

Disclosure statement

The author declares no conflict of interest.

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Analysis of the Pros and Cons of the Current Chinese Medicine Education System and Strategies for Improvement

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Abstract: The current system of Chinese medicine education is centered on institutional education, teacher-training education, and continuing education, and it has realized the dynamic match between the supply of talents and the demand of the industry through large-scale cultivation, innovative teacher-training integration, and multi-dimensional continuing education. However, there are still problems such as the disconnection between the theory and practice of institutional education, the limited development of teacher-training education on a large scale, the uneven quality of continuing education, the conflict of combined education of traditional Chinese medicine and Western medicine, and the obstruction of internationalized education. This paper proposes to reconstruct the institutional curriculum system, innovate the stratified classification system of teacher training, strengthen the practice orientation of continuing education, promote the in-depth integration of Chinese and Western medicine, and improve the policy guarantee mechanism, and other improvement paths, aiming to build a new type of Chinese medicine personnel training system that emphasizes both classical inheritance and modern innovation, and the complementarity between institutional education and teacher training, so as to provide a decision-making reference for the sustainable development of Chinese medicine education.

Keywords: Institutional education; Teacher training; Continuing education; Pros and cons analysis

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1. Introduction

Chinese medicine, as the “art of Qi and Huang” inherited for thousands of years, condenses the life wisdom and cultural genes of the Chinese nation and is an important carrier to maintaining the continuity of Chinese civilization. Its essence is guided by the philosophy of the unity of heaven and mankind, exploring the laws of human life and health through a dynamic and balanced way of thinking, and forming a unique theoretical system in thousands of years of practice ^[1]. In the theoretical construction and practical verification of successive generations of medical doctors, Chinese medicine has gradually established a complete medical

system with the doctrine of yin and yang and five elements as the theoretical foundation, and the holistic view and the methodological core of diagnosis and treatment. As an original medical science with independent intellectual property rights, it has not only ensured the reproduction of the Chinese nation for generations but also played an irreplaceable role in the fields of disease control and health care ^[2]. However, with the rapid development of modern biomedicine, traditional Chinese medicine (TCM) is facing serious challenges in theoretical interpretation and clinical transformation. In particular, the problem of adaptability between the TCM personnel training system and the contemporary medical education model is becoming more and more prominent. Although the current higher education in TCM has formed a three-stage training system of “institutional education—post-graduation education—continuing education,” the effectiveness of the training of clinical practice ability is still insufficient. This kind of education status quo, which is disconnected between theory and practice, and unbalanced between inheritance and innovation, seriously restricts the sustainable development of Chinese medicine. Based on the perspective of system theory, this paper analyzes the existing problems of the education system of Chinese medicine and explores the path of its innovation and development through the combination of literature analysis and case study to provide decision-making references for the construction of Chinese medicine personnel training system that meets the needs of the times.

2. Overview of the current Chinese medicine education system

The education system of Chinese medicine is centered on institutional education, teacher training, and continuing education, forming a multi-level and multi-dimensional training framework that combines the dual characteristics of traditional inheritance and modern standardization ^[3].

Institutional education is the mainstream of Chinese medicine education, covering specialist, undergraduate, master’s degree, doctoral degree, and other levels of training; where specialist education is usually three years, the curriculum is mainly designed to cultivate students’ basic theories and skills, which is suitable for the needs of primary health care; undergraduate education is usually five years, the curriculum includes basic theories of Chinese medicine, diagnostics, traditional Chinese medicine, pharmacology, *Neijing* (Internal Classic of Medicine), typhoid fever, the Essentials of the Golden Gui, warm diseases, etc., knowledge of Chinese medicine like acupuncture, moxibustion, etc., as well as modern medicine. In addition to theoretical knowledge, a clinical internship is required, a process that is usually completed in affiliated hospitals or cooperative medical institutions ^[3,4]. Master’s and doctoral degree programs in TCM usually last for three years, with the master’s degree focusing on deepening TCM theory and clinical skills, and the doctoral education focusing on TCM research and advanced clinical skills.

Teacher education in TCM is a traditional teaching model that helps apprentices master TCM theories and clinical skills mainly through oral transmission from master to apprentice. This mode places special emphasis on practical teaching and the transmission of clinical experience. However, with the development of the times, the form of modern TCM teacher education has changed. Nowadays, it is more often the case that students in medical schools, on the basis of theoretical learning, follow experienced Chinese medicine practitioners in clinical practice to deepen their understanding of Chinese medicine knowledge and their ability to apply it through the actual diagnosis and treatment process. This combination of traditional teacher training and modern education retains the essence of teacher training and adapts to the needs of the modern medical education system ^[5-8].

Continuing education in Chinese medicine is a lifelong learning system for practicing Chinese medicine

practitioners, aiming to help them keep abreast of the development of Chinese medicine disciplines and improve their clinical diagnosis and treatment expertise and professional competence through systematic and diversified forms of education. Currently, the main forms of education include: thematic training courses focusing on specific diseases or techniques, academic conferences bringing together cutting-edge achievements of the industry, online courses relying on digital platforms, and clinical training programs with teachers. This continuous education mechanism not only makes up for the slow updating of knowledge in traditional teacher training but also promotes the modernization of TCM practitioners' diagnostic and therapeutic capabilities based on inheritance through the closed-loop model of "theoretical learning-clinical practice-technical iteration"^[9,10].

It should be noted in particular that after completing systematic professional education in Chinese medicine, practitioners are not yet legally qualified to independently carry out Chinese medicine practice. According to the Law of the People's Republic of China on Medical Practitioners, a practitioner must pass the qualification examination for TCM practitioners, which consists of a dual assessment system of written theoretical tests and practical skills, in order to obtain a practicing certificate and legally practice medicine^[11]. In addition, the career development path of Chinese medicine practitioners is closely related to the title system, where they can be promoted step by step through the health professional and technical qualification examination to the titles of attending physician, deputy chief physician, and chief physician. The evaluation criteria cover the assessment of clinical efficacy, academic output, difficult cases handling ability, and other multi-dimensional indexes, and require the completion of the compulsory continuing education hours. This dual-track mechanism of "access-promotion" not only ensures the standardization of the quality of Chinese medicine services but also promotes the lifelong professional growth of practitioners through a ladder system of competency certification.

In recent years, the application value of TCM in the fields of chronic disease management, rehabilitation therapy, and disease prevention has received increasing international attention, which has given rise to a new trend of globalization and development of TCM education. The World Health Organization (WHO) included for the first time a chapter on traditional medicine in the International Classification of Diseases, Eleventh Edition (ICD-11), marking the further consolidation of the legitimacy of TCM theories and practices in the international healthcare system^[12]. Developed countries such as the United States, Germany, and Australia have incorporated acupuncture, moxibustion, and traditional Chinese medicine into their higher education systems and offered localized TCM courses. Currently, the internationalized education of TCM is mainly promoted through the following modes: (1) Transnational joint education: Beijing University of Traditional Chinese Medicine (BUTM) and Middlesex University of the United Kingdom (UK) jointly set up a bachelor's degree program in TCM, and Henan University of Traditional Chinese Medicine (HUTM) established an overseas branch in Malaysia^[13]; (2) Cultural dissemination platform empowerment: Hundreds of Confucius Institutes around the world have added Chinese medicine courses, combined with workshops and experiential camps, to popularize practical techniques such as Tai Chi and acupressure to the overseas public^[14]; (3) International special training program: WHO and China have jointly launched the "Traditional Medicine Cooperation Center" program to train medical personnel in countries along the "Belt and Road" in Chinese medicine diagnosis and treatment techniques, and to help improve the capacity of local primary medical services^[15]. Such cooperation not only accelerates the cross-border flow of TCM knowledge and technology but also promotes TCM as an important part of global health governance by building a synergistic network of "policy, education, and industry."

3. Analysis of the advantages of the current TCM education system

3.1. Facilitating the scale and standardization of the training of Chinese medicine talents

Through unified teaching materials, standardized curricula, and standardized management, modern TCM institutional education is driven by a modularized curriculum system and a national unified licensing examination system, both through “theory-practice” spiral teaching to establish the knowledge and ability benchmarks, and to realize the large-scale cultivation of TCM talents ^[16]. Xu *et al.* found through a cross-sectional survey that nurses in tertiary general hospitals scored significantly higher than nurses in secondary hospitals in terms of their knowledge of TCM nursing techniques, suggesting that institutional education has a positive effect on the systematic construction of the knowledge system ^[17]. By 2022, TCM graduates have risen from 59,900 to 135,500, an increase of 76,500, with an average annual growth rate of 9.67% ^[18]. This model provides TCM practitioners with a solid foundation and broad knowledge. In order to meet the differentiated needs of primary healthcare institutions, TCM specialty hospitals, and research platforms for talents, modern TCM education has built a three-stage progressive cultivation system, namely, “vocational and technical education, undergraduate general education, and postgraduate innovation education.” Under this structure, higher vocational colleges and universities focus on practical technology and output skilled talents; undergraduate education strengthens the cross-fertilization of classical curriculum and modern medicine; and master’s and doctoral postgraduate education deepens the cutting-edge research on the prevention and treatment of major diseases in traditional Chinese medicine through the National Key Research and Development Program (“Modernization of Traditional Chinese Medicine” special project), Qihuang Scholars’ Mentor Team, and other carriers. The researchers have also been working on the development of the Chinese medicine industry. Statistics show that from 1996 to 2015, the number of SCI papers on Chinese medicine in China rose from 111 to 9,437, with an 85-fold increase in the annual number of papers issued during the 20-year period ^[19]. This hierarchical education model not only realizes the dynamic match between the talent supply structure and the industry job demand but also drives the transformation of TCM discipline from empirical medicine to evidence-based medicine paradigm.

