

Exploration and Reform of a Multidimensional Teaching Model in the Identification of Chinese Materia Medica

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Abstract Identification of Chinese Materia Medica is a core professional course in the discipline of Chinese Materia Medica, providing essential skills for identifying medicinal materials and ensuring quality control. To better align this course with talent training objectives, this paper explores and reforms a multidimensional teaching model based on an analysis of students' learning contexts. Teaching strategies, including visual teaching methods, matrix QR code-based learning, flipped classroom, integration of licensed pharmacist examinations, and curriculum-based ideological and political education, are introduced in the reform, in order to address key challenges in student learning, foster active learning and problem-solving abilities, cultivate innovative thinking, and ultimately achieve the desired talent development goals.

Key words Identification of Chinese Materia Medica, Teaching model, Exploration, Reform

1 Introduction

At present, higher education in China has entered a stage of high-quality development. It is necessary not only to cultivate builders who can adapt to social development, but also to foster innovative talents capable of building an innovation-oriented country and leading high-quality social development^[1]. Identification of Chinese Materia Medica is a fundamental course for students majoring in Chinese materia medica. This discipline is essential for enabling students to distinguish between authentic and counterfeit Chinese medicines and to conduct quality control effectively^[2]. This course equips students with traditional skills in identifying Chinese materia medica, thereby laying a foundation for their future endeavors in authentication, quality evaluation, development, and application of Chinese medicines^[3]. According to the university's talent training program, the course Identification of Chinese Materia Medica comprises a total of 126 class hours, which include 86 h of theoretical instruction and 40 h of practical experimentation. Under the constraints of extensive content and limited class hours, it is imperative to explore effective strategies to achieve teaching objectives, improve teaching quality and effectiveness^[4], further stimulate students' enthusiasm for learning, shift from passive reception to active learning, ensure thorough mastery of the course material, accurately distinguish authentic, counterfeit, superior, and inferior Chinese medicinal materials, and ensure medication safety. These issues require careful consideration and resolution throughout the teaching process^[5–6].

A multidimensional teaching model for the Identification of Chinese Materia Medica is explored and reformed, taking Kunming Medical University Haiyuan College as a case. To enhance learning outcomes, the college has established a distinctive teaching

platform. A digital microscopic interactive laboratory has been established, equipped with 50 sets of digital microscopic interactive systems and updated digital interactive software to facilitate experimental teaching in the microscopic identification of Chinese medicinal materials. Additionally, a simulated Chinese medicine pharmacy has been constructed, housing 430 types of prepared Chinese medicine specimens and 195 types of counterfeit specimens, with 189 types of prepared Chinese medicines displayed in medicine cabinets.

2 Development of the multivariate evaluation system

Identification of Chinese Materia Medica is a highly practical discipline, with experimental teaching serving as a crucial component of its teaching process^[7]. Centered on students, the course emphasizes formative assessment and optimizes the weighting of various assessment components. By adjusting the ratio between regular grades and final examination grades and introducing a midterm examination, the proportion of process assessment (including regular performance, midterm examination, and experimental grades) has been raised from the original 30% to 40%. Specifically, regular performance accounts for 10%, experimental assessments and reports for 25%, and the midterm examination for 5%. The proportion of the summative assessment, specifically the final examination grade, has been reduced from the original 70% to 60%. A multivariate assessment model covering theoretical knowledge, experimental work, and daily performance has been established according to each teaching link. The specific adjustments and their respective proportions are shown in Fig. 1.

3 Exploration and reform of the multidimensional teaching model

To systematically enhance teaching effectiveness, we have developed a multidimensional teaching model with several complementary teaching strategies, aiming to address learning issues from foundational knowledge acquisition to professional competence development and value cultivation. The following sections present the key components of this model.

