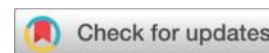


**Title: Research on innovative mode of orthopedic Traditional Chinese Medicine
knowledge inheritance based on multimodal teaching**



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Research on innovative mode of orthopedic Traditional Chinese Medicine knowledge inheritance based on multimodal teaching

Abstract: As a vital component of traditional Chinese medicine (TCM), Traditional Chinese Medicine (TCM) in Orthopedics demonstrates unique therapeutic philosophies and methodologies. However, with the rapid advancement of modern medicine, traditional TCM education faces dual challenges in knowledge transmission and innovation. Multimodal teaching, an innovative educational approach integrating text, images, audio, and video formats, effectively overcomes the limitations of conventional pedagogy. Through multisensory engagement, it enables students to comprehensively grasp complex orthopedic TCM knowledge. This study explores the application of multimodal teaching in TCM knowledge transmission within orthopedics, analyzing its advantages and challenges in content presentation, clinical skill training, and cognitive development. The research reveals that multimodal teaching not only enhances classroom participation and interaction but also facilitates the transformation of abstract theories into practical applications, thereby improving clinical reasoning and real-world implementation capabilities. Although current implementations face technical limitations and uneven resource distribution, multimodal teaching shows great potential for advancing TCM education modernization and efficiency in orthopedic practice.

Key words: multimodal teaching; orthopedics; Traditional Chinese medicine knowledge; inheritance and innovation

foreword

As a traditional medical system in China, Traditional Chinese Medicine (TCM) has accumulated rich theoretical knowledge and clinical experience over thousands of years of development. Particularly in orthopedics, it has formed unique therapeutic concepts and methods. Orthopedic diseases such as fractures, joint dislocations, and

spinal disorders require treatment that goes beyond surgical or pharmacological interventions. Instead, it emphasizes holistic regulation and syndrome differentiation to restore bodily functions, achieving therapeutic goals like promoting bone healing, alleviating pain, and restoring joint mobility. The core principles of TCM in orthopedic treatment—such as "activating blood circulation to resolve stasis," "tonifying liver and kidney," and "dispelling wind-dampness" —serve as significant supplements to modern orthopedic therapies, especially in long-term management of chronic conditions, osteoarthropathy, and spinal disorders. However, with the advancement of modern medicine and continuous innovations in orthopedic clinical techniques, traditional TCM knowledge faces dual challenges of inheritance and innovation. Traditional teaching models dominated by instructors, emphasizing classical literature study and clinical experience transmission, often neglect the integration of theory and practice. These models lack systematic evaluation of student learning outcomes and personalized guidance. Particularly in TCM orthopedic education, how to combine traditional theoretical knowledge with modern medical technologies and adapt them to contemporary educational demands has become a key focus of current clinical research.

In recent years, with the rapid development of information technology, multimodal teaching has gradually become an important direction in medical education reform. By comprehensively utilizing various media such as text, images, sound, video, and virtual reality, multimodal teaching breaks through traditional single-method instruction. It provides learning materials from multiple dimensions, effectively enhances learning experiences, and promotes students' comprehensive understanding and mastery of knowledge. In the medical field, particularly in orthopedic traditional Chinese medicine (TCM) education, adopting multimodal teaching models not only increases classroom engagement but also helps students transform complex theoretical knowledge into more intuitive and practical applications, thereby improving their clinical thinking and real-world application skills. However, multimodal teaching still faces challenges in the inheritance of orthopedic TCM knowledge. On one hand, due to the vast and profound nature of TCM's theoretical system, traditional teaching methods rely on teachers

'experience and textual explanations, lacking systematicness and wholeness, which fails to meet students' requirements for depth and breadth of knowledge. On the other hand, implementing multimodal teaching requires robust technical support and innovative educational platforms. Currently, many educational institutions lack adequate technical facilities, while instructors' application capabilities and teaching resources remain insufficient, creating bottlenecks in the promotion and implementation of multimodal teaching [1]. Based on this context, this study aims to explore innovative multimodal teaching models for orthopedic TCM knowledge inheritance, analyze their application effects in education, and particularly examine their advantages and challenges in knowledge transmission, clinical skill training, and the cultivation of students' thinking abilities.

I. Theoretical basis of multimodal teaching

1.1 Definition of multimodal teaching

Multimodal teaching is an educational approach that enhances learning outcomes by integrating multiple sensory inputs. Its core philosophy lies in incorporating various media forms such as text, images, audio, video, and interactive simulations into instructional activities to promote students' deep understanding and memory retention of knowledge. Compared with traditional single-method teaching, multimodal teaching can more comprehensively engage students' visual, auditory, tactile, and even kinesthetic senses, thereby creating a more vivid and holistic learning experience. This teaching model is particularly suitable for complex and abstract subject content, demonstrating significant advantages in helping students comprehend and apply knowledge effectively.