3.2. Innovative integration of teacher education improves the quality of TCM talent cultivation

Teacher training is centered on clinical practice, and experience is passed on through personalized guidance by tutors. The current education system of Chinese medicine colleges and universities institutionalizes the teacher training model embedded in the talent training process through the “early clinical-mentorship” dual-track mechanism to make up for the defects of standardized teaching and clinical disconnect. For example, Zhejiang University of Traditional Chinese Medicine has implemented the “Famous Doctor Studio Follow-up Program,” which requires undergraduate TCM students to complete eight hours of clinical practice per week, and systematically participate in the whole process of diagnosis and treatment such as history-taking, four-diagnosis, and acupuncture prescription under the guidance of the deputy chief physician and tutors. This kind of practice breaks through the boundary of the traditional teacher-apprentice system, forming a three-stage competence development model of “observation-assistance-semi-independent operation” ^[20]. It is noteworthy that digital technology is reconfiguring the experience transmission model. For example, AI-assisted Chinese medicine diagnosis system, students can use an AI-assisted Chinese medicine diagnosis system for clinical thinking training, and generate structured learning maps and realize the explicit transfer of tacit knowledge through the AI analysis of diagnosis and treatment decision-making logic ^[21]. This new type of “institutional guarantee, technology-enabled” teacher-training system not only retains the advantages of personalized training, but also

realizes the quality control of teaching through the Mini-CEX scale and other tools, providing a standardized paradigm for the growth of Chinese medicine talents.

3.3. Multidimensional adaptation and innovative development of continuing education guarantees continuous improvement of TCM talents' professional levels

Continuing education in Chinese medicine builds a lifelong learning system that meets the needs of professional development through the “platform-content-certification” trinity model. Its flexibility is reflected in: (1) Time and space elasticity: Relying on mobile learning platforms (such as “Qihuang e-learning” app), grassroots physicians can independently choose online live broadcasting, case library access, AI simulation diagnosis and treatment, and other forms of learning ^[22]; (2) Modularization of the content: Tiered course packages are set up for different ranks, such as the resident should emphasize basic skills and humanistic qualities ^[23], attending physicians need to highlight clinical thinking and difficult case management ^[24], and associate physicians should focus on scientific research, teaching management, and complex case management ^[25]; (3) Education hybridization: A hybrid continuing education method, i.e., “online + offline” hybrid teaching mode is adopted, combining the advantages of online learning and offline practice, which can effectively improve the learning effect and skill level. For example, in disaster nursing continuing education for orthopedic nurses, online + offline blended teaching significantly improved the scores of the theory and skills assessment, the scores of the disaster nursing core competency scale, and the scores of the disaster relief attitude assessment questionnaire ^[26]. In addition, the rain classroom-based blended teaching model combined with the mind mapping construct also showed significant advantages in developing independent learning ability and sharing learning content ^[27].

4. Deficiencies in the current system

4.1. Difficulty in realizing the organic combination of theoretical teaching and practice in institutional education

The current education in TCM colleges and universities is generally characterized by problems such as insufficient basic skills in medicine, unsystematic knowledge structure of TCM, and disconnection between theory and practice, etc. There is a significant tendency to emphasize theory but not practice ^[28]. Taking the five-year undergraduate education as an example, the traditional “4+1” segmentation model (four years of theory + one year of internship) cuts the continuity of cognitive construction. Cognitive neuroscience research has shown that the unique imagery thinking of TCM (e.g., “elevation of qi” and “five elements”) needs to be internalized in depth through embodied cognition in clinical situations. However, about 83% of the abstract concepts taught in core courses such as Basic Theory of Chinese Medicine are still confined to the classroom environment, resulting in students falling into the cognitive dilemma of “mechanical memorization, rapid forgetting” ^[29].

In addition, there is also a shortage of clinical teaching resources. At the hardware level, the number of beds in hospitals affiliated with many provincial TCM colleges and universities is less than 800, making it difficult to meet the practice demand of 0.3 beds per capita for students ^[30]; at the software level, the clinical ability of teaching staff varies, and many clinical teachers have less than 2,000 outpatient visits per year, which makes it difficult to provide high-quality demonstration of casework for students. In terms of the application of modern technology, although most of the institutions have introduced virtual simulation laboratories, the application of technology mostly stays at a shallow level such as “three-dimensional demonstration of acupuncture points,” and there is an obvious lack of interaction in the key competence training links.

4.2. Realistic dilemmas in the development of teacher education on a large scale

Currently, Chinese medicine teacher education is facing structural contradictions: Firstly, the aging of high-quality teachers and the insufficient clinical experience of young teachers have posed significant challenges. Meanwhile, the success of renowned Chinese medicine practitioners has been largely dependent on long-term apprenticeship, typically lasting 10 to 15 years on average, resulting in potential disruptions in the inheritance of tacit knowledge^[31]. Secondly, the knowledge transformation rate of the teacher-training education model is low, and the traditional “one-to-one” model has the defects of planarization and homogenization, which is difficult to adapt to the needs of scaling. The average daily number of patients in the expert clinic is 40, but the students can only observe 2–3 typical cases, and the knowledge conversion rate is less than 15%. More seriously, the burden of scientific research squeezes clinical time. Studies have shown that research pressure is negatively correlated with teaching initiative, and excessive quantitative assessment leads to the weakening of clinical ability^[32]. This tendency of “laboratorization” has weakened the ability of some teachers to identify evidence and treatments, making it difficult to instruct students in the dynamic analysis of complex disease mechanisms. In addition, the promotion of digital teacher training is also limited by the cost of technology and teacher training^[33].

4.3. Uneven quality of continuing education

Currently, there are significant differences in program quality in the field of continuing education in Chinese medicine, which are manifested in the following areas: (1) Disconnect between course content and practice: Some training institutions are oriented to the completion of credit hour targets, and their course design does not follow the frontier of TCM disciplines (e.g., AI-assisted diagnosis and treatment technology). They still use outdated teaching materials, which leads to a low degree of match between the teaching content and the actual clinical needs. (2) Unitary teaching mode: There is an over-reliance on online recording and broadcasting courses, a lack of interactive teaching (e.g., case discussion, practical exercises), insufficient participation of students, and difficulty in realizing in-depth learning. (3) Formalized assessment mechanism: Some courses only use online question and answer or check-in time as the assessment standard, without setting up clinical skills assessment, resulting in the common phenomenon of “brushing the class time,” which cannot truly reflect the effect of ability enhancement. (4) Stagnation of vocational competence: For example, in the continuing education of community nurses in Zhangye City, 65.58% of the nurses believe that the curriculum should strengthen rehabilitation nursing and traditional Chinese medicine techniques, but the existing training is still based on general knowledge, which is out of touch with the grassroots’ needs^[34]. (5) Declining trust in the profession: Low-quality training has led to lagging diagnostic and treatment skills among some practitioners, indirectly affecting patient outcomes and the credibility of TCM in society. (6) Policy goal deviation: The goal of “hierarchical, classified, and precise training” proposed in the “14th Five-Year Plan” of the State Administration of Traditional Chinese Medicine (SACTM) is difficult to realize due to implementation deviation, which restricts the overall upgrade of the service capacity of traditional Chinese medicine.

4.4. Conflict between Chinese and Western medicine education

There are structural contradictions in the integration of Chinese and Western medicine curricula. There are big controversies in the teaching mode and method of integrated Chinese and Western medicine education, especially in undergraduate teaching, the rationality and effectiveness of the curriculum, teaching content, and teaching methods are more prominent^[35]. For example, the increase in the number of courses, the heavier academic workload, and the diversity of teaching methods have been observed, yet their effectiveness remains

inconsistent^[36]. Many students of Integrative Medicine perceive the curriculum as a “mix of Chinese and Western approaches,” resulting in confusion within the knowledge system. Although the combined model of problem-oriented learning and case teaching has improved clinical thinking in teaching, how to balance the holistic view of Chinese medicine with the reductionism of Western medicine, and how to promote the in-depth integration of Chinese and Western medicine is still a difficult problem.

Under the impact of the evidence-based system of modern medicine and the technological revolution, Chinese medicine education is facing a two-dimensional structural reconstruction: on the one hand, it needs to defend the integrity of the theoretical kernel, and on the other hand, it needs to build a mechanism of dialogue with modern medicine. Medical schools offer complementary medicine courses, but they cannot fully realize the organic integration of traditional theory and modern technology, reflecting the deep dilemma of cultural translation. The structural challenges are as follows: (1) Deep cognitive gap: Students in TCM colleges and universities are exposed to modern medical technology (e.g., genetic testing, diagnostic imaging) for a relatively small number of hours, resulting in the fragmentation of clinical practice, in which “pulse diagnosis is not abandoned, and imaging must be examined.” (2) Conflict of research paradigms: In the Chinese medicine projects of the National Natural Science Foundation of China, there are a lot of molecular biology research paradigms, but only a small number of them can effectively explain the mechanism of the association of “signs and symptoms—prescription and medicine,” which exposes the problem of the integration of the reductionist theory of Western medicine and the holistic view of Chinese medicine. (3) Clinical decision-making dilemma: Hospital doctors still prioritize the use of modern medicine in the treatment of acute and critical illnesses, while traditional therapies are mostly limited to the management of chronic diseases.

4.5. Restrictions on internationalized education in TCM

From the viewpoint of cultural cognition and theoretical system, there exists an obvious cognitive gap between China and the West, and the internationalization of Chinese medicine faces the obstacle of theoretical interpretation. Chinese medicine is centered on the doctrine of yin and yang and five elements, emphasizing the holistic view, dynamic balance, and unity of mankind; while Western medicine is based on the four elements of the ancient Greek theory of fluid pathology, emphasizing local anatomy and experimental verification, the two philosophical systems are difficult to be compatible^[37]. For example, the concept of “qi” in Chinese medicine is often questioned as “pseudoscience” by Western scholars because it lacks a material entity^[38]. In Russia, the inclusion of acupuncture in “reflexology” has diluted the cultural connotations of Chinese medicine, leading to its “de-Chinese-medicalization”^[39].

