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Original Paper

Research on the Collaborative Integration of Science and Education to Enhance the Innovation Ability Training Model for Undergraduate Students in Traditional Chinese Medicine

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Abstract

The cultivation of innovative awareness and practical competence among undergraduate students has become a central theme in higher education reform worldwide. Within the field of Traditional Chinese Medicine (TCM), the integration of scientific research and education is particularly significant, as it not only preserves traditional medical knowledge but also equips students with the skills to address contemporary healthcare challenges. This study explores the developmental trajectory, current status, and future prospects of innovation-oriented education in TCM undergraduate programs, with a focus on the collaborative model of "integration of science and education." Through literature review, policy analysis, and case study of ongoing initiatives, the paper identifies major challenges such as narrow curriculum design, insufficient research engagement, limited exposure to interdisciplinary learning, and weak support mechanisms. To address these issues, a framework driven by research projects is proposed, emphasizing multi-level integration of teaching, research, and practice. The study also highlights the necessity of robust support systems, including funding guarantees, faculty development, infrastructure, and evaluation mechanisms. Findings suggest that project-driven participation in research activities significantly enhances students' ability to think critically, solve problems, and translate knowledge into practice. The paper concludes that building a sustainable and systematic innovation training model is essential for strengthening the competitiveness of TCM education and for cultivating a new generation of practitioners and researchers capable of bridging tradition with modern science.

Keywords

Traditional Chinese Medicine, Undergraduate Education, Innovation Training, Integration of Science and Education, Project-Based Learning

Introduction

Innovation capacity constitutes the core competitiveness of a nation. In the context of contemporary international dynamics, building China into an innovation-oriented country has become an urgent national mission. The Outline of the National Innovation-Driven Development Strategy proposes a three-step objective: to join the ranks of innovative countries by 2020, to move into the forefront of innovative countries by 2030, and to establish China as a global powerhouse of science and technology innovation by 2050 (The Central Committee of the Communist Party of China and the State Council, 2016). Traditional Chinese Medicine (TCM), as a discipline of unique advantage in China, has historically safeguarded public health and promoted sustainable social development, thereby exerting significant influence on the country's developmental trajectory. The integration of TCM into the "Belt and Road" Initiative has rendered it a cultural and medical bridge that facilitates people-to-people connectivity, mutual learning among civilizations, and the establishment of a global community of health. Consequently, the international recognition and influence of TCM have steadily risen (Liu, Qu, Wang et al., 2025). In this context, the cultivation of a large number of high-quality and innovative talents in the TCM field has become not only an urgent requirement of the discipline itself but also an inevitable demand of China's strategy to become an innovative nation.

1. Historical Evolution of Science–Education Collaboration

The idea of integrating teaching with research in talent cultivation is deeply rooted in educational history. It originates from German educator Wilhelm von Humboldt, who, more than two centuries ago, proposed the principle of "unity of teaching and research" during the founding of the University of Berlin. This philosophy subsequently influenced the establishment of graduate education institutions in the United States, most notably at Johns Hopkins University, where teaching and research were integrated into a coherent model of higher education. Over time, this model gradually evolved into a global paradigm (Humboldt, n.d.).

By the late twentieth century, as the tension between teaching and research within American universities persisted, Ernest Boyer advanced the notion of "scholarship reconsidered," which emphasized the importance of integrating research with teaching. On this basis, some universities reintroduced the principle of "research–teaching–learning unity" into undergraduate education, thereby establishing a new path of talent cultivation grounded in science–education integration (Boyer, 1990).

2. Current Challenges in the Implementation of Science–Education Collaboration

2.1 Insufficient Collaboration between Research Platforms and Academic Colleges

Although Henan University of Chinese Medicine has established multiple research platforms, most of them operate as independent units and lack effective collaboration with academic colleges. Even within colleges, research teams often function independently of teaching activities, with limited engagement in undergraduate education. This disjunction creates a gap between cutting-edge research resources and student learning.

As a result, undergraduates often demonstrate a fragmented understanding of their major, remaining at a superficial and perceptual level. This hinders their motivation for active learning and reduces their capacity for innovative thinking. Integrating research platforms into undergraduate education could provide students with a more direct sense of professional engagement, authentic research experiences, and opportunities to connect theory with practice. Such integration has the potential to significantly enhance students' enthusiasm for scientific research and to stimulate their innovative vitality (Reports on research platform engagement in undergraduate education, n.d.).