1.2 Theoretical basis of multimodal teaching

1.2.1 Cognitive load theory

The cognitive load theory, proposed by international researchers, highlights that human working memory has inherent limitations during learning processes [2]. Exceeding this capacity through cognitive overload negatively impacts learning outcomes. Multimodal teaching effectively alleviates cognitive load by strategically

designing diverse learning materials and presentation formats. Through visual aids like images, animations, and videos, complex theoretical knowledge can be presented intuitively, thereby reducing students' cognitive burden when grasping abstract concepts and enhancing learning efficiency. In orthopedic traditional Chinese medicine education, three-dimensional models or virtual reality technology are employed to demonstrate intricate anatomical structures and pathological processes. This approach not only improves understanding but also strengthens memory retention.

1.2.2 Multiple Intelligences Theory

Scholars have proposed that human intelligence is not singular but comprises multiple distinct intelligences, including linguistic, logical-mathematical, spatial, and musical intelligence [3]. Multimodal teaching builds upon this theory by utilizing diverse sensory inputs to stimulate students' various cognitive capacities. In orthopedic traditional Chinese medicine education, learners must not only grasp theoretical concepts but also engage in hands-on practice. Through visual perception, they analyze anatomical structures; via auditory learning, they absorb expert insights; and even through virtual reality technology, they "personally" perform surgical procedures. This multi-sensory approach enables students to discover their optimal learning pathways, ultimately achieving peak academic performance.

1.2.3 Social constructivist learning theory

Social constructivist learning theory posits that knowledge acquisition occurs within social interactions and cultural contexts. It emphasizes that knowledge development is not merely an individual cognitive process, but rather a collaborative endeavor involving communication and interaction with others. Multimodal teaching provides students with an interactive learning platform where teachers, peers, and virtual environments interact. Through these interactions, students deepen their understanding of knowledge by engaging in communication and collaboration. In orthopedic traditional Chinese medicine education, students utilize online platforms to participate in remote discussions with instructors and classmates, sharing personal insights and questions. By employing multimedia resources such as videos,

infographics, and case analyses, they collectively construct knowledge through collaborative learning, thereby achieving deep comprehension and internalization of the subject matter.

1.2.4 Self-learning theory

Self-directed learning theory emphasizes students' proactive engagement and self-regulation in the educational process. Multimodal teaching provides flexible learning resources and autonomous opportunities, allowing learners to select materials tailored to their pace and interests for personalized study. Through video courses, interactive experiments, and simulated scenarios, students can independently explore and practice without direct teacher guidance, thereby enhancing their problem-solving and critical thinking skills. This approach proves particularly crucial in orthopedic traditional Chinese medicine education, as it not only helps students master foundational theories but also cultivates independent reasoning and problem-solving abilities through clinical practice.

1.3 Core elements of multimodal teaching

The core elements of multimodal teaching models include content presentation methods, technical support, learner engagement, and feedback mechanisms. The way content is presented determines the effectiveness of instructional delivery. By utilizing multiple formats such as text, images, audio, and video, we can significantly enhance students' learning interest and comprehension. In orthopedic traditional Chinese medicine education, traditional written materials often pose challenges due to complex textual explanations and unclear diagrams. However, modern information technologies like virtual reality and 3D modeling can vividly demonstrate pathological processes of orthopedic diseases and treatment methods, substantially improving learning efficiency [4]. Moreover, multimodal teaching emphasizes not only knowledge transmission but also active student participation. Interactive learning, real-time feedback, and post-class discussions stimulate learners' interest and cognitive engagement. Enhanced participation facilitates deeper understanding and practical application of knowledge. Activities such as simulated case analyses and role-playing allow orthopedic TCM

knowledge to be effectively applied in clinical scenarios, cultivating students' clinical decision-making skills [5]. Simultaneously, multimodal teaching prioritizes immediate feedback and self-regulation. Learning platforms provide real-time progress tracking and assessment functions, enabling students to adjust their approach based on feedback. This mechanism not only helps identify knowledge gaps but also allows teachers to better understand student learning dynamics, facilitating timely instructional adjustments.

2. Characteristics of Traditional Chinese medicine knowledge in orthopedics

2.1 Uniqueness of orthopedic TCM

Orthopedic Traditional Chinese Medicine (TCM) is a vital branch of Chinese medicine. Its therapeutic concepts and methods have evolved through millennia of clinical practice, forming a distinctive theoretical system. TCM orthopedic treatment emphasizes holistic perspectives and syndrome differentiation, implementing personalized therapies by considering individual patient differences. Beyond external methods like acupuncture, tuina (acupressure), cupping, and guasha (scraping), it prioritizes internal therapies—particularly herbal medicine regulation—to restore organ functions and promote bone and joint healing [6].