The cross-cultural adaptation of educational resources also faces dilemmas, such as the structural imbalance of teachers and the translational bottleneck of localization of teaching materials. Data on overseas TCM education show that 78% of the core curriculum is still undertaken by expatriate Chinese teachers, and only 12% of the local teachers have a systematic TCM education background^[40]. TCM terminology and concepts are difficult to convey accurately when translated into other languages. For example, the concepts of “yin and yang” and “five elements” in Chinese medicine do not have direct equivalents in English, which leads to the loss or misunderstanding of information in the translation process. A comparative analysis of the textbooks shows that in the English version of *Basic Theory of Chinese Medicine*, only the chapter of “Five Elements” has a cultural translation loss rate as high as 63%^[41,42].

The standard of systematic construction of TCM education also varies among countries. To ensure the quality and competence of TCM practitioners, many countries and international organizations are making

efforts to develop and implement self-regulatory standards for education and training ^[43]. However, they still face problems such as large differences in assessment standards and insufficient clinical competence of students. Acupuncturists in some countries only need 500 hours of training to practice, which is much lower than the Chinese standard ^[44], and the mobility of talents is severely limited.

5. Suggestions for improvement and breakthrough paths

5.1. Restructuring of institutional curricula

We need to promote the integration of theory and clinical practice to further strengthen students' clinical practice skills. The “early clinical + classical reinforcement” model should be implemented, such as the penetration of traditional culture and thinking training in the teaching of “Internal Canon,” to enhance the coherence of students' thinking in Chinese medicine ^[45]. Setting contextualized teaching mode, for example, we can embed the “ward live classroom” in the course of “TCM Diagnostics,” presenting the four diagnostic processes of the leading physician in real time through 5G transmission; the students synchronously carry out remote diagnosis and analysis, constructing the AI model of TCM diagnosis and treatment decision tree, training the neural network based on real cases, and carrying out diagnostic training through the virtual patients. Conversation robots for evidence identification training and real-time feedback from the system on diagnosis and prescription bias provide an in-depth drive to integrate theoretical learning with clinical practice. We should strengthen cooperation with medical institutions, provide students with more abundant and diversified internship opportunities, and strengthen blended teaching (online theory + offline practice) to better solve the problem of fragmentation between theory and practice ^[46]. It enables students to obtain valuable opportunities to learn and exercise in real medical environments so that they can better understand and master what they have learned. This cooperation model not only promotes the organic combination of theory and practice but also delivers fresh talent with potential and vitality to medical institutions, realizing a win-win situation.

5.2. Innovations in the teacher education system

We have designed a tiered mentor system, constructed a three-tier mentor echelon of “national masters-provincial famous doctors-grass-roots cadres,” and implemented a differentiated teaching program. The national mentors will focus on the inheritance of academic ideas, guide students to explore the profoundness of traditional Chinese medicine through in-depth analysis of the essence of Chinese medicine theories, and encourage them to form independent academic insights. Provincial famous doctors will focus on cultivating students' clinical diagnosis and treatment ability through practical exercises and case analysis, so that students can master the diagnosis and treatment skills of diseases in practice and enhance their ability to solve practical problems. Primary Backbone Mentors, on the other hand, focus on the teaching of primary care practice, emphasizing the practicality and popularity of healthcare services. By guiding students to conduct internships in primary care institutions, students are able to understand the current situation and challenges of primary care, and cultivate the awareness and ability to take root in the grassroots and serve the public ^[47]. The design and implementation of this system aims to effectively improve students' professional skills and comprehensive quality in a targeted manner and to cultivate more excellent talents for the inheritance and development of Chinese medicine. In addition, we can also expand the coverage of mentorship through the establishment of a “Regional Sharing Platform for Famous Doctors,” expand the coverage of mentorship through teleconsultation and cross-institutional follow-up, and draw reference from Hong Kong's “Chinese Medicine Specialist Training Scheme” to formulate standards of specialization and promote specialist teacher training ^[48].

5.3. Enhancing the quality of continuing education

A demand-oriented approach is adopted in the design of continuing education, with course development based on job competency analysis. For example, in Zhangye City, a “four-module” framework (professional quality, basic skills, core skills, and comprehensive ability) was designed for community nurses, incorporating 160 hours of practical training to enhance the program’s applicability ^[34]. The supervision of continuing education is strengthened to ensure course quality through the establishment of a comprehensive “declaration-implementation-assessment” management system. A system of random checks has been improved, and an assessment mechanism has been established. A review group, composed of provincial departments overseeing traditional Chinese medicine in collaboration with tertiary hospitals, colleges, and universities, has been set up to conduct dynamic audits of course content and teacher qualifications. A red and yellow card system for course quality has been implemented, whereby contractors receiving student satisfaction ratings below 70% for two consecutive years will be disqualified from submitting courses. Low-quality courses are eliminated, and a regularly updated “quality course catalog” is published. Assessment methods are enhanced with a stronger emphasis on practical evaluations. In addition to existing theoretical assessments, practical components such as video submissions of clinical consultations with instructors and case analysis defenses have been introduced, with the weight of practical assessments being increased. A resource-sharing platform has been developed, leveraging the National Base for Continuing Education in Chinese Medicine. High-level instructors have been integrated to develop standardized course packages, facilitating the dissemination of resources through open sharing.

5.4. Deep integration of Chinese and Western medicine and innovation

Greater emphasis should be placed on promoting “cultural integration” rather than mere “technological superposition” between Chinese and Western medicine. The “cultural adaptation theory” should be applied to enhance the complementarity between Chinese medicine principles and Western evidence-based medicine within the curriculum, rather than simply “juxtaposing knowledge” ^[49]. The content of modern medicine courses should be actively expanded to include not only fundamental medical theories and clinical diagnostic and treatment techniques but also the latest medical research findings and practical advancements ^[50]. At the same time, the integration of Chinese and Western medicine has become a key focus of educational reform. This is being pursued through the establishment of specialized courses, including classical Chinese medicine theory, acupuncture and massage, and traditional Chinese medicine, while also incorporating interdisciplinary teaching by interweaving modern medical curricula. Such an approach is intended to enhance students’ ability to apply evidence-based thinking, enabling them to master precise diagnostic and treatment techniques in Western medicine while gaining a profound understanding of the holistic concepts and evidence-based principles of Chinese medicine. For example, the multidisciplinary collaboration model in oncology teaching has been shown to improve students’ integrated diagnostic and treatment capabilities through joint case discussions between Chinese and Western medicine practitioners ^[51]. In advancing the integration of Chinese and Western medical technologies, innovative approaches are being explored. The “Intelligent Tongue Diagnostic Instrument for Chinese Medicine,” developed by Shanghai University of Traditional Chinese Medicine, has successfully established correlations between tongue features and metabolomics data by training on two million image cases, achieving an 89% accuracy in the correlation between tongue diagnosis and laboratory indicators ^[52]. Additionally, the latest NCCIH-funded “Multi-Organomics Study of Acupuncture Neuromodulation” is pioneering an interdisciplinary research paradigm that connects acupuncture sensory transmission with brain

network regulation. This approach of “interpreting traditional wisdom in modern language” may serve as a critical breakthrough in overcoming cultural barriers^[53].

5.5. Policy guarantees and long-term mechanisms

The national standards for the quality of Chinese medicine education will continue to be improved, with specific guidelines established for the construction of clinical practice bases. Mandatory indicators, such as the per capita area for practical training and the number of standardized diseases covered, will be clearly defined. Teacher-training education will be incorporated into the system of undergraduate teaching audits and institutional evaluations. Innovations in the talent incentive mechanism will be implemented, ensuring that the process of “Chinese medicine training-teacher training-title promotion” is effectively integrated. The attainment of a provincial-level or higher teaching certificate will be recognized as equivalent to continuing education credits. Additionally, medical institutions that achieve significant results in integrating traditional Chinese and Western medicine will be granted preferential policies in medical insurance reimbursement and scientific research funding.

6. Conclusion

Chinese medicine education continues to evolve through both inheritance and innovation. While the current education system benefits from its scale and standardized training, challenges remain, such as the disconnect between theory and practice and the limited scope of teacher-training education. By strengthening clinical practice, expanding teacher-training programs, improving the quality of continuing education, promoting the integration of Chinese and Western medicine, and enhancing policy guarantee mechanisms, the TCM education system can be further refined to support its sustainable development. Through these systematic improvements, a modernized TCM talent cultivation system can be established—one that balances classical inheritance with contemporary innovation, integrates institutional education with teacher training, and effectively combines the essence of TCM with Western medical advancements. This approach will address core issues in TCM education, including the gap between theoretical knowledge and practical application, as well as the challenge of maintaining a balance between tradition and modernization.

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An In-Depth Analysis of the Paradigm of Virtual-Reality Fusion in Creating New Media Art in the Context of Meta-Universe

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Abstract: Under the background of the era of rapid development of the meta-universe, the fusion of virtual and reality in new media art creation has become a key trend. Starting from the concept of meta-universe and new media art, this paper analyzes the connection between the two in depth, elaborates on the manifestation of the fusion of virtual and reality in new media art creation, explores the challenges and problems it faces, and puts forward coping strategies with the aim of providing theoretical support for the development of the creation of new media art under the context of the meta-universe, and promoting the innovation and progress of art creation.

Keywords: Meta-universe; New media art; Fusion of virtual and reality; Artistic creation

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1. Introduction

Since its introduction, the concept of the meta-universe has aroused extensive attention and discussion worldwide, and its rapid development has had a profound impact on many fields. As an art form closely connected with science and technology, new media art has ushered in new development opportunities and challenges in the context of the meta-universe. The fusion of virtual and reality is an important feature and trend of new media art creation in the context of the meta-universe, and an in-depth study of this fusion paradigm is of great significance to the understanding of the development direction of new media art and the promotion of art creation innovation.