2.2 Limited Awareness of Science–Education Collaborative Models

The growth of undergraduate students largely depends on well-designed training programs. However, most current programs lack explicit requirements for students to participate in scientific research or engage in faculty-led projects. This omission makes it difficult to stimulate students' interest in research activities. Consequently, undergraduates tend to prioritize coursework grades and rankings, relegating research to a secondary pursuit, often postponed until the graduate level. Both teachers and students generally lack a deep understanding of science–education collaborative models, which restricts the implementation of reform.

2.3 Inadequate Incentive Mechanisms for Faculty Teaching Engagement

From the perspective of synergy theory, incentive mechanisms are at the core of collaborative development. In practice, faculty assessment and evaluation systems in many universities overemphasize research output while undervaluing teaching contributions. This imbalance has produced unintended consequences, as faculty members prioritize research achievements tied to personal reputation, promotion, and financial benefits, while neglecting their teaching responsibilities.

Reports from 42 "Double First-Class" universities reveal that national policies have yet to establish effective incentives for research to support teaching. Existing teacher promotion and reward systems emphasize research performance, leaving the motivation for faculty to engage deeply in undergraduate teaching relatively weak. The absence of systematic evaluation mechanisms, insufficient attention to teaching processes, limited teaching rewards, and insufficient involvement of top-tier scholars in undergraduate education all contribute to the imbalance between teaching and research.

2.4 Weak Institutional Support for Science–Education Collaboration

At the institutional level, the integration of science and education has only recently been introduced as a strategic plan by the Ministry of Education and related agencies. However, systematic support in terms of policy design, funding allocation, and resource distribution remains insufficient. Most universities still lack comprehensive strategies to coordinate teaching and research. Issues such as student training plans, professional curricula, and degree requirements have not fully reflected the philosophy of science–education collaboration. Similarly, teacher evaluation systems, resource allocation policies, and mechanisms for translating research outcomes into teaching resources are underdeveloped. Without effective institutional safeguards, collaborative education initiatives risk falling into passive or superficial implementation, with unclear accountability and limited sustainability (Ministry of Education, China, n.d.).

3. Exploration and Practice of Talent Training Models

Henan University of Chinese Medicine possesses intrinsic advantages for realizing science–education integration. It is a comprehensive institution that combines robust teaching faculty with advanced research facilities, enabling the mutual reinforcement of high-level scientific research and talent cultivation. By promoting "research-driven teaching" and "teaching-enhanced research," the university leverages its disciplinary breadth, favorable academic environment, and longstanding experience in collaborative education to foster innovation. Talent is regarded as the "first resource," while innovation is the "primary driving force."

3.1 Establishing Talent Training Goals for Collaborative Teaching and Research

Talent cultivation objectives embody the ultimate aims of education and highlight the key elements of the training process. At HUCMS, the integration of research platforms into teaching facilitates the shift from traditional theory-centered instruction to a model that emphasizes both theory and practice. By embedding the philosophy of science–education collaboration into training programs, the university seeks to establish a comprehensive research-oriented system of talent cultivation. Advanced research infrastructure and abundant resources provide a solid foundation for high-quality research, stimulate students' innovative thinking, and invigorate traditional coursework with creativity and practice.

3.2 Optimizing the Second Curriculum System to Build Synergistic Education

The university actively encourages faculty members to integrate innovative undergraduates into research teams, thereby creating opportunities for early exposure to research. Research projects are closely linked with student research programs, innovation and entrepreneurship competitions, and thesis work. Students are encouraged to "enter laboratories early, join research teams early, and engage in projects early." Faculty members are urged to use high-level research achievements to enrich education, employing research activities as vehicles for knowledge transfer and capacity building.

This approach emphasizes experiential learning: from hypothesis generation and scientific verification to the transformation of methods and results into teaching resources. Through group meetings, seminars, reading clubs, and informal exchanges, students are guided to transform knowledge into capability, strengthen innovative thinking, and enhance problem-solving skills.

3.3 Integrating Research Achievements into the Classroom

Internationally, research-based teaching reform has been widely explored, with mature models such as the Seminar system at Harvard University, the guided-reading system at Stanford University, and the workshop system at the University of Berlin. Inspired by these practices, HUCMS has begun to incorporate cutting-edge TCM research into classroom teaching. By linking research results with pedagogy, the university ensures that teaching content remains innovative and practically relevant.

