical Sciences.

2. Challenges Faced in the Opening of Teaching Laboratories in Local Universities

2.1 Structural Constraints on Laboratory Opening Conditions, Failing to Meet the Demand for High-Level Opening-Up

Multi-campus operation has become a mainstream trend in the development of universities. To expand educational space and optimize the allocation of educational resources, some universities have adopted a multi-campus parallel operation mode. However, against the backdrop of multi-campus operation, unbalanced resource allocation has emerged as a core factor restricting the quality of laboratory opening-up, mainly reflected in the uneven distribution of instruments and equipment due to differences in the functional positioning of various campuses, which limits the conduct of high-level cross-campus experiments [4]. At the same time, geographical distance increases the management difficulty and cost of the consumables supply chain, easily leading to supply disruptions and affecting the continuity of laboratory opening-up.

In addition, with the operational needs of local universities, as educational space continues to expand and teaching instruments and equipment increase steadily in the development process, the lag in informatization construction prevents the integration and open sharing of various resources with teachers and students. This results in a situation where “obviously the university has relevant openable venues, instruments and equipment, but teachers and students are unable to obtain information about them,” hindering the improvement of the level of laboratory opening-up at the underlying architecture level and making it difficult to meet the new requirements of “Medical + X” interdisciplinary talent training.

2.2 Barriers to the Interconnection Between Scientific Research and Teaching Systems in Laboratories, Failing to Provide Effective Support

Universities invest substantial resources in building scientific research platforms to attract high-level scientific research talents and produce cutting-edge scientific research achievements. In this process, scientific research talents can serve as teachers for open experimental projects to guide students, while scientific research achievements can be transformed into in-depth extensions of teaching experimental projects. Correspondingly, teaching practice can not only provide effective feedback and inspiration for scientific research but also offer a preliminary verification platform and valuable talent reserve, forming a virtuous cycle of complementary scientific research and teaching. However, when there is a lack of resource sharing and functional coordination between teaching and scientific research laboratories, scientific research resources cannot feed back into teaching in a timely manner. For students, it is difficult for them to access cutting-edge scientific practices during their undergraduate studies, the update of their knowledge system lags behind, and the cultivation of their innovative capabilities is constrained. For teaching, the content of experimental courses is disconnected from real scientific research, making it hard to improve teaching quality and appeal. For universities, this results in a huge waste of educational resources and is not conducive to the achievement of the strategic goal of cultivating innovative talents [5].

2.3 Lag in the Construction of Experimental Teaching Teams, Restricting the Improvement of Open Experiment Quality

According to the core requirements of the Ministry of Education’s Guiding Opinions on Strengthening the Construction of Young Teachers’ Teams in Colleges and Universities in the New Era: “Strengthen research on the regularity and forward-looking nature of young teachers’ team construction, clarify the direction, focus and type of talent allocation in combination with the university’s overall development goals and discipline construction priorities, coordinate short-term and long-term needs, precisely plan talent recruitment positions, refine recruitment standards, and implement classified talent recruitment with an emphasis on basic disciplines, emerging disciplines and interdisciplinary disciplines” [6]. At present, the experimental teaching teams in colleges and universities are unbalanced in quantity allocation, with a low proportion of full-time staff. Teaching tasks rely heavily on part-time teachers, leading to fixed opening hours and insufficient depth of guidance, which affects the efficiency of resource allocation. Meanwhile, the team structure is unreasonable: there is a shortage of high-educated and high-professional-title personnel, teachers’ knowledge update lags behind, and their ability to develop interdisciplinary experiments is weak, which restricts the cutting-edge nature and innovation of open experiment content. In addition, the proportion of personnel with professional safety qualifications is extremely low, making it difficult to build a high-standard safety assurance environment and laying potential safety hazards for laboratory opening-up [7-8].

