Teaching Reform of Traditional Chinese Medicine Pharmaceutics Oriented by Interdisciplinary Talent Cultivation: Exploration and Practice in a Private Undergraduate Institution

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Abstract In response to the problems of inadequate alignment between teaching of Traditional Chinese Medicine (TCM) Pharmaceutics and policy and industry development, rigid teaching models, and limited resources in private undergraduate institutions, closely aligning with the educational orientation of the local "101 Program", Haiyuan College of Kunming Medical University has constructed a dualmodule collaborative reform pathway consisting of "theoretical teaching + experimental (practical) teaching" based on the advantages of its laboratory platform. Theoretical teaching implements a "threeinone" integration of "ideological and political education + technology + scientific research" to strengthen cultural inheritance and modern technical literacy. Experimental (practical) teaching relies on a model of "virtualreal integration + scientific research empowerment + competitionresearchindustry linkage" to enhance practical skills and job adaptability. This pathway aims to cultivate threedimensional interdisciplinary talents possessing the characteristics of cultural inheritors, technological innovators, and career adapters, providing a replicable practical paradigm for teaching reform in similar institutions.

Key words Traditional Chinese Medicine Pharmaceutics, Teaching reform, Private undergraduate institution, Interdisciplinary talent cultivation, Threedimensional interdisciplinary talent

1 Introduction

Traditional Chinese Medicine (TCM) Pharmaceutics is a core course for TCM majors. Its core connotation lies in applying TCM theories and modern pharmaceutical technology to realize the scientific design of TCM dosage forms, the optimization and control of preparation processes, the establishment and improvement of quality standards, and the precise assurance of clinical efficacy[1].

In recent years, China has put forward more precise newera requirements for the cultivation of TCM talents. The *Outline of the Strategic Plan for the Development of Traditional Chinese Medicine* (2016 - 2030) proposes to vigorously develop TCM, promote the integration of the TCM industry with modern science, and put forward higher requirements for the cultivation of innovative talents[2]. In 2024, the *Several Opinions on Promoting the Development of Digital Traditional Chinese Medicine* explicitly stated the need to "accelerate the cultivation of digital TCM talents, and train interdisciplinary talents who are adept at converting, researching, mining, and utilizing data, thereby building a solid talent foundation for the digital development of TCM"[3]. Yunnan Province's local "101 Program" further explicitly requires talents to possess "craftsman's spirit, ethical literacy, and industry responsibility". The 15th Five Year Plan further emphasizes the need to promote the inheritance and innovation of TCM, facilitate the integration of Chinese and Western medicine, and cultivate highquality TCM talents who combine inheritance ability, innovative thinking, and industrial adaptability.

Under this background, private undergraduate institutions have played an important supplementary role in the cultivation of TCM talents by virtue of their advantages of "flexible school-running mechanism, direct industrial alignment and precise talent cultivation orientation". with their advantages of "flexible educational mechanisms, direct industry alignment, and precise talent cultivation positioning", have played an important supplementary role in the training of TCM talents. However, with regard to the teaching of TCM pharmaceutics, Haiyuan College of Kunming Medical University still has certain shortcomings. First, the course content does not sufficiently cover cuttingedge scientific technologies such as digital preparations and novel drug delivery systems. Second, the teaching model is largely dominated by oneway transmission, and the central role of students has not been fully highlighted. Third, the quality of practical teaching is limited by resources, and experiments are mostly confirmatory operations.

In response to the aforementioned issues, the college has constructed a dualmodule collaborative reform pathway consisting of "theoretical teaching + experimental/practical teaching" by leveraging the research and resource advantages of its laboratory platform and closely aligning with the educational orientation and core requirements of the local "101 Program". In theoretical teaching, a "threeinone" integration of "ideological and political education + technology + scientific research" is adopted, incorporating cuttingedge content such as digital preparations and new pharmaceutical technologies, and innovating diverse teaching models. In experimental (practical) teaching, relying on "virtualreal integration + scientific research empowerment + competitionresearchindustry linkage", the deep integration of research platforms and industrial resources is strengthened, and students' inheritance and innovation abilities are comprehensively enhanced, so as to cultivate "three-dimensional composite talents" in TCM: cultural inheritors, technological innovators, and career adapters.