Students gain exposure to the latest developments in TCM research, which deepens their professional interest. Elective courses in scientific techniques, based on large-scale research instruments, enable students to learn according to disciplinary preferences. In addition, lecture series such as the "Hundred Scholars Forum" and postgraduate academic symposia provide platforms to enhance students' engagement in research. This integration promotes the convergence of frontier knowledge with traditional TCM culture, laying a foundation for cultivating innovative modern professionals.

3.4 Embedding Research Training into Undergraduate Programs

Through faculty mentorship systems and undergraduate research projects, research training is systematically incorporated into undergraduate education. Students participate in the entire cycle of research—from project application and implementation to completion—thereby deepening their understanding of knowledge application.

Teaching in research-related courses emphasizes both scientific rigor and frontier orientation, with a focus on constructing rational knowledge structures and enhancing practical relevance. The adoption of blended learning models combines online platforms (such as simulated clinical systems and digital databases) with offline teamwork and communication exercises. At the same time, the university advances digital transformation in education, developing online libraries and digital resources to support comprehensive student development.

4. Safeguard Mechanisms for Talent Training Models

4.1 Motivational Mechanisms: Enhancing Teacher and Student Engagement

The effectiveness of science–education collaboration depends largely on the active involvement of teachers and students. Future reforms must therefore strengthen promotional campaigns and practical initiatives that help teachers and students recognize the value of integrating research into education. At the institutional level, both teaching and research departments must establish smooth communication channels, create a favorable learning and working environment, and link research activities—such as literature review, topic selection, and publication—with education.

Learning evaluation systems should be reformed to incorporate student participation in research into overall assessments. Students who excel in research activities should receive priority in scholarships, awards, and postgraduate recommendations. To support this, the university must establish special funding programs for undergraduate research training, encouraging students to engage in innovative projects and cultivate intrinsic motivation.

4.2 Operational Mechanisms: Optimizing Faculty Evaluation and Incentives

Evaluation policies and indicators shape faculty behavior by signaling institutional priorities. To promote science–education collaboration, universities must reform evaluation systems to give equal weight to teaching and research, matching content, methods, and outcomes. HUCMS has proposed strengthening the overall design of teaching evaluation systems and establishing long-term incentives for faculty investment in undergraduate teaching.

Regular training programs are necessary to enhance faculty competence in collaborative teaching and research. Teachers who actively integrate research into classrooms and explore pedagogical reform should be rewarded, thereby creating a positive and diverse incentive environment.

4.3 Institutional Safeguards: Building Policy Support Mechanisms

Effective policy mechanisms are vital to coordinate the allocation of teaching and research resources, stimulate faculty interest, and cultivate innovative talents. Institutional safeguards should include clear indicators encouraging science–education integration, comprehensive funding schemes, and project management regulations that cover application, review, implementation, and evaluation.

Additionally, policies should encourage faculty to incorporate frontier research outcomes into case-based teaching, thereby broadening student horizons and stimulating their scientific interest. Establishing a favorable collaborative environment ensures that teaching and research reinforce each other in a sustainable manner (Higher education management guidelines on project funding and evaluation, n.d.).

4.4 Establishing Comprehensive Evaluation Systems

Currently, TCM universities tend to evaluate students primarily based on academic performance. This narrow focus undermines the cultivation of innovation. A more comprehensive evaluation system—incorporating feedback from teachers, peers, self-assessment, and external experts—is needed. Such a multidimensional approach would better reflect student performance in scientific exploration, practical skills, and innovative capacity, thereby fostering initiative and creativity.

5. Conclusion

The cultivation of innovative talents is the cornerstone of the sustainable development and prosperity of Traditional Chinese Medicine. As science and technology continue to evolve rapidly, the integration of research and education has become increasingly indispensable. At Henan University of Chinese Medicine, reforms based on the philosophy of science–education collaboration have been undertaken in accordance with the discipline’s unique characteristics and the developmental of TCM talents. By transforming research resources into teaching assets and constructing a distinctive innovation-oriented training model, the university aims to produce a new generation of high-level TCM professionals with strong innovation capacities. This will establish a new paradigm of science–education synergy, contributing both to the inheritance and the modernization of TCM.

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