2.4 Lack of the Student-Centered Guidance Mechanism, Affecting the Actual Effectiveness of Laboratory Opening-Up

In accordance with the requirements of the Guiding Opinions of the Ministry of Education on Deepening the Reform of the Assessment and Evaluation System for University Teachers: “Eliminate the ‘research-only’ tendency and strengthen the weight of teaching performance in evaluation” and the Guiding Opinions of the General Office of the State Council on Accelerating the Innovative Development of Medical Education: “Cultivate compound medical innovative talents” [9-10], there is still an imbalance in the evaluation orientation of experimental teaching in current universities. Affected by the research-dominated professional title and performance evaluation mechanism, teachers invest insufficiently in experimental teaching, which weakens teaching innovation and student guidance. In turn, this subtly leads students to lean towards utilitarian goals, with weak basic operational skills and design thinking. The deeper problem lies in the lack of systematic pre-experiment guidance—students have a shallow understanding of complex equipment and insufficient practical operation capabilities, making it difficult for them to achieve the transformation from “passive execution” to “active design,” which restricts the effective cultivation of compound medical innovative talents [11-12].

3. Exploration and Practice of Open Teaching Laboratories in Local Universities

Against the backdrop of the talent training transformation emphasized by the construction of New Medical Sciences—featuring a “student-centered and competency-based” approach—teaching laboratories serve as the core platform for cultivating medical students’ practical abilities and innovative thinking. The quality of their opening-up is directly related to the training effectiveness of high-level medical talents. By constructing a four-level closed-loop feedback platform involving universities, administrative departments, teachers, and students (see Figure 1 for details), an overall framework for the opening of university teaching laboratories is established. On the basis of strengthening hierarchical management, structural reforms on both the supply and demand sides are promoted (see Table 1 for details), and targeted measures are implemented to achieve dynamic adaptation between the supply of open resources and students' development needs. This provides a theoretical basis and practical path for the systematic reconstruction of the laboratory opening-up system under the background of New Medical Sciences.

3.1 Constructing a Four-Level Closed-Loop Feedback Platform to Strengthen Collaborative Governance

3.1.1 University Level

Enhancing Top-Level Design and Resource Coordination. In terms of top-level design, as the top-level decision-making body for laboratory opening-up, the university should establish a three-level management responsibility system covering the university, colleges, and experimental centers, clarifying the boundaries of authority and responsibility as well as collaboration mechanisms. Resource allocation must closely align with the development needs of New Medical Sciences, and combine with key discipline construction to systematically upgrade characteristic experimental teaching centers [13]. In terms of system design, it is necessary to formulate implementation rules for the management of laboratory opening-up and resource sharing, standardizing the budget formulation, distribution ratio, and scope of use of open sharing funds. In terms of external cooperation, the university should actively expand stable collaborations with high-level scientific research institutions at home and abroad, build a resource sharing network, and introduce advanced experimental teaching concepts and technical resources.

3.1.2 Management Level

Optimizing Process Control and Service Efficiency. The essence of work at the management level is to build a seamless, safe, and efficient service environment for teachers and students to participate in experiments [14], an idea that runs through the entire process of their experimental participation. In the access link, an online-offline integrated system integrates safety commitments, permission reviews, and experiment reservations into a smooth process, enabling efficient and standardized access management. In the process link, by setting clear construction standards and full-cycle assessment requirements for experimental projects, continuous monitoring and guarantee of project quality are achieved. In the support link, through a model combining full-time positions and zone-based responsibility, stable and professional support covering equipment maintenance, technical consultation, and open services is provided for each experimental area.

3.1.3 Teacher Level

Enhancing Teaching Capabilities and Innovation Transformation. Teachers are the primary driver for ensuring the quality and depth of laboratory opening-up [15], with core functions reflected in three aspects. Firstly, in systematic training: construct a hierarchical and classified teacher development system, design differentiated training based on teaching experience, professional titles, and academic backgrounds, and continuously improve their comprehensive capabilities in experimental skills, teaching methods, and cutting-edge disciplinary fields. Secondly, in leading innovative teaching: innovative experimental teachers who have completed training take the lead in promoting innovative teaching, actively establish transformation channels for scientific research achievements to teaching experiments, and drive the conversion of scientific research advantages into teaching advantages. Finally, in full-process control: implement dynamic optimization of experimental project guidance, and ensure the teaching feasibility of each open experimental project through strict pre-experiment evaluation and special training access mechanisms.