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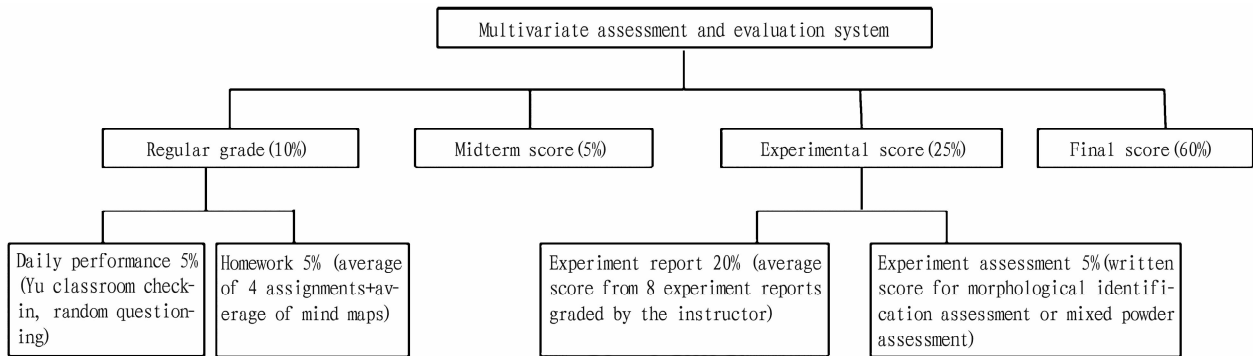


Fig.1 Structure of the multivariate assessment and evaluation system

3.1 Construction of a dual-qualified teaching team Identification of Chinese Materia Medica is a highly professional and practical course. In its teaching, academic leaders play a crucial role, while teachers with both dual-qualified competence and industry experience are particularly valuable^[7]. To further improve students' application abilities, a combination of training and employment can be implemented to offer dual guidance in both theoretical knowledge and practical experience. In this manner, a dual-qualified teaching team that makes use of complementary advantages between universities and enterprises can be established^[8]. Based on the actual situation of our university, the course Identification of Chinese Materia Medica is taught by five teachers, including the course director, who is an associate professor and a licensed pharmacist. The specific construction of the teaching team is shown in Fig. 2.

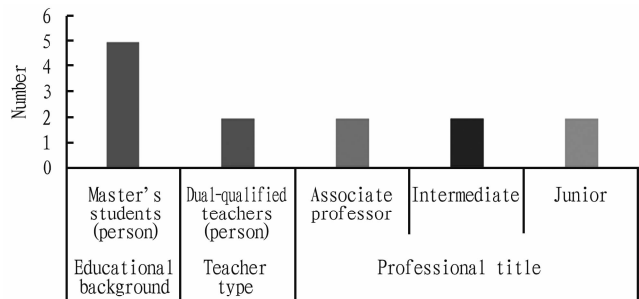


Fig.2 Construction of the teaching team

3.2 Teaching methods

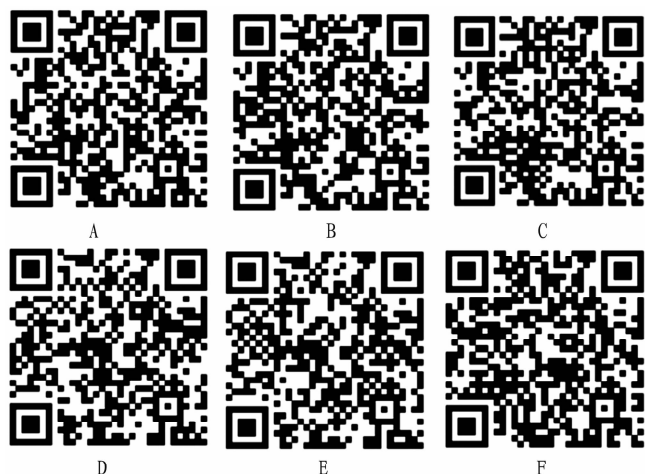
3.2.1 Visual teaching. method. First, identification is carried out according to the morphology of the medicinal materials. For instance, the cortex of Radix Morindae Officinalis resembles a string of beads or chicken intestines, which has led to its common designation as "Chicken Intestine Wind"^[9]. Second, special characteristics of the sliced surface are recognized, such as "cloud-patterned markings", "star spots", "cinnabar spots", "wheelstriations", "golden well with jade rail", "connected rubber threads", "chrysanthemum core", "sand holes" and so on. Third, medicinal materials derived from multiple sources are compared and examined based on their morphological characteristics to