2. Overview of meta-universe and new media art

Meta-universe provides a new field for the development of new media art, and its technological innovation influences the way of creation, the circulation and dissemination of works, and the presentation of themes of new media art. New media art and digital technology are highly related, and the focus of the meta-universe

is precisely digital technology, and the two are complementary to each other ^[1]. For example, blockchain as the underlying technology of meta-universe combines with art to produce NFT and crypto art, solving the problem of digital art circulation and authentication, making algorithms and game mechanisms become art works, and expanding the art presentation and audience base; online virtual space enhances the efficiency of the dissemination of new media art and the dimension of viewing, and improves the interactive experience, prompting the traditional art organizations to reflect on the changes; the distributed network and decentralized features of meta-universe generate the new media art creation methods and theme presentation. The distributed network and decentralized characteristics of the meta-universe have given rise to the DAO organization, which provides a possibility for the social participation and relationship network construction of art. The meta-universe is like a “field” in which new media art is influenced by its technological nodes, continuously forming a perfect digital art ecology.

3. Expression of virtual and reality integration in new media art creation in the meta-universe context

3.1. Application of virtual reality technology

In new media art creation, virtual reality (VR) technology is widely used to create an immersive experience for the audience. Through hardware such as head-mounted display devices, viewers can immerse themselves in virtual art scenes and experience the charm of artworks in 360 degrees. For example, in some VR art exhibitions, the audience seems to walk into the interior of the work of art, interacting with the elements in the virtual environment to enhance the understanding and feeling of the work. In the virtual concert, the audience can interact with singers and other audience members in the virtual space with the help of VR equipment, breaking the traditional viewing mode limitations ^[2].

Artists utilize VR technology to build virtual scenes that break through the limitations of real physical space and give play to unlimited creativity. These virtual scenes can be digital reproductions of real scenes or completely fictional fantasy worlds. In digital artworks, artists create beautiful virtual cities, mysterious alien worlds, and other scenes, allowing the audience to feel the unique artistic atmosphere through the equipment. For example, some pioneering artworks construct surreal virtual scenes to challenge the audience’s cognition and expand the boundaries of artistic expression.

3.2. Integration of augmented reality

Augmented reality (AR) technology superimposes virtual information on real-life scenes, bringing new possibilities for new media art creation. Through devices such as cell phones, tablet PCs, or AR glasses, viewers can see and interact with virtual art elements that do not exist in the real scene. In the field of public art, some AR works superimpose virtual sculptures, paintings, etc., on real-life scenes such as city streets and buildings, so that residents and tourists can discover and experience artworks in their daily lives, enhancing the connection between art and life. In the field of education, AR technology makes art teaching more vivid, and students can see the static pictures in the teaching materials transformed into dynamic and three-dimensional virtual art scenes through the equipment, deepening their understanding of art knowledge.

AR technology realizes the real-time fusion of virtual and real elements to create unique artistic effects. Through clever design, artists combine virtual light and shadow, animation, and other elements with real objects to produce marvelous visual effects ^[3]. In stage performances, AR technology creates scenes where virtual backgrounds, special effects, and actors perform in tandem with each other, enhancing the ornamental and artistic impact of performances. In commercial advertisements, AR technology creates a combination of virtual

and real advertising experiences, attracts consumers' attention, and enhances the advertising communication effect.

3.3. Innovative practices in mixed reality

Mixed reality (MR) technology integrates the advantages of VR and AR technology to realize the seamless connection between virtual and reality. In new media art creation, MR technology makes it difficult for viewers to distinguish the boundaries between the virtual and the real, creating a more realistic and natural interactive experience. For example, in some MR art installations, the audience's movements in real space can be fed back to the virtual environment in real time, and the virtual objects can have physical interaction with the real objects, such as the virtual ball can be kicked by the audience in reality, and the trajectory of the ball is in line with the physical laws, which is a seamless interactive experience that brings a new dimension to the creation of art.

MR technology promotes the exploration of new interaction methods in new media art creation. Artists develop a variety of novel interaction methods with the tracking and recognition functions of MR devices. Viewers can interact with virtual artworks through gestures, voice, eyes, etc., making the art experience more personalized and natural ^[4]. In some MR artworks, viewers can select and operate virtual elements just by looking at them with their eyes, realizing in-depth interaction with the artworks, and this new type of interaction brings more creative space and possibilities for art creation.

4. Impact and significance of the integration of virtual and reality in the creation of new media art in the context of meta-universe

4.1. Impact on artistic creation

The fusion of virtual and reality in the context of a meta-universe provides artists with a broad creative space. While traditional art creation is limited by real physical conditions, in the meta-universe, artists can utilize digital technology to create a variety of virtual scenes, characters, and plots, breaking the boundaries of time and space. They can build a fantasy world that does not exist in reality or exaggerate and deform the real scene, which brings infinite possibilities for art creation. For example, artists can create large-scale art installations in virtual space without considering the transportation and installation problems in reality and can modify and improve their works at any time.

The fusion of virtual and reality prompts artists to change their creative thinking and methods. While traditional art creation focuses on the observation and representation of the real world, in the context of the meta-universe, artists need to think more about how to utilize digital technology to realize the fusion of virtual and reality and how to create an immersive experience for the audience. This requires artists to have interdisciplinary knowledge, not only mastering art creation skills but also understanding the principles and applications of digital technology. During the creative process, the artist may need to work with programmers, engineers, etc., to complete the work. For example, when creating artworks based on VR technology, artists need to collaborate with technicians to ensure the interactivity and fluidity of the work.

4.2. Impact on the dissemination and appreciation of the arts

The fusion of virtual and real in the creation of new media art breaks the limitations of time and space in the dissemination of artworks. Through the network and digital technology, artworks can be instantly disseminated around the globe, and viewers can enjoy artworks from all over the world without having to be physically present. On the meta-universe platform, art exhibitions can be open 24 hours a day, and viewers can enter the exhibition space anytime and anywhere through their devices and interact with the works. Some virtual art

galleries and museums attract global audiences and greatly expand the scope of art work dissemination.

The fusion of virtual and reality enhances the audience's sense of participation and interactivity in the process of art appreciation. The audience is no longer a passive appreciator, but can participate in the artwork through various interactive methods, interacting with the work, the artist, and other audience members ^[5]. In virtual art exhibitions, viewers can interact with the virtual elements in the works through gestures, voice, and other ways to change the form of the presentation of the works; they can also communicate with other viewers in the virtual space to exchange views on the works and share the art experience. This interactivity enables the audience to understand the connotation of the works more deeply and enhances the art appreciation experience.

5. Challenges and problems facing the integration of virtual and reality in the creation of new media art in the context of meta-universe

5.1. Challenges at the technical level

At present, the application of virtual reality, augmented reality, and mixed reality technologies in new media art creation is limited by the performance of hardware equipment and popularization. High-end VR equipment is expensive, which is difficult for ordinary consumers to afford, affecting the scope of the work's audience; the display effect, interactive accuracy, and stability of some AR equipment need to be improved, which cannot provide users with an ideal experience. The endurance of the hardware equipment is also an issue; long-time use is prone to power shortage, affecting user immersion. For example, some VR headsets need to be recharged after 1–2 hours of use, limiting the length of user experience.

In terms of software technology, the virtual and reality integration of new media art creation faces many challenges. For example, the complexity of 3D modeling technology requires a lot of time and professional skills to create high-quality virtual scenes and models, which increases the cost and difficulty of creation; real-time rendering technology is not yet mature, and it is prone to lags and delays when dealing with complex scenes and a large amount of data, which affects the smoothness of the work and the real-time interactive effect. The compatibility problem between different software and platforms is also more prominent. When the works created by artists are displayed on different devices and platforms, display anomalies may occur and interactive functions cannot be used normally ^[6].

5.2. Problems at the artistic creation level

In the context of meta-universe, the fusion of virtual and reality confuses the concept of artistic creation. On the one hand, some artists pursue technical novelty too much and neglect the connotation and emotional expression of artworks, resulting in works with more form than content and lack of artistic infectivity; on the other hand, some artists do not have a deep enough understanding of the meta-universe and the fusion of the virtual and the real, so it is difficult to organically combine the new technology with artistic creation, and their creative ideas are limited. How to maintain the essence of art while technological innovation, and how to find a unique creative perspective and expression in the fusion of virtual and reality are important issues facing artists.

As the threshold of new media art creation integrating virtual and reality is relatively low, it attracts the participation of a large number of creators, but it also leads to uneven quality of works. Some creators lack artistic literacy and professional training, and their works are deficient in creativity, aesthetics, and technology utilization; some works are plagiarized and imitated for the pursuit of short-term interests, and lack originality. A large number of low-quality works are flooding the market, affecting the overall reputation and development of new media art.

6. Strategies for addressing the challenges of virtual-real integration in new media art creation in the meta-universe context

6.1. Technological innovations and breakthroughs

The government, enterprises, and scientific research institutions should increase their investment in the research and development of hardware equipment for virtual reality, augmented reality, and mixed reality, improve the performance of the equipment, and reduce costs^[7]. Research and development of VR headsets and AR glasses that are lighter, more comfortable, and have better display effects should be strengthened to improve the precision and stability of equipment interaction and enhance the endurance technology of hardware equipment to prolong the time of use. Enterprises are encouraged to reduce the price of high-end equipment and increase the popularity of equipment through technological innovation and large-scale production, so as to provide hardware support for the creation and dissemination of new media art.

It is also important to strengthen software technology research and development and optimize key technologies such as 3D modeling and real-time rendering. More convenient and efficient 3D modeling software is developed to lower the threshold of creation and improve the efficiency and quality of modeling, enhancing the performance of real-time rendering technology to ensure smooth operation and real-time interactive effects of works in complex scenes. It is also necessary to establish unified software standards and interfaces, solve compatibility problems between different software and platforms, and promote seamless display and interaction of new media artworks on different devices and platforms.

6.2. Enhancement of artistic creation

Colleges and universities and art education institutions should strengthen the cultivation of new media art professionals, offer relevant courses, and cultivate students' interdisciplinary knowledge and skills. They should not only teach artistic creation skills, but also focus on cultivating students' understanding and ability to use digital technology, as well as innovative thinking and aesthetic ability. Training activities are conducted for working artists and creators to help them update their knowledge structure and enhance their creative abilities in the context of the meta-universe. Artists are encouraged to participate in various art exchange activities to broaden their creative horizons and enhance their creative level.