2.2 Characteristics of orthopedic TCM

(1) Differentiated treatment: The treatment methods of orthopedics in TCM not only pay attention to the superficial symptoms of diseases, but also pay more attention to the overall physical condition and individual differences of patients. Through differential diagnosis and treatment, it is emphasized that the occurrence and development of diseases are closely related to the dysfunction of organs, poor circulation of qi and blood, etc., and the treatment focuses on regulating the overall health status of patients [7].

(2) Emphasis on non-surgical therapy: Different from western orthopedic treatment which mostly relies on surgery and modern medical technology, Traditional Chinese orthopedics focuses on treating orthopedic diseases through non-invasive means, such as acupuncture and massage. These treatments can not only relieve

patients' symptoms, but also improve the rehabilitation effect of patients by regulating qi and blood and unblocking meridians.

(3) Personalized TCM treatment: In orthopedic diseases, the application of TCM is usually based on different patients' constitution and disease characteristics to formulate personalized TCM formulas. TCM can help patients restore bone repair ability and alleviate systemic symptoms caused by the disease by regulating the balance of yin and yang in the human body.

(4) Systematic treatment: In the process of treatment, orthopedic TCM not only pays attention to local lesions such as fracture and arthritis, but also attaches importance to the functional status of other organs in the body, and carries out systemic regulation and treatment. Through organ harmony, blood and qi circulation and yin-yang balance are promoted, and the overall health status of patients can be effectively improved.

Third, the predicament of inheritance of traditional Chinese medicine knowledge in orthopedics

3.1 Complexity and non-standardization of knowledge system

The knowledge system of Traditional Chinese Orthopedics is vast and complex, encompassing multiple aspects such as anatomy, pathology, and clinical treatment. Due to TCM's emphasis on individualized treatment and syndrome differentiation, each therapeutic plan may be tailored according to the patient's specific condition and constitutional characteristics. This highly personalized approach poses significant challenges for the transmission of TCM orthopedic knowledge. For educators, imparting such specialized knowledge without standardized guidelines has become a thorny issue. Moreover, TCM classical texts are abundant and rich in content—from the *Huangdi Neijing* (Yellow Emperor's Inner Canon) to *Shanghan Zhabing Lun* (Treatise on Cold Damage and Miscellaneous Diseases), from *Jin Kui Yao Lue* (Essential Prescriptions from the Golden Chamber) to *Waiké Zhengzong* [8], these valuable texts are often preserved in classical Chinese with high interpretive difficulty. Many traditional knowledge lacks modern standardized translations and annotations, making learning and inheritance particularly challenging.

3.2 Transmission of clinical experience and standardization

Traditional Chinese orthopedic treatments often rely on accumulated clinical experience and individual physicians' expertise. This knowledge-based approach to teaching leads to significant variations in treatment methods among practitioners. While this personalized method effectively addresses complex clinical scenarios, it faces challenges in modern medical education due to the lack of systematic pedagogical frameworks and standardized protocols for orthopedic TCM instruction [9].

3.3 Stress and conflict in modern medical education

Modern medical education is putting unprecedented pressure on the inheritance of traditional Chinese medicine (TCM) knowledge. With the continuous development of Western medical technologies and modern medical theories, students may perceive conflicts between traditional TCM knowledge and contemporary medical techniques during their studies. In orthopedic treatment, Western medicine achieves remarkable results through precise imaging examinations, surgical techniques, and pharmacological therapies, while TCM emphasizes holistic regulation and personalized treatment. These differences often diminish students' interest in TCM orthopedics [10].

3.4 Lack of students' learning interest and motivation

In contemporary medical education, students' interest in and motivation to learn Traditional Chinese Medicine (TCM) orthopedics are gradually diminishing. This trend is particularly evident in orthopedic training, where advancements in Western medical technologies, the widespread use of medical imaging, and surgical techniques have led many medical students to favor modern treatment approaches over TCM's traditional wisdom. Many students perceive TCM treatments as less precise and systematic compared to Western medicine, while also finding TCM learning burdensome due to its complex theoretical framework and clinical skill requirements. These factors collectively contribute to students' resistance toward studying TCM orthopedics [11].

IV. Application of multimodal teaching in the inheritance of orthopedic Traditional Chinese medicine knowledge

In the inheritance of orthopedic TCM knowledge, adopting multimodal teaching

can effectively address issues such as "the disconnect between theory and practice" and "difficult knowledge transmission" in traditional teaching methods. The design of multimodal teaching should not only align with the characteristics of orthopedic TCM disciplines but also fully utilize modern information technology to create a comprehensive and multi-dimensional learning experience [12].