facilitate identification according to their unique properties. For example, rhubarb includes *Rheum palmatum*, *Rheum tanguticum*, and *Rheum officinale*. These species can be identified and memorized based on variations in the morphology of their medicinal materials; the section of *R. palmatum* exhibits a light reddish-brown color; that of *R. tanguticum* is darker, ranging from brownish-black to blackish-brown; and that of *R. officinale* is light reddish-brown with prominent rays. Features including shape, section, odor, and taste of medicinal materials are summarized to facilitate differentiation and learning.

3.2.2 Experimental teaching method. This course emphasizes the close integration of theoretical teaching and experimental practice, consistently combining theory with practical application. Practical teaching of morphological identification is incorporated throughout the entire course. Through traditional identification techniques, such as morphological observation, tactile inspection, olfactory evaluation, taste assessment, water testing, and fire testing, students can effectively acquire an intuitive understanding of morphological characteristics of medicinal materials, thereby strengthening their practical foundation. In microscopic experimental teaching, based on the observation of permanent sections of Chinese medicinal slices, the course focuses on training in powder preparation and microscopic observation of Chinese medicinal materials. Students are guided to proficiently identify key microscopic characteristics, including starch grains, cluster crystals of calcium oxalate, prismatic crystals of calcium oxalate, acicular crystals of calcium oxalate, crystal fibers, inulin, vessels, fibers, and cork cells, so as to further consolidate and deepen their theoretical understanding. According to the university's talent training program, this course provides a total of 40 h of laboratory sessions, with each session lasting 5 h. The experimental content is structured progressively, ranging from simple to complex tasks. Additionally, exploratory experimental projects are set up to enhance students' abilities in independent inquiry and comprehensive analysis. The experimental assessment involves selecting between morphological identification and mixed powder identification. The experimental score accounts for 5% of the total course score, thereby achieving an effective integration of process assessment

and summative evaluation.

3.2.3 Matrix QR code teaching method for Chinese Materia Medica. In recent years, QR code technology has developed rapidly and has been increasingly applied in fields such as daily payments, media, and education, thereby enhancing individuals' learning methods and access to knowledge^[10–12]. QR code technology offers several advantages, including a large information capacity, a wide coding range, strong fault tolerance, good confidentiality, ease of production, and convenient decoding. Two-dimensional barcodes are generally classified into stacked/row-based and matrix types. Matrix QR codes can be scanned and decoded by mobile terminals such as smartphones and tablets to obtain the embedded information, making them the most widely used form^[13–14]. Based on students' actual conditions, our university has focused the content on data including the names, sources, characters, identification methods (microscopic, physicochemical), main components, inspections, assays, processing methods, tastes and meridian tropism, functions and indications, usage and dosage, and storage of Chinese medicinal materials. Additionally, relevant texts, images, videos, and audio materials are incorporated, which are utilized in the production of labels for simulated traditional Chinese medicine pharmacies (Fig. 3).



NOTE A. Pericarpium Trichosanthis; B. Semen Trichosanthis; C. Fructus Trichosanthis; D. Fructus Lycii; E. Fructus Gardeniae; F. Fructus Foeniculi.