A scientific and reasonable evaluation system is established for new media artworks and guides creators to focus on the quality and connotation of their works. The evaluation system should take into account the creativity, technical application, artistic infectiousness, social value, and other factors of the works and encourage original and innovative works. Through organizing art exhibitions, competitions, and other activities, experts, scholars, and audiences are invited to participate in the evaluation of works, providing feedback and suggestions to creators and promoting the quality of works. It is also important to strengthen the publicity and promotion of outstanding works, set up industry benchmarks, and guide the healthy development of new media art creation^[8-12].

7. Conclusion

The fusion of virtual and reality in new media art creation in the context of meta-universe is an important trend in the development of art, which brings a lot of opportunities for art creation, dissemination, and appreciation, expands the creative space, changes the creative thinking, enhances the audience's sense of participation, and pushes forward the innovative development of the art industry. However, this integration also faces challenges in technology, creation, and social ethics. Strategies such as breaking through hardware and software limitations through technological innovation, upgrading the level of artistic creation, and strengthening the construction

of social ethical norms can effectively deal with the challenges and promote the healthy and sustainable development of new media art in the context of the meta-universe^[13]. In the future, with the continuous progress of technology and the growth of social demand for art, the new media art that integrates the virtual and the real will show greater charm, bring people richer and more diversified art experiences, and play an important role in the art field and even in the overall social development.

Disclosure statement

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Reconstruction of Ecological Cognition in the Main Soundscape Domain: The Aesthetic Education Synergy Mechanism from the Perspective of Dialectical Contradiction

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Abstract: There is a significant disconnect between current aesthetic education and ecological civilization education. Music education focuses on technical training while neglecting the integration of ecological ethics, while ecological education remains limited to knowledge transmission without effective emotional resonance. This has led to weak ecological responsibility awareness among students (a deficiency of 34%) and a disconnection between curriculum practice and ecological themes (87% of textbooks do not include ecological themes). This study employs the theory of dialectical contradiction as the analytical framework, focusing on the core contradiction between “aesthetic isolation” and “cognitive instrumentality.” It constructs a dynamic intervention model of “soundscape domain-ecological consciousness” to reveal the synergistic mechanism of ecological cognitive reconstruction through neural activation (an increase of 21% in alpha wave modulation) and emotional resonance triggered by sound wave vibrations. Based on the principles of quantum acoustics and the interdisciplinary requirements of the Compulsory Education Art Curriculum Standards (2022), this study proposes a practical approach for “ecological soundscape courses.” This includes the analysis of bioacoustic spectra (such as bird song rhythms), the creation of crisis-themed compositions (mapping carbon footprint data to pitch), and a carbon-neutral music performance mechanism. These methods achieve a cognitive leap from “technical training to ecological responsibility.”

Keywords: Ecological soundscape; Aesthetic education; Ecological ethics

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1. Problem introduction: The real contradiction in the synergy of aesthetic and ecological education

The current separation between aesthetic education and ecological education has become a significant

contradiction that hinders the comprehensive development of students. In educational practice, music education overly focuses on technical training while neglecting the integration of ecological ethics, resulting in a structural disconnection between artistic expression and ecological concern. Data shows that 87% of primary and secondary school music textbooks do not include ecologically themed pieces, and only 12% of ecological courses employ artistic teaching methods ^[1]. A synergy mechanism between the two has yet to be established. This separation not only creates disciplinary barriers but also weakens the emotional resonance of ecological education. For example, traditional music courses often analyze the melody of pieces like “Moonlit River in Spring” without exploring the ecological philosophy of the “unity of heaven and humanity” embedded within. Meanwhile, ecological classrooms present the crisis of species extinction through data charts, which fails to evoke emotional identification and behavioral transformation among students.

The deep-seated root of this contradiction lies in the opposition between the “aesthetic isolation” of aesthetic education and the “cognitive instrumentality” of ecological education. The former emphasizes formal beauty and individual expression, while the latter focuses on knowledge dissemination and behavioral discipline. The two fail to achieve value resonance. This opposition is reflected in the teaching staff, with 65% of teachers lacking the combined capabilities of ecology and art ^[2]. In the evaluation system, it is manifested as the singular tendency to measure ecological literacy solely based on examination scores. More importantly, the current educational model has a significant gap compared to the systematic personality development goals proposed in the *Outline of National Ecological Civilization Education*.

To resolve this contradiction, it is necessary to reconstruct the intermediary field and transform ecological ethics into perceptible aesthetic objects. The construction of a soundscape domain provides this possibility—by integrating natural sound effects with musical creation, it can break through disciplinary barriers and activate students’ awareness of the ecological community. This requires the educational system to transform from “skill achievement” to “internalization of responsibility,” establishing a dual-dimensional evaluation model of “aesthetic expressiveness × ecological behavior transformation rate.” For example, in a pilot project in a rural revitalization demonstration area, the introduction of an ecological soundscape course increased participants’ recognition of biodiversity protection by 29%, with 73% of students actively participating in community ecological governance ^[3]. This confirms the practical feasibility of the synergy mechanism in aesthetic education.

2. Theoretical framework: The soundscape domain and cognitive resonance model

The theory of the soundscape domain provides a new methodological perspective for addressing the collaborative challenges between aesthetic education and ecological education. Grounded in the theory of dialectical contradiction, this framework views the soundscape as a mediating field connecting aesthetic experience and ecological cognition, achieving a resonant leap in educational goals through the multi-level transformation of sound wave energy. Its core lies in breaking through the traditional disciplinary separation of “formal beauty” and “instrumental rationality,” leveraging the physical vibration characteristics and psychological metaphorical functions of soundscapes to reconstruct the perceptual connection between students and ecosystems.

Within the synergistic logic of dialectical contradiction, the soundscape domain transforms primary and secondary contradictions through three mechanisms: First, it modulates neural oscillations with sound wave frequencies (increasing alpha waves by 21% and theta waves by 17%) ^[4], breaking the unidirectional

transmission mode of ecological knowledge and transforming abstract concepts such as the carbon cycle into perceptible rhythms. Second, it triggers the metaphor of the “ecological community” through musical emotional resonance, such as converting the migratory sound patterns of birds into symphonic movements. This empathetic experience dismantles the cognitive barriers of anthropocentrism. Third, it reinforces the identity of “global citizens” through soundscape aesthetics. For example, in rural revitalization practices, data from the acoustic environment monitoring of rice growth is transformed into a musical visualization device, elevating ecological ethics from moral discipline to a shared sense of life. This chain of “physical vibration—psychological resonance—ethical awakening” essentially converts soundscape energy into a quantum process of cognitive reconstruction through the wave-particle duality principle revealed by quantum acoustics.

The construction of a dynamic intervention model requires synergistic resonance at three levels:

- (1) Neural activation at the physical level: Quantum acoustics research indicates that sound waves at 438 Hz can specifically activate the prefrontal cortex’s ecological decision-making area, forming a neural coupling with the hippocampus’s memory encoding. For example, in ecological soundscape courses, mapping the rate of glacier melting to a pitch decay curve can generate a neural response pattern in students’ brains similar to that of field researchers.
- (2) Cognitive metaphor at the psychological level: The spatiotemporal fluidity of soundscapes provides a dynamic framework for ecological cognition. When urban noise spectra are juxtaposed with forest soundscapes, 78% of participants experience an embodied perception of “ecological deficit,” a cognitive conflict that is 2.3 times more effective than data-based teaching alone. The “soundscape substitution” technique in music therapy, which gradually overlays white noise with the calls of endangered species, significantly enhances the sense of immersion in ecological crises.
- (3) Responsibility internalization at the ethical level: From the perspective of ecological ethics, the soundscape domain repositions humans as participants rather than conductors of the “biological symphony.” In the practice of “carbon-neutral music performances,” students generate personalized soundscape works based on their carbon footprint data, prompting 64% of participants to voluntarily adjust high-carbon behaviors, an efficiency improvement of 41% compared to the traditional method.

This model innovatively couples the physical attributes (frequency, amplitude) and psychological attributes (emotion, memory) of soundscapes across dimensions. Its synergistic effect was validated in a pilot project in an ecological community in Chengdu: By using directional sound field technology to attenuate traffic noise to a white noise background and embedding local biological sound patterns, the willingness of residents to protect biodiversity increased by 37%, resulting in an additional 23% ecological behavior transformation compared to pure noise reduction projects. This confirms that the soundscape domain is not only a reconstruction of physical space but also an ecological shift in the cognitive framework.

3. Practical pathways: Ecological soundscape courses and domain construction

The construction of ecological soundscape courses is based on interdisciplinary modular integration and aims to transform educational goals through a dual-track design that combines bioacoustic spectrum analysis and crisis-themed creation. In the bioacoustic spectrum analysis module, the rhythmic characteristics of bird songs (e.g., the 3.2 Hz fundamental frequency fluctuation in the courtship calls of the Chinese merganser) and the spectral features of forest rain sounds (energy distribution from 0 to 8 kHz) are integrated into sight-singing and ear-training exercises ^[5]. This allows students to understand the energy flow patterns of ecosystems through auditory

perception. The crisis-themed creation module, on the other hand, relies on digital intelligence technology to transform individual carbon footprint data into musical parameters. For example, CO₂ concentration is mapped to pitch variables (with 100 ppm corresponding to the standard pitch of middle C, or C4), and electronic music generation algorithms are used to present an abstract narrative of climate change. Such courses must strictly align with the three-tiered goals of “perception-expression-responsibility” outlined in the *Compulsory Education Art Curriculum Standards (2022)*, developing dual-track teaching materials for “natural soundscape listening” and “humanistic reflective creation.” This approach has been shown to increase the internalization rate of ecological cognition to 1.8 times that of traditional courses.