3.1.4 Student Level

Promoting Demand Expression and Accelerating Feedback Response. On one hand, by building diversified feedback channels combining online and offline methods, the goal is to "broaden channels for expression", break information barriers, and ensure that universities can truly and comprehensively grasp students' actual experiences and demands. On the other hand, by establishing a time-bound feedback handling mechanism with clear timelines, the core is to "consolidate responsibilities", transforming the vague "paying attention to students' opinions" into a clear and assessable management process. This ensures that students' learning experiences can be effectively converted into specific actions for optimizing governance.

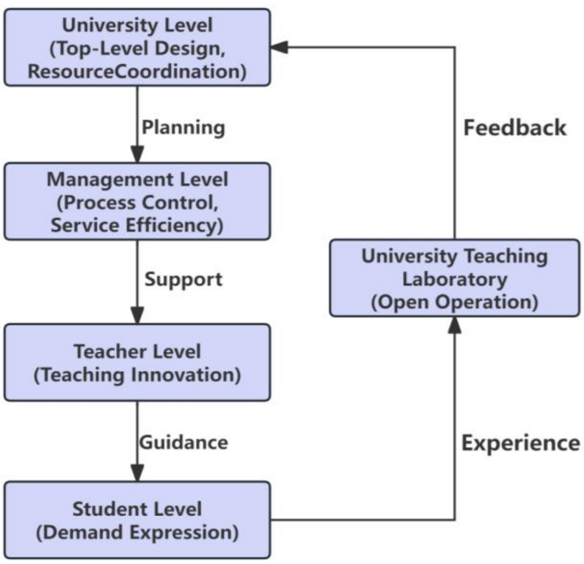

Figure 1: Collaborative System for the Opening-Up of Teaching Laboratories

3.2 Deepening Aligned Structural Reforms on Both the Supply and Demand Sides to Build a New Path for High-Quality Development

3.2.1 Supply-Side Reform: Promoting Systematic and Targeted Construction

Optimizing Resource Supply: Building an Intensive and Efficient Sharing System. Construct a resource management system featuring full-process online operation, efficient allocation, and self-optimization. The foundation is to build an integrated university-level resource management platform, which integrates scattered equipment, space, and teaching resources to realize full-process online services covering inquiry, reservation, usage, and evaluation, laying the cornerstone for efficient resource utilization. Furthermore, implement precise management and control of key resources such as large-scale instruments; through hierarchical management, performance evaluation, and intelligent scheduling, maximize the utilization efficiency of high-value equipment. Finally, establish a regular assessment system for resource utilization efficiency: timely adjust sharing strategies for equipment with low utilization rates or promote cross-institutional collaboration, thereby activating existing resources and achieving sustainable improvement and dynamic optimization of the overall resource utilization efficiency.

Building the Teaching Team: Adopting a Competency-Oriented Development Approach. Optimize the team structure through a dual-channel approach of "in-house cultivation + external recruitment" and formulate clear competency standards to define development goals for teachers at different levels. Then implement systematic cultivation support: provide continuous empowerment for teachers to enhance their capabilities through regular technical training, academic exchanges, and teaching reform projects. Finally, improve the assessment and incentive mechanism—for example, calculate the workload of open experimental teaching and provide class hour remuneration—to fundamentally stimulate teachers' enthusiasm and creativity, forming a virtuous cycle from "recruitment and cultivation" to "development" and then to "incentivization."

Improving the Institutional System: Establishing a Long-Term Mechanism of Safety and Standardization. Construct a preventive safety assurance system: through strict access procedures, training, and emergency response plans, minimize value losses caused by safety accidents and provide a stable operating environment for all activities. Meanwhile, substantially integrate experimental teaching effectiveness into professional title evaluation and establish a guiding performance evaluation system; through scientific indicator design and hard linkage with resource allocation, incentivize efficient utilization and achievement output, thereby driving continuous improvement in value creation. From the two dimensions of "defense" and "proactivity," these two mechanisms systematically guarantee and enhance the comprehensive value of laboratory opening-up.

3.2.2 Demand-Side Reform: Constructing an Integrated Participation System of "Incentivization-Empowerment-Support"

The core of demand-side reform lies in building a virtuous participation closed loop starting with students' intrinsic motivation and guaranteed by systematic capacity support. By integrating elements such as incentivization, information, training, and guidance, students' potential demands are transformed into continuous, efficient, and high-level experimental participation.