Fig.3 Representative QR code diagram of Chinese medicinal specimens

3.2.4 Flipped classroom teaching method. In line with the student-centered teaching philosophy, the traditional lecture-based classroom teaching model has been reformed through the adoption of the flipped classroom approach. This approach positions students at the center of the learning process, with students assuming a leading role while teachers serve as guides and facilitators^[15]. Students are organized into groups of 8 to 10 members. Each group selects a topic of interest from the teaching plan and then undertakes learning tasks including division of labor, group discussion, literature review, and knowledge sorting as required,

culminating in the production of a PowerPoint presentation (PPT). Finally, a representative from the group presents the topic in class. After the presentation, teachers and students from other groups pose questions regarding points of interest or areas of uncertainty, and members of the presenting group respond^[1]. The flipped classroom has transformed the traditional teaching model^[16]. Through cooperative learning, students have fully developed their abilities in independent and collaborative learning, logical reasoning and oral expression. This approach has also stimulated their initiative and promoted the improvement of critical thinking and innovative abilities.

3.2.5 Practicing pharmacist association teaching method. The national pharmacist professional qualification examination (Chinese medicine) consists of four subjects: Chinese Materia Medica Professional Knowledge (I), Chinese Materia Medica Professional Knowledge (II), Pharmaceutical Administration and Regulations, and Comprehensive Knowledge and Skills of Chinese Materia Medica. The course Identification of Chinese Materia Medica is one of the core components of Chinese Materia Medica Professional Knowledge (I), and its annual score ranges from 30 to 40 points. In the national pharmacist professional qualification examination, the main content of this course is the identification of properties, the recognition of Chinese materia medica through color pictures (visual identification of drugs), and microscopic identification. It also includes the content of origin, processing, source, and physical and chemical identification. In the teaching team of this course, two teachers have passed the national pharmacist professional qualification examination. In the classroom teaching, the course content closely follows the latest version of the *National Pharmacist Professional Qualification Examination Outline*, emphasizing the content of the national pharmacist professional qualification examination and marking it, and integrating mnemonic methods to enhance students' memory of knowledge points. After the content explanation, practice can be embedded in the classroom using true questions from the national pharmacist professional qualification examination. In the after-class exercises, the past five years of pharmacist examination true questions are released through the Rain Classroom platform.

3.2.6 The method of integrating course ideological education into classroom teaching. The course Pharmaceutical Identification has 40 cases of course ideological and political education. Taking the thirteenth chapter, the herbs of the whole plant category, as an example, the ideological and political education is taken as the starting point by Professor Tu Pengfei, the "father of safflower". In the teaching process and methods, case teaching is used for explanation. Twenty-seven years ago, Professor Tu Pengfei went alone into the Xinjiang desert, "taking a sauna" in temperatures ranging from 40 to 50 °C, using an iron pickaxe like an archaeologist to search for the legendary wild safflower. For over two thousand years, this safflower, which enjoys the reputation of "desert ginseng" and has no roots of its own, parasitizing on the roots of

other plants, has always been a mystery that is difficult to solve. There has been no successful precedent for artificial cultivation of safflower worldwide. Under the efforts of Professor Tu Pengfei, safflower was the first to break through a series of key technologies such as seed germination and artificial inoculation of parasitic plants internationally. Professor Tu Pengfei's spirit not only embodies the persistent pursuit of scientific researchers, but also reflects the professional ethics and dedication spirit that Chinese medicine practitioners should have.

4 Conclusions

The course Identification of Chinese Materia Medica adopts teaching methods such as visual teaching, experimental teaching, Chinese herbal matrix QR codes, flipped classroom, association learning with licensed pharmacists, and integrating course ideological education into the classroom to focus on student-centered learning. This enables students to have an intuitive understanding of the course content. Outside of class, the course content is digitized and made accessible to students. At the same time, it highlights the learning of professional knowledge by combining ideological education, thereby achieving the integration of knowledge transmission and value guidance for students. Through these teaching reforms, a multidimensional teaching model for the Identification of Chinese Materia Medica has been initially established. This teaching model enhances students' interest in learning and improves the quality of talent cultivation. However, this teaching model still has some limitations. In the future, we will continue to pay attention to the pass rate of the licensed pharmacist examination for students and continuously improve the teaching model for the Identification of Chinese Materia Medica.

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