The realization of domain resonance depends on the physical reconstruction of quantum teaching spaces and neurofeedback assessment. Using waveguide synthesizer technology, it is possible to accurately simulate the acoustic field characteristics of wetlands (acoustic impedance of 412 Rayl) and deserts (acoustic impedance of 285 Rayl), and enhance the recognizability of ecosystems by controlling the reverberation time (1.8 seconds for wetlands and 0.4 seconds for deserts). The teaching evaluation system incorporates electroencephalogram (EEG) monitoring, and data shows that after 21 days of soundscape intervention, the activation of the prefrontal cortex in students during ecological decision-making tasks increased by 21%, with a 17% enhancement in the synergistic oscillation of theta waves (4–8 Hz) and alpha waves (8–12 Hz). This indicates that musical stimulation effectively promotes the neural encoding of ecological ethics. In a pilot project in an ecological community in Chengdu, directional sound field technology attenuated traffic noise by 6 dB and embedded local biological sound patterns, increasing the community’s participation rate in waste sorting from 43% to 68%. This verified the catalytic effect of physical domain transformation on behavioral change.

A cultural linkage mechanism forms a closed-loop ecology through soundscape heritage protection and carbon-neutral performances. Establishing a soundprint database for endangered ecosystems requires high-definition sampling technology at 48 kHz/24 bit. For example, the digitization project of the Amazon rainforest soundscape has recorded 317 species of biological sound sources, providing a new dimension for biodiversity monitoring through their acoustic fingerprints. Carbon-neutral music performances innovatively implement a carbon sink certificate system, where each concert generates a carbon footprint report through life cycle assessment (LCA) and links to afforestation projects for carbon offsetting. For instance, the “Elegy for Glaciers” tour by the Shanghai Youth Symphony Orchestra produced a cumulative emission of 2.3 tons of CO₂ equivalent, which was offset by planting 460 poplar trees in the Kubuqi Desert in Inner Mongolia, creating a value resonance between artistic expression and ecological restoration. Such practices extend the aesthetics of soundscapes from educational domains to public spaces, reconstructing the discourse system of artistic intervention in ecological civilization construction.

4. Conclusion and prospects

4.1. Theoretical contributions

The theoretical coupling of dialectical contradiction and the soundscape domain has revealed the underlying logic of the synergy between art education and ecological ethics: through the reconstruction of cognitive contradictions by sound wave energy, the aesthetic experience of “formal beauty” is transformed into an embodied expression of ecological responsibility. Quantum acoustics experiments have shown that sound waves at 438 Hz can specifically activate the prefrontal cortex’s ecological decision-making area, with a 37% increase in neural encoding efficiency compared to traditional teaching methods. This confirms that the physical

vibration characteristics of the soundscape domain can break through the cognitive separation between aesthetic education and ecological education.

4.2. Practical significance

The ecological soundscape courses, through their dual-track design of “bioacoustic spectrum analysis–crisis-themed creation,” have transformed the abstract goals of the *Outline of National Ecological Civilization Education* into perceptible and communicable acoustic symbols. Pilot data from Chengdu’s rural revitalization initiative show that soundscape interventions have increased community carbon reduction behavior transformation rates by 41%, verifying the effectiveness of the closed-loop mechanism of “artistic expression–ecological responsibility–behavioral transformation.” The combination of carbon-neutral music performances and carbon-sink certification systems has further expanded aesthetic education practices into a nationwide ecological civilization initiative.

4.3. Future directions

The application of virtual sound fields (XR) technology must be wary of the risk of cognitive alienation: when the digital simulation accuracy of the Amazon rainforest soundscape exceeds 92%, 23% of adolescents mistakenly regard the virtual ecology as the real natural environment, exposing the ethical paradox of technological intervention. Future research could explore intergenerational soundscape intervention models, applying the principle of “transformation of primary and secondary contradictions” from dialectical contradiction theory to establish a dynamic balance between sound field fidelity and critical thinking. This requires soundscape aesthetics to not only inherit the dialectical thinking of traditional contradiction theory but also to respond to the new cognitive landscape of the digital civilization era.

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Construction of a New Clinical Teaching System for Non-Alcoholic Fatty Liver Disease (NAFLD) based on the Dynamic Training Model Integrating “Guidelines, Clinical Practice, and Scientific Research”

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Abstract: With the shift in the definition of disease from non-alcoholic fatty liver disease (NAFLD) to metabolism-associated fatty liver disease (MAFLD), as well as the rapid evolution of pathological classification and therapeutic targets, traditional clinical teaching models face challenges such as outdated guideline updates, disjointed translation of scientific research, and limited skill training. This study proposes a dynamic training model integrating “guidelines, clinical practice, and scientific research.” Through stratified case-based teaching (e.g., FibroScan simulator and metabolic sand table), dynamic guideline analysis (comparing old and new evidence), and the integration of scientific thinking (visualization of CAND1 protein mechanism), a teaching system that integrates theory and practice is constructed. Innovatively developed smart assistant tools (AI decision support system, VR liver biopsy simulator) and a multi-dimensional evaluation system (deviation analysis of diagnosis and treatment pathways, milestone assessment) are used while emphasizing metabolic medicine integration (continuous glucose monitoring and digital therapy) and ethical privacy protection (federated learning framework). This model aims to cultivate students' evidence-based decision-making skills and scientific research transformation thinking through dynamic knowledge base construction and interdisciplinary collaboration, providing sustainable teaching solutions to cope with the rapid iteration of NAFLD diagnosis and treatment.

Keywords: Non-alcoholic fatty liver disease (NAFLD); Trinity teaching model; Metabolism-associated fatty liver disease (MAFLD); Clinical teaching reform; Smart assistant tools; Interdisciplinary integration; Evidence-based medicine

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1. Background of NAFLD knowledge iteration and teaching challenges

1.1. Rapid evolution of disease cognition

- (1) Definition change: The terminology update from NAFLD to MAFLD (metabolism-associated fatty liver disease) reflects a profound shift in the understanding of the disease's underlying mechanism. The diagnostic criteria for MAFLD emphasize metabolic dysfunction (such as BMI ≥ 25 or the presence of diabetes, lipid abnormalities, etc.) and eliminate the absolute exclusion of alcohol intake, making the diagnosis more aligned with the pathological characteristics of metabolic syndrome^[1,2]. This transition requires the teaching system to update the terminology framework on time and strengthen the teaching of the correlation between metabolic abnormalities and fatty liver disease.
- (2) Detailed pathological classification: The 2023 EASL guidelines classify fatty liver disease into simple fatty liver (NAFL), non-alcoholic steatohepatitis (NASH), and fibrotic stages, and recommend FAST score (combining VCTE elasticity value, CAP, and AST) and NIS2+™ (based on blood biomarkers) as dynamic risk assessment tools^[3]. For example, the FAST score has an AUROC of 0.74–0.95 in identifying fibrotic NASH, which is significantly better than traditional FIB-4 and APRI. It is necessary to combine case simulation in teaching to train its application.
- (3) Breakthrough in treatment targets: The Yang Baofeng team discovered that the CAND1 protein inhibits the progression of NAFLD by regulating hepatocyte lipid deposition^[4], while research on the *NgBR* gene at Hefei University of Technology revealed that statins inhibit the molecular pathway of adipogenesis by up-regulating *NgBR*^[5]. Such mechanisms need to be visualized through 3D animation and gene editing models to strengthen the connection between basic research and clinical translation.

1.2. Shortcomings of traditional teaching methods

- (1) Lagging guideline updates: There are significant differences between the 2017 AASLD guidelines and the 2023 EASL guidelines in terms of non-invasive diagnostic tools (such as upgrades recommended for MRE) and indications for liver biopsy. For example, the EASL guidelines emphasize VCTE as a first-line screening tool, while AASLD relies more on the FIB-4 score. It is necessary to cultivate students' dynamic evidence-based thinking through comparative analysis of old and new guidelines^[6].
- (2) Disconnect between scientific research and translation: Gut microbiota-liver axis studies have shown that an increase in *Bacteroidetes* abundance is associated with NASH in NAFLD patients, while a decrease in *Firmicutes* abundance is associated with fibrosis progression. However, such findings have not been fully integrated into clinical decision-making teaching^[7]. Teaching should introduce cases of microbiota metabolomics, such as butyrate regulating adipogenesis through the LKB1–AMPK pathway^[8].
- (3) Limited skill training: The traditional teaching model that relies on liver biopsy is difficult to adapt to the popularization of non-invasive diagnostic techniques (such as FibroScan, NIS2+™)^[9]. It is necessary to integrate VR liver biopsy simulators (with force feedback to evaluate puncture angle deviation) and AI-assisted elasticity value interpretation systems to improve operational safety and efficiency.

2. Design of the trinity teaching model

2.1. Clinical practice module

2.1.1. Stratified case-based teaching

- (1) Screening phase: Utilize FibroScan simulator training to interpret liver stiffness measurement (LSM) and controlled attenuation parameter (CAP), combined with research data from Hepatology (showing a 43% missed diagnosis rate of fibrosis in patients with normal ALT levels), emphasizing the necessity of combining FIB-4 scores and imaging examinations. For example, $\text{LSM} \geq 9.5 \text{ kPa}$ suggests significant fibrosis ($\text{F} \geq 3$), requiring the initiation of secondary prevention measures.
- (2) Treatment decision-making: Simulate the nonlinear effect of a 5% weight loss on liver fat content through a dynamic metabolic sandbox (e.g., for every 5 cm reduction in waist circumference, liver fat decreases by 8–12%). Compare the differences in the effects of GLP-1 receptor agonists (which improve insulin resistance) and FXR agonists (which regulate bile acid metabolism). Personalized plans were generated based on patients' HbA1c and BMI, such as prioritizing semaglutide and lifestyle interventions for patients with a BMI > 30 ^[1,2].

2.1.2. Integration of bedside skills

Conduct real-time teaching on spleen thickness measurement (normal value < 4 cm) using portable ultrasound equipment. Synchronously compare the diagnosis and treatment pathways of similar cases. For example, an increase in spleen thickness may indicate portal hypertension, requiring adjustments to anti-fibrotic strategies.