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2 Current situation of TCM Pharmaceutics teaching and analysis of core problems

2.1 Insufficient policy alignment: disconnection between cultural inheritance and innovation orientation The cultivation of TCM talents emphasizes the core characteristics of "integrating medicine and pharmacy, and connecting ancient and modern knowledge". It requires not only a solid foundation in TCM basic theories and traditional preparation techniques, but also the innovative ability to empower TCM research and development with modern pharmaceutical technology. This is highly consistent with the requirement of the *National Standards for Teaching Quality of Undergraduate Majors* for TCM majors, which states that "cultivation must highlight the characteristics of TCM and cultivate specialized talents with both inheritance and innovation abilities"[4].

At the level of cultural inheritance, current course content deviates from the rigid requirements for TCM inheritance, with most classrooms still focusing on instilling theoretical knowledge. Meanwhile, the course rarely integrates ideological and political elements such as TCM ethics and the craftsman's spirit embodied in processing techniques. General Secretary Xi Jinping clearly stated in the report of the 20th National Congress of the Communist Party of China that efforts should be made to promote the inheritance and innovative development of traditional Chinese medicine and advance the construction of a Healthy China. The Ministry of Education has also explicitly emphasized the need to "comprehensively advance the integration of ideological and political education into university curricula"[5-6]. Under this backdrop, enhancing the deep integration of traditional craftsmanship and ideological-political elements in the course Traditional Chinese Medicine Pharmaceutics has become an inevitable choice for implementing national strategic deployments and responding to rigid policy requirements.

At the level of innovation and development, there is a disconnect between the course content and the policies for the modernization and digitalization of TCM. In the current course, especially in the design of experimental sessions, most content remains focused on traditional TCM dosage forms. The explanation of modern pharmaceutical technology largely stays at the conceptual level, and the application cases of digital technology in formulation development are not sufficiently introduced, which is significantly different from the standard of innovative talents expected by the policy.

2.2 Rigid teaching model: students' dominant role not fully reflected Theoretical teaching still relies mainly on "teacher lectures + PPT presentations". This oneway knowledge transmission model lacks interactivity and inquiry. Students passively receive knowledge, making it difficult for them to connect TCM formulation principles with clinical applications and industrial practices, resulting in weak knowledgetransformation ability. Experimental teaching largely consists of "recipefollowing" confirmatory experiments, during which students operate mechanically, and there is a lack of space for independent design and problem inquiry. It is difficult to cultivate scientific research thinking and innovative practical abilities.

2.3 Weak connection between practice and employment: insufficient job adaptability Traditional experimental projects account for an excessively high proportion of the experimental teaching content, resulting in insufficient training in core skills valued by pharmaceutical enterprises, such as process optimization, quality control, and new formulation development. The linkage mechanism among "competitionresearchindustry" is weak, and students have limited opportunities to participate in academic competitions, research projects, and corporate internships, making it difficult for them to transform classroom knowledge into the ability to solve practical problems[7].

2.4 Insufficient resource support: prominent bottlenecks in the development of private institutions The dual problems of incomplete allocation of teaching resources and insufficient application effectiveness constitute the core shortcomings of TCM pharmaceutics teaching. On the one hand, there is a clear gap in resource allocation, with insufficient supply of key equipment for modern formulation development, so it is difficult to support researchgrade experimental teaching. Meanwhile, there is a lack of supporting digital resources such as course videos and research case databases, which cannot meet students' needs for autonomous learning and indepth inquiry. On the other hand, the application effectiveness of existing resources needs to be improved. They have not been deeply developed in combination with industrial practices and research needs, which restricts the improvement of talent cultivation quality.

3 Practical reform pathway for teaching of pharmaceutical technology of traditional Chinese medicine

3.1 Theoretical teaching: "threeinone" integration and innovation of "ideological and political education + technology + scientific research" Theoretical teaching focuses on policy requirements, research advantages, and the cultivation of students' core abilities. Through systematic innovation in content, teaching methods, and research empowerment, it breaks the traditional oneway transmission model and achieves the simultaneous implementation of "knowledge transmission, value shaping, ability cultivation, and research enlightenment".