Taking Diversified Incentive Mechanisms and Targeted Information Push as the Foundation to Effectively Stimulate Students' Participation Interest. Enhancing the attractiveness of experimental projects is a systematic project that requires the coordinated efforts of intrinsic incentivization and external outreach—like two wings of an integrated system. One wing focuses on strengthening the intrinsic incentive value of projects: by promoting the linkage between teaching and scientific research and incorporating innovative achievements into evaluation, the sense of accomplishment and gain from participation is fundamentally improved, creating a strong atmosphere of "being worthy of participation." The other wing aims to optimize the efficiency of project information outreach: through integrated channels for structured and personalized targeted push, students are ensured to fully understand the value and benefits of projects, addressing the issue of "knowing and being willing to participate." These two aspects complement each other, jointly driving students from "knowing" to "liking" and ultimately to "enjoying" participation.

Taking a Hierarchical and Classified Experimental Project System and Supporting Courses as the Backing to Systematically Improve Students' Participation Capabilities. Construct a three-level project system covering "basic skill training, comprehensive application practice, and research innovation exploration," paired with specialized training courses and workshops. This ensures students possess the necessary knowledge and skills, realizing a progressive leap from "daring to participate" to "being able to participate."

Taking the Deepening of the Undergraduate Tutorial System as the Core to Provide Personalized Development Support. At the micro level, taking the deepening of the undergraduate tutorial system as the core grasp, personalized guidance is deeply integrated into the entire process of project selection, capacity improvement, and problem-solving, providing students with continuous professional guidance. At the macro level, relying on a sound supervision, evaluation, and dynamic adjustment mechanism, resource allocation and project settings are optimized through quality monitoring, data analysis, and effect evaluation. These two levels work synergistically to ensure that the open system not only provides strong support for individual growth but also makes timely adjustments based on overall effects, continuously improving the accuracy and effectiveness of supply-demand matching.

Table 1: Core Framework of Supply-Side and Demand-Side Reforms for the Open Operation of Teaching Laboratories

Reform Direction	Core Dimension	Key Measures
Supply-Side Reform	Resource Supply	Platform Integration Precise Management & Control Dynamic Optimization
	Teaching Team	Structural Optimization Systematic Cultivation Effective Incentivization
	nstitutional System	Safety Prevention Performance Guidance
Demand-Side Reform	Stimulate Interest	Intrinsic Incentivization Targeted Push
	Enhance Capabilities	Three-Level Project System Supporting Courses
	Provide Support	Tutorial System (Micro Level) Dynamic Adjustment (Macro Level)

4. Conclusion

The transformation of teaching laboratories from closed management to high-level opening-up is far from a simple opening of space and equipment, but rather an in-depth reform related to the quality of talent training. Faced with multiple challenges such as unbalanced resource allocation across multiple campuses, weak management systems, insufficient faculty motivation, and passive student participation, the solution inevitably relies on the systematic reconstruction of top-level design. By constructing a four-level collaborative closed-loop governance mechanism involving universities, management departments, teachers, and students, and simultaneously advancing targeted reforms on both the supply and demand sides, laboratories are transformed from single teaching auxiliary venues into core platforms supporting the coordinated development of students' practical abilities, innovative thinking, and interdisciplinary literacy. This transformation is an indispensable key link in responding to the construction of New Medical Sciences and cultivating compound medical innovative talents.

The key to improving the quality and efficiency of laboratory opening-up lies in realizing a leap from one-way, rigid "management" to diversified, interactive "governance." This transformation is reflected in two dimensions: in vertical collaboration, by establishing a closed loop of "planning-implementation-feedback-optimization," the feedback channel from university-level decision-making to student experience is unblocked, enabling institutional design to dynamically respond to grassroots needs; in horizontal linkage, through the construction of resource intensification, faculty professionalization, and institutional long-term effectiveness on the supply side, coupled with the mutual promotion of incentivization, empowerment, and personalized support on the demand side, a new pattern of laboratory opening-up characterized by efficient resource flow and vibrant participation of all stakeholders is jointly created.