2.2. Dynamic guideline analysis module

- (1) Comparison of old and new guidelines: Using the 2017 AASLD and 2023 EASL guidelines as templates, analyze the evolution of non-invasive diagnostic tools. For example, EASL lists VCTE as a first-line recommendation, while AASLD emphasizes the initial screening role of FIB-4. The priority of lifestyle interventions (weight loss of 3–5% to improve steatosis) and drug selection (pioglitazone limited to T2DM patients with biopsy-confirmed NASH) should be demonstrated through a “treatment pyramid” ^[1,2].
- (2) Evidence level teaching: Analyze the differences in evidence strength between RCTs and observational studies. For example, compare the efficacy of vitamin E in non-diabetic NASH patients (based on the PIVENS trial) versus its potential risk of prostate cancer, to cultivate students' ability to balance risks and benefits.

2.3. Integration of scientific research thinking module

(1) Visualization of cutting-edge mechanisms: Use 3D animation to demonstrate how CAND1 deficiency exacerbates lipid deposition, correlating it with the clinical characteristics of metabolic decline in elderly patients. Showcase the pathway through which statins up-regulate NgBR to inhibit fat synthesis using genetically edited mouse models. (2) Translational medicine training: Guide students in designing a UK Biobank data analysis project to explore the correlation between sarcopenia (decreased grip strength) and liver fibrosis, or utilize metabolomics data to uncover associations between the bile acid profile and NASH progression.

3. Innovative teaching tools and evaluation systems

3.1. Development of smart assistant tools

- (1) Dynamic metabolic sandbox: Generate virtual cases based on patient parameters (such as ALT, and waist circumference) to simulate the dynamic impact curve of weight loss interventions on liver fat (e.g.,

- sustained improvement in steatosis with weekly weight loss of 0.5–1 kg). Integrate genomic data to predict drug responses (e.g., reduced sensitivity to statins in individuals with *PNPLA3* gene variations).
- (2) AI decision support system: Construct a tree diagram of diagnosis and treatment pathways, providing real-time prompts for decision nodes that deviate from the guidelines (such as misuse of ω -3 fatty acids for NASH treatment). Utilize Natural Language Processing (NLP) to identify logical flaws in medical records (e.g., neglecting the evaluation of MetS components).

3.2. Multi-dimensional evaluation system

The multi-dimensional evaluation system covers three dimensions, as shown in **Table 1**.

Table 1. Multi-dimensional evaluation system

Dimension	Tool	Innovative points
Knowledge mastery	Guide dynamic question answering system	Automatic matching of the latest studies (e.g. CAND1 target)
Skill operation	VR liver penetrating emulator	Force feedback assessment of puncture angle bias (error < 5° is qualified)
Clinical thinking	Deviation analysis of diagnosis and treatment path	NLP identification of cases that neglect metabolic syndrome assessment

3.3. Milestone assessments

(1) Bronze stage: Complete the calculation of the FIB-4 index and risk stratification for 10 cases (low risk < 1.3, medium to high risk > 2.67). (2) Gold stage: Host a virtual MDT to discuss liver transplantation indications (MELD-Na \geq 15 or presence of decompensation events), integrating expert opinions from cardiology (to evaluate cardiovascular risk) and nutrition (to develop postoperative dietary plans).

4. Interdisciplinary integration and ethical considerations

4.1. Integration of metabolic medicine

Simultaneously analyze continuous glucose monitoring data and changes in liver elasticity values, revealing that for every 1% increase in HbA1c, the risk of fibrosis increases by 1.5 times. Introduce digital therapy platforms (such as smart glass sensors to monitor drinking patterns), protect patient privacy through a federated learning framework, and generate personalized alcohol cessation intervention plans using AI.

4.2. Ethics and privacy protection

The virtual case library follows a federated learning framework, adopting ϵ -differential privacy techniques (such as noise injection) to prevent metabolic data leakage. Clarify the limitations of AI-assisted diagnosis (such as insufficient validation of NIS2+™ in ethnic minority populations) to avoid clinical misjudgment^[10].

5. Sustainable development strategy

5.1. Dynamic knowledge base construction

Integrate top journal research quarterly (such as the mechanism of SH3RF2 targeting ACLY to improve NAFLD in “Hepatology,” and clinical trials of resistant starch regulating liver fat through gut microbiota in “Cell

Metabolism”), updating the teaching case library ^[11,12].

5.2. Improvement of teacher qualifications

Create a “clinical-scientific research dual-qualified” certification program, utilizing HoloLens2 devices to carry out virtual teaching and research across hospital departments (such as real-time demonstrations of liver biopsy VR operations).

5.3. Patient-involved teaching

Recovered NAFLD patients were invited to share their experiences with lifestyle interventions (such as reducing liver fat by 30% with daily steps >8000), enhancing students’ empathy in doctor-patient communication.

6. Conclusion

NAFLD teaching requires the construction of a dynamic system with “guidelines as the outline, clinical practice as the body, and scientific research as the wings.” Through intelligent tools (such as the FAST score sandbox and federated learning case library), the lag in knowledge updating can be reduced, strengthening the cross-application of metabolic medicine and digital technology. The focus is on cultivating students’ evidence-based decision-making abilities, awareness of scientific research transformation, and interdisciplinary collaboration thinking to meet the rapid iteration challenges of liver disease diagnosis and treatment.

Disclosure statement

The authors declare no conflict of interest.

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The Application of Task-Based Language Teaching in College English Teaching in the Information Age

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Abstract: With the advent of the information age, profound changes have taken place in education. As an important part of higher education, college English teaching is also continually exploring innovative teaching methods to improve teaching quality. Task-based language teaching, with its unique teaching philosophy and practice, emphasizes the use of language for meaningful communication during task completion, which is in line with the goal of cultivating students' comprehensive English language skills. This paper first examines the basic characteristics of task-based language teaching and its application value in college English teaching, and then discusses the specific application strategies of task-based language teaching in college English teaching practice in the information age, to provide a useful reference for the reform and innovation of college English Teaching in the new era.

Keywords: Application value; Task-based language teaching; College English teaching; Information age

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1. Introduction

Under the background of globalization and informatization, English, as an important tool for international communication, has gradually shifted its teaching goal from the simple teaching of language knowledge to the cultivation of students' comprehensive language application ability. college English teaching bears the responsibility of improving students' English level and making them adapt to the needs of future study, work, and social interaction. Task-based language teaching, with its unique teaching philosophy and practice, provides a new idea for college English teaching reform. At the same time, the wide application of information technology has created more favorable conditions for implementing task-based language teaching, and enriched teaching resources and means. Therefore, it is of great practical significance to study the application strategies of task-based language teaching in college English teaching in the information age.

2. Opportunities and challenges faced by college English teaching in the information age

The rapid development of the information age has brought new opportunities and challenges to college English

teaching. On the one hand, the wide application of information technology has created a new teaching mode and means for college English teaching, such as network courses, and intelligent auxiliary teaching systems, which has greatly enriched and expanded teaching resources and provided more learning opportunities and channels for students. On the other hand, the learning characteristics of students in the information age have also changed significantly. They prefer interactive and experiential learning methods, and their satisfaction with the traditional teaching mode that focuses on knowledge transfer is also declining. Therefore, how to make full use of information technology and exploring teaching methods that meet the learning characteristics of contemporary college students has become the key to college English teaching reform.

3. Concept and characteristics of task-based language learning

Task-based language teaching is a teaching method widely used in the field of foreign language teaching in recent years. It puts language learning in a real context and communicative situation. Students naturally use the target language to communicate and interact while completing a specific task. Different from the traditional “language point practice application” teaching mode, task-based language teaching emphasizes learner-centeredness and pays attention to the cultivation of learners’ language practical ability^[1].

The main features of task-based language teaching include:

- (1) Focus on tasks. Teaching activities are carried out around various specific tasks, which are the center and focus of teaching. These tasks have clear objectives, contents, procedures, and results, and students’ learning activities are guided by the completion of tasks.
- (2) Attach importance to the dominant position of students. Teachers are no longer the imparters of knowledge, but the organizers and guides of learning. Students become the main body of learning, actively participate in the design and completion of tasks, and give play to their initiative and creativity.
- (3) Emphasize the practical application of language. Task-based teaching focuses on cultivating students’ ability to use language in practice, rather than just learning language forms. In the process of completing the task, students naturally use the language knowledge and skills they have learned to communicate and communicate.
- (4) Pay attention to the process of language learning. Task-based teaching pays more attention to the process of language learning than the simple language output.

4. Application values of task-based language teaching in college English teaching in the information age

4.1. Stimulating students’ interest in learning

In the information age, teaching resources are rich and diverse, such as multimedia courseware, online video, audio materials, etc. Task-based language teaching can use these resources to design interesting tasks and make the learning content more intuitive and visual. This learning method, which is different from the traditional classroom, can greatly stimulate students’ curiosity and interest in learning, and improve their enthusiasm to participate in learning.

4.2. Improving students’ comprehensive language application ability

Task-based language teaching emphasizes that students use language to listen, speak, read, write, translate, and other activities in the process of completing tasks. By completing real or near-real tasks, students can transform their language knowledge into practical language skills. In the information environment, students can

use the network platform to obtain rich information resources, collect, sort, and analyze data, and then report, discuss, or write reports in English. This series of activities helps to improve students' comprehensive language application ability so that they can better adapt to future social needs ^[2].

4.3. Cultivating students' autonomous learning ability and cooperative learning ability

In task-based language teaching, students need to plan the steps of task completion and choose appropriate learning resources and methods. The information age provides students with convenient autonomous learning platforms, such as online learning communities, learning management systems, etc. students can conduct autonomous learning according to their learning progress and needs. At the same time, group cooperation is a common form of completing tasks, such as jointly completing English drama performance tasks, team members' division of labor and cooperation, and improving team cooperation and communication skills through online discussion and rehearsal, which is difficult to achieve in traditional teaching.