3.1.1 Deep integration of ideological and political education with professional content. Closely aligning with the core educational objectives of the local "101 Program" for the TCM pharmaceutics course, the college focuses on the main thread of independently cultivating topnotch innovative TCM talents. It has constructed a threedimensional "traditionmodernityvalue" ideological and political case database, deeply integrating TCM ethics, craftsman's spirit, and industry responsibility into the entire process of theoretical teaching, thereby achieving the coordinated implementation of knowledge transmission, value shaping, and ability cultivation. Using a multidimensional presentation format of "text + images + videos" by chapter, a total of 42 ideological and

political case materials have been established. Taking pills as an example, the clinical practice of the emergency efficacy of Angong Niuhuang Pill, the foremost of the "Three Treasures of Warm Diseases", combined with the "Liu Hairuo incident" that shocked the world in 2002, allows students to intuitively appreciate the clinical value of traditional dosage forms. By deconstructing the rigorous "sovereignministerassistantenvoy" compatibility of the formula, the strict requirements for choice genuine and precious materials, and the process of ultimately producing a standard 3 g honey pill wrapped in gold leaf as thin as a cicada's wing after multiple precise procedures such as grinding, mixing, and pillmaking, the extreme pursuit of excellence from material selection to processing enables students to deeply understand the core of the craftsman's spirit: "No matter how complex the processing, one dare not omit any labor, and no matter how precious the ingredients, one dare not reduce any effort."

3.1.2 Empowerment with modern teaching techniques, research resources, and diverse models. BOPPPS, PBL, TBL, CBL, splitclass teaching, bilingual teaching, and other models are currently common educational teaching models, with their core characteristic being "studentcentered"[8-11]. The above teaching models have achieved good results in teaching, and their effective integration into teaching will be conducive to enhancing students' abilities in TCM pharmaceutics.

The college has promoted digital teaching reform and constructed a studentcentered interactive teaching system. It has innovatively built a "online + offline + research" threeinone blended teaching system by deeply integrating the Rain Classroom teaching platform with the research resources of the college's laboratories. Through the deep integration of multiple teaching models, the dominant role of students is highlighted, and the coordinated advancement of knowledge transmission, ability cultivation, and research enlightenment is achieved. Taking the teaching of "cyclodextrin inclusion technology" in the chapter "New Preparation Techniques for Chinese Medicine" and the "preparation of the inclusion complex of hydroxypropylβcyclodextrin (HPβCD) from *Ligusticum sinense* volatile oil" as an example, the specific implementation pathway is as follows:

Before class, the Rain Classroom platform is used to build preview resources, push cuttingedge literature on modern preparation techniques and microlectures on core knowledge points, and deeply integrate the core content of scientific frontier topics such as the *Study on the Preparation and Properties of the Inclusion Complex of Hydroxypropyl-β-cyclodextrin (HP-β-CD) from* Ligusticum sinense *Volatile Oil*[12]. Meanwhile, a preclass questionnaire is designed to accurately identify cognitive blind spots through questions such as the "core objective of *Ligusticum sinense* volatile oil inclusion" and "factors affecting the inclusion efficiency", and to collect students' interests in research directions such as process optimization and stability investigation. During class, the BOPPPS closedloop model is used as the framework, integrating multiple teaching models such as PBL, TBL, CBL, and split classroom. The session begins with an introduction to the research pain point of "limitations of *Ligusticum sinense* volatile oil dosage forms", clarifying learning objectives such as technical principles and process optimization. The core PBL question, "optimize the inclusion process and achieve an inclusion efficiency $\geqslant 90\%$", is used, and students are divided into interest groups to collaborate on designing experimental plans using TBL. The Rain Classroom posttest is used to assess core knowledge points, and teachers and students summarize together to form a closed teaching loop. After class, personalized assignments and scientific research case analyses are pushed, requiring students to refine their experimental plans and write inquiry reports. Learning data analysis reports are generated to provide targeted guidance for weak links.