Looking ahead, the open system of teaching laboratories needs to develop in a deeper direction of intelligentization and diversification on the existing basis. In the next step, efforts should be made to promote the in-depth integration of information technology and experimental teaching, build a smart laboratory management platform, and realize intelligent perception and precise regulation of resources, safety, and teaching processes. Meanwhile, it is imperative to continuously strengthen the "integration of science and education" mechanism, break down the barriers between scientific research and teaching, ensure that cutting-edge scientific research achievements can be efficiently transformed into inquiry-based experimental projects, and keep laboratories at the forefront of disciplinary development. Ultimately, by constructing a more open, intelligent, and student-centered learning environment, teaching laboratories can truly become the core value carrier for stimulating innovative potential and shaping future medical talents.

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References

[1] Ministry of Education of the People's Republic of China. Launch Conference of "Six Excellence and One Top-Tier Program 2.0" Held: Sparking a Quality Revolution in Higher Education to Support the Building of Quality China [EB/OL]. (2019-04-29) http://www.moe.gov.cn/jyb_zzjg/huodong/201904/t20190429_380009.html.
[2] Ministry of Education, National Health Commission of the People's Republic of China, National Administration of Traditional Chinese Medicine. Opinions on Strengthening the Integration of Medical Education and Clinical Practice to Implement the Outstanding Doctor Education and Training Program 2.0 [J]. Gazette of the Ministry of Education of the People's Republic of China, 2018(10):16-19.
[3] XU Dongyuan, SHEN Minghua, LI Xiangdan, et al. Exploration and Practice of Improving Practical and Innovative Capabilities of Undergraduates Majoring in Traditional Chinese Medicine in Comprehensive Universities [J]. Lishizhen Medicine and Materia Medica Research, 2019, 30(6):1483-1484.
[4] SI Shanghua, SONG Lijun, CHEN Zhipeng, et al. Impact of Multi-Campus Operation on Undergraduate Academic Performance and Improvement Measures—A Case Study of Xi'an Shiyou University [J]. Western China Quality Education, 2024, 10(18):169-172+181. DOI:10.16681/j.cnki.wcqe.202418039.
[5] LE Teng, WEI Hao. Research on University Laboratory Management Modes Under the New Situation [J]. Shanxi Youth, 2025(03):60-62.
[6] Ministry of Education. Guiding Opinions of the Ministry of Education and Other Six Ministries and Commissions on Strengthening the Construction of Young Teachers' Teams in Colleges and Universities in the New Era (Jiaoshi〔2025〕No.5) [Z]. 2025.
[7] FA Wenjun, BAI Chunyong, DU Yuping, et al. Research on Countermeasures for Laboratory Opening and Resource Sharing in Local Engineering Colleges and Universities [J]. Technology Wind, 2022(28):131-133. DOI:10.19392/j.cnki.1671-7341.202228044.
[8] ZHANG Zhe. Practical Research on the Open Management of University Teaching Laboratories Under the New Situation [J]. University, 2021(22):42-44.
[9] Ministry of Education. Guiding Opinions of the Ministry of Education on Deepening the Reform of the Assessment and Evaluation System for University

Teachers [J]. Gazette of the Ministry of Education of the People's Republic of China, 2016(10):32-35.
[10] General Office of the State Council. Guiding Opinions of the General Office of the State Council on Accelerating the Innovative Development of Medical Education [J]. Gazette of the Ministry of Education of the People's Republic of China, 2020(10):10-14.
[11] HAN Qinglin, WANG Ailing, LI Xianglin, et al. Exploration of Laboratory Management Modes Based on Medical Students' Innovation and Entrepreneurship [J]. China Continuing Medical Education, 2024, 16(04):182-185.
[12] LU Xuli. Research and Design of University Laboratory Open Management System Based on B/S Architecture [J]. Software, 2023, 44(05):168-171.
[13] DENG Yanmei, ZHANG Yingxia, WANG Wenqiang, et al. Exploration of Laboratory Construction and Dual Innovation Talent Training Modes [J]. Laboratory Science, 2022, 25(06):221-223.
[14] WANG Hui, GUO Xuesong, YU Xiaolei, et al. Research on the Open Operation and Management of Laboratories in Local Universities [J]. Continuing Medical Education, 2022, 36(05):13-16.
[15] LI Ying, LU Feng. Problems and Countermeasures in University Laboratory Management and Experimental Teaching [J]. Journal of Puer University, 2022, 38(03):34-36.

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