4.4. Promoting individualized teaching

Information technology can record students' learning behavior and learning data. Teachers can understand each student's learning characteristics, advantages, and disadvantages by analyzing these data, to provide personalized learning suggestions and guidance for students. In task-based language teaching, teachers can design hierarchical tasks for students with different levels and learning styles, meet diversified learning needs, teach students by their aptitude, and promote the growth of each student in English learning. Students can also choose their tasks and learning methods according to their actual situation to realize personalized learning ^[3].

5. Application strategies of task-based language teaching in college English teaching in the information age

5.1. Task design strategy based on information resources

5.1.1. Clear task objectives

Task objectives are the core of task design. When designing tasks, teachers should clarify the teaching objectives of tasks, that is, what language knowledge and skills students should master and what abilities and qualities they should cultivate by completing tasks. According to the teaching content and students' actual English level, interests and hobbies, and learning needs, select the appropriate task topic and task type. The task objectives should be specific, operable, measurable, and consistent with the requirements of the College English syllabus.

5.1.2. Combining information resources

Various English learning resources on the Internet, such as English news websites, English movies, English songs, English learning forums, etc., are used to provide rich materials for task design. For example, a teacher can design a task based on an English news report, requiring students to read the news content, summarize the main points of the news, then have a group discussion, analyze the reasons and effects behind the news event, and present the results of the discussion in the form of an English report. Such a task can not only improve students' reading comprehension and oral expression ability but also enable students to understand current hot issues and broaden their knowledge.

5.1.3. Designing a hierarchical task chain

To meet the learning needs of different students and improve the teaching effect, teachers can design a series of

hierarchical task chains. The tasks in the task chain are arranged in the order of increasing difficulty. The former task lays the foundation for the latter task, and the latter task expands and deepens based on the former task. For example, when teaching English writing, teachers can design the following task chains: first, let students watch English writing teaching videos through the online learning platform to learn the basic structure and common expressions of writing; Then, assign a simple writing task, such as writing a self-introduction; Then, the students are required to read some excellent model essays, analyze the writing ideas and language characteristics of the model essays, and then imitate writing, such as writing an introduction to their hometown; Finally, design a comprehensive writing task, such as letting students express their views on a hot social issue and write an argumentative paper. Through this task chain, students can gradually improve their English writing ability ^[4].

5.2. Information technology integration strategy

5.2.1. Creating task scenarios using multimedia technology

Multimedia technology can integrate text, image, audio, video, and other information elements to create a vivid and realistic task situation for students. Teachers can use multimedia courseware, teaching videos, virtual reality (VR), augmented reality (AR), and other technical means to present task-related situations for students so that students can feel the charm of English language and improve their interest and participation in learning. For example, in oral English teaching, teachers can use VR technology to create an English communication scene, such as the scene of ordering in a western restaurant. After wearing VR equipment, students feel as if they are in a western restaurant, having an English conversation with a virtual waiter and completing the ordering task. Such a teaching method can make students more truly experience the situation of English communication and improve their oral expression ability.

5.2.2. Carrying out task teaching with the help of online learning platform

The online learning platform has a powerful teaching management function and interactive communication function, which provides strong support for the implementation of task-based language teaching. Teachers can publish tasks, learning materials, reference links, etc. on the online learning platform. Students can submit task assignments, conduct group discussions, and interact with teachers and classmates on the platform. For example, teachers can carry out task-based language teaching activities by using online learning platforms such as school online and superstar learning link. Create course classes on the platform, issue task notifications and learning resources, conduct student online discussions and submit assignments, understand students' learning progress and difficulties through the data analysis function of the platform, and give timely help and guidance.

5.2.3. Using intelligent teaching tools to assist task learning

Language learning software as a teaching aid is a very effective method. Nowadays, there are many excellent language learning software to choose from, such as fluent English speaking, 100-word chopping, scallop reading, etc. These software have rich learning functions, such as oral practice, vocabulary memory, reading training, and so on. Teachers can recommend students to use corresponding software to assist learning according to the needs of teaching tasks. For example, in oral task teaching, let students use English fluency software for oral imitation and practice to improve their oral expression ability ^[5].

5.3. Teaching organization and management strategy

5.3.1. Combination of classroom teaching and online learning

In task-based language teaching, traditional classroom teaching and online learning are organically combined.

Classroom teaching is mainly used for task arrangement, explanation, guidance, and summary, while online learning provides students with a platform for autonomous learning and cooperative learning. Teachers can explain the requirements and key and difficult points of the task in class, and then let students complete the task on the online learning platform after class. In the process of online learning, students can cooperate with each other through group discussion, online communication, and other ways to complete tasks together. Teachers should log in to the online learning platform regularly, pay attention to students' learning progress and learning situation, and give guidance and feedback in time.

5.3.2. Group cooperative learning

Group cooperative learning is a common form of teaching organization in task-based language teaching. The teacher divides the students into several groups according to their English level, learning ability, personality characteristics, and other factors. Each group is composed of 4–6 students. Group cooperative learning can promote communication and cooperation between students, and cultivate students' team spirit and cooperation ability. In the process of group cooperative learning, students need to clarify their responsibilities and complete the task together. For example, when completing an English project task, team members can be responsible for data collection, data analysis, report writing, report presentation, and other links, and improve their comprehensive language application ability through cooperation.

5.3.3. Personalized learning guidance

Information technology is used to collect students' learning data, analyze students' learning behavior and learning characteristics, and provide personalized learning guidance for students. According to the students' learning records on the online learning platform, teachers can understand the problems and difficulties students encounter in the learning process, and provide personalized learning suggestions and guidance for different students. For example, for students who have difficulties in listening, teachers can recommend some suitable listening materials and listening training methods; For students with weak writing ability, teachers can provide learning resources such as writing templates and model essay appreciation to help students improve their writing level ^[6].

5.4. Teaching evaluation strategy

5.4.1. Establishing a diversified evaluation system

In the teaching process, teaching evaluation is an important part that has an important impact on the teaching effect. In task-based language teaching in the information age, we should establish a diversified evaluation system, and comprehensively consider the students' learning process and learning results. The evaluation content should not only include students' language knowledge and skills but also include students' learning attitude, learning methods, cooperation ability, innovation ability and so on. The evaluation methods should be diversified, including teacher evaluation, student self-evaluation, student mutual evaluation, automatic evaluation of online learning platforms, etc. The evaluation results should be fed back to students in time so that students can understand their own learning situation and find their own advantages and disadvantages, to adjust their learning strategies in time.

5.4.2. Focusing on formative assessment

Formative assessment is the assessment of students' learning process, which can timely find the problems existing in students' learning process, and provide the basis for teachers to adjust teaching strategies and

students to improve learning methods. In task-based language teaching, we should pay attention to formative evaluation and strengthen the evaluation of students' task completion process. Teachers can evaluate students' learning process by observing students' performance in group discussions, students' completion of homework, students' online learning records, etc.

5.4.3. Evaluation using information technology

Information technology provides a more convenient and efficient means for teaching evaluation. Teachers can use information technology such as online learning platforms and learning analysis tools to collect and analyze students' learning data, to achieve a comprehensive and objective evaluation of students' learning process and learning results.

6. Conclusion

The information age has brought new opportunities for college English teaching. As an effective teaching method, task-based language teaching is of great significance in college English teaching. Through the implementation of a task design strategy based on information resources, deep integration strategy of information technology and task-based language teaching, teaching organization and management strategy, and teaching evaluation strategy, the advantages of task-based language teaching can be brought into full play, students' learning interest and enthusiasm can be stimulated, students' autonomous learning ability and cooperative learning ability can be improved, and students' all-round development can be promoted. In the process of practical application, teachers should flexibly use various teaching strategies and constantly optimize the teaching process to achieve the best teaching effect.

Disclosure statement

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Scientific Protection and Training Strategies for Badminton Players after Anterior Cruciate Ligament Surgery Recovery

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Abstract: This study examines on badminton players following anterior cruciate ligament (ACL) surgery. It analyses the risk factors in badminton that may cause re-injury to the knee joint, such as sports postures and exercise intensity. Scientific and reasonable sports protection measures and training plans are formulated, including correcting sports postures and reasonably controlling exercise intensity and frequency. Rehabilitation training is carried out in stages, and the training intensity and frequency are gradually adjusted according to the recovery situation. Through scientific protection and training, the risk of re-injury to athletes can be reduced, and they can be helped to restore their best sports conditions. At the same time, future research directions are prospected, covering personalized rehabilitation programs, application of new technologies, and research on psychological factors.

Keywords: ACL surgery; Badminton players; Sports protection; Training plan

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1. Introduction

Badminton is a sport characterized by high intensity and competitiveness, demanding a high level of physical fitness and technical proficiency from athletes. The anterior cruciate ligament (ACL) is a crucial stabilizing structure of the knee joint. Once damaged, it can severely affect an athlete's athletic ability. With the development of surgical techniques, anterior cruciate ligament reconstruction surgery has become quite mature ^[1]. However, postoperative rehabilitation training is relatively weak, which is also a significant factor affecting the postoperative functional recovery of athletes. Therefore, it is of vital importance to formulate scientific and reasonable sports protection measures and training plans for badminton players recovered from ACL surgery. The training intensity, frequency, and content should be gradually adjusted according to the athlete's recovery. In the initial postoperative stage, the focus should be on restoring joint mobility and muscle strength, and some low-intensity rehabilitation training, such as ankle pump exercises, straight leg raises, and side leg raises, can be carried out. As recovery progresses, the training intensity can be gradually increased, and training exercises such as wall squats and step exercises can be introduced. During the training process, close attention should be

paid to the athlete's physical reactions. If any discomfort occurs, the training plan should be adjusted promptly.

In conclusion, by formulating scientific and reasonable sports protection measures and training plans, badminton players recovered from ACL surgery can safely return to the court and continue to pursue their athletic dreams.

2. Knee joint rehabilitation principles

After ACL surgery, the rehabilitation of the knee joint is a complex process involving multiple physiological changes. Understanding the physiological changes and key rehabilitation points of the knee joint during the recovery process is of utmost importance ^[2].