Meanwhile, in alignment with international development policies, an elective module "English for Chinese Medicine" has been introduced, incorporating core English terms and international standards, and guiding students to write English abstracts of experimental plans to enhance their crosscultural communication skills. The entire process is studentcentered, achieving the coordinated cultivation of professional skills, research thinking, and teamwork abilities, meeting the policy requirements for cultivating interdisciplinary TCM talents.

3.2 Experimental/practical teaching reform: "virtualreal integration + scientific research empowerment + competitionresearchindustry linkage"

3.2.1 Experimental teaching: equal emphasis on virtualreal integration, scientific research empowerment, and innovative design. Relying on the equipment and technical advantages of the college's laboratory, a fourstage experimental model of "virtual simulation + practical verification + research extension + innovative design" is adopted. For example, before class, students use the TCM virtual simulation experiment platform to independently simulate the optimization process of operational parameters for techniques such as granule preparation, βcyclodextrin inclusion technique, and microcapsule preparation. Meanwhile, they learn the operating specifications of relevant laboratory research equipment and submit preset experimental plans and research extension ideas. During class, the session is divided into two stages. In the first stage, students complete standard operation verification of core processes in basic laboratories. In the second stage, relying on the precision instruments in laboratories of the college, they carry out researchgrade experimental extensions. After class, students are required to produce three deliverables: an experimental report, interpretation of research data, and an innovation proposal, thereby cultivating research thinking and technology translation abilities.

3.2.2 Practical teaching: "research practice + competitionresearchindustry linkage" empowers dual competitiveness for employment and further studies. Relying on the college's key laboratory platform, a multidimensional practical education platform has been constructed. The first dimension is "Research Practice Integration". Basic laboratory research positions are open to all

students, encouraging them to participate in provincial/ministerial and universitylevel research projects led by faculty. Under the guidance of research supervisors, students complete document retrieval, experimental design, and data collection and analysis, and master the basic processes of scientific research. The second is "Learning Through Competition". Supported by laboratories's technology and resources, students are organized to participate in innovation and entrepreneurship competitions. Competition topics focus on innovations in traditional dosage forms of Yunnan's characteristic Chinese medicines and the development of new preparations, thereby strengthening experimental operation skills, teamwork, and research innovation abilities. The third is "Industrydriven Education". Practical bases are jointly established with TCM pharmaceutical enterprises. Students are arranged to participate in real enterprise projects. Under the dual guidance of enterprise mentors and laboratory research supervisors, they apply modern new technologies to solve practical production problems, become familiar with industry processes and job standards, and achieve the employment adaptation goal of "ready to work upon graduation".

4 Conclusions

As a core supporting course for the inheritance and innovation of traditional Chinese medicine and industrial upgrading, the teaching reform of TCM Pharmaceutics is an inevitable choice for private undergraduate institutions to respond to national TCM talent cultivation policies and adapt to the development needs of the industry. In response to prominent problems such as the inadequate alignment between curriculum content and policy and industry development, rigid teaching models, and insufficient practical resources, the college, leveraging the advantages of the Yunnan Provincial Key Laboratory platform and its responsibility as a participating unit in the local "101 Program", has constructed a dualmodule collaborative reform pathway consisting of "theoretical teaching + experimental (practical) teaching". Through the "threeinone" theoretical innovation of "ideological and political education + technology + scientific research" and the practical upgrade of "virtualreal integration + scientific research empowerment + competitionresearchindustry linkage", it has achieved the realization of the threedimensional talent cultivation goals of "cultural inheritors, technological innovators, and career adapters". This reform not only strengthens the deep integration of traditional dosage form techniques with modern pharmaceutical technology, but also resolves the contradiction between the shortage of practical resources in private undergraduate institutions and the improvement of talent cultivation quality through the empowerment of research resources and the innovation of diverse teaching models. It provides a systematic solution for building students' cultural confidence, honing their technical skills, and cultivating their professional competence. In the future, the college will continue to deepen teaching reform, dynamically align with policy requirements and industrial upgrading needs, and optimize course content and teaching models. It will deliver more highquality interdisciplinary talents to the TCM industry, provide a more practical reference paradigm for the teaching reform of TCM Pharmaceutics in similar institutions, and thereby support the highquality development of the TCM industry.

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