4.1 Diversified presentation of teaching content

The transmission of theoretical knowledge forms the foundation of orthopedic TCM education. However, traditional teaching methods relying on written materials and lectures have limitations in students' comprehension and retention. Multimodal teaching employs various formats including text, images, animations, and videos to enhance understanding of complex orthopedic TCM theories. Instructors should establish core objectives based on curriculum guidelines [13], helping students grasp fundamental TCM principles and treatment methods while developing clinical thinking and diagnostic skills. Assessment criteria should cover theoretical knowledge mastery, clinical practice, and cognitive abilities. Teachers should select appropriate multimodal resources like textual materials, visual aids, and video clips, designing interactive activities that integrate multimedia tools such as PPT and video for theoretical instruction [14]. For example, when explaining "fracture healing delay caused by liver-kidney deficiency," instructors can use textbook explanations or PPT animations to demonstrate how this deficiency affects bone growth and repair. Pathological mechanisms are illustrated with diagrams, while animations show bone remodeling processes under different conditions and their impact on healing. 3D models can visualize cellular division and blood circulation during fracture healing, complemented by TCM's "liver-kidney tonification" therapy [15].

4.2 Clinical experience and case analysis simulation teaching

In orthopedic TCM education, students face the challenge of translating theoretical knowledge into clinical practice. Virtual case analysis and simulation teaching help students develop clinical thinking in virtual environments. By posing questions, presenting cases or videos, these methods stimulate students' interest and critical

thinking [16]. For example, when teaching "traumatic fracture treatment," using specific cases to demonstrate TCM applications in orthopedic diseases enables students to integrate theory with practice. Additionally, virtual case simulations [17] allow students to analyze and diagnose through interactive platforms. By reviewing case reports, examining CT or X-ray images of fracture sites, and analyzing patient symptoms and signs, students extract key information to formulate treatment plans. Through multimodal presentations, students gain clearer understanding of TCM approaches for fracture treatment, such as using "blood-activating and stasis-resolving" formulas and massage therapy to promote healing [18].

4.3 Interactive learning and autonomous learning

Through the online interactive platform, students can discuss with teachers and classmates in real time, share their personal learning experiences and doubts. An integrated case database and discussion area platform can be designed, in which students can choose different cases for analysis during the learning process, and interact with teachers and other students through online discussion to put forward their own opinions [19].

4.4 Clinical skills and multimodal practice

In orthopedic TCM education, the use of model-based simulation allows students to practice clinical treatments like tuina (acupressure) and acupuncture through interactive models. For example, when learning "Tuina Treatment for Lumbar Disc Herniation," students work in groups practicing techniques such as tuina manipulation and acupuncture positioning using patient models, while instructors provide real-time guidance to correct their postures and methods. This interactive training approach not only enhances practical skills but also helps students understand the principles and mechanisms underlying TCM therapies in orthopedics [20].

4.5 Feedback and evaluation mechanism

In multimodal teaching, real-time feedback plays a crucial role. Through the multimodal teaching platform, instructors can monitor students' learning progress and comprehension in real time, providing timely guidance and corrections. After students

complete case analyses, the system automatically evaluates their diagnostic results, offering correct answers and detailed explanations to help them identify and correct errors. Additionally, data analysis enables teachers to assess each student's learning progress and engagement level, allowing for personalized teaching adjustments. The learning evaluation system also provides periodic assessments, helping students understand their strengths and weaknesses in orthopedic traditional Chinese medicine studies [21].

V. CONCLUSIONS

As medical education models continue to evolve, traditional teaching methods are increasingly failing to meet modern educational demands, particularly in the field of Traditional Chinese Medicine (TCM). The integration of traditional therapeutic concepts with modern educational technologies has become a critical challenge requiring resolution. Multimodal teaching, an innovative educational approach that combines text, images, audio, and video formats, significantly enhances learning experiences and facilitates knowledge acquisition. In orthopedic TCM education, this method not only breaks away from the rigidity of conventional teaching approaches but also leverages multisensory engagement to help students better comprehend complex TCM knowledge. By enabling learners to identify learning challenges and make timely adjustments, it strengthens personalized and targeted instructional practices.

While multimodal teaching offers numerous advantages, it still faces practical challenges such as insufficient technical support, uneven distribution of educational resources, and varying teacher adaptability. Moving forward, greater efforts should be made to develop and build multimodal teaching platforms that enable resource sharing and optimization. Moreover, as traditional Chinese medicine (TCM) treatment concepts and methods in orthopedics continue to evolve with the times, the teaching content within these platforms must be regularly updated and refined to incorporate the latest clinical research findings and therapeutic approaches, ensuring both relevance and practicality in pedagogical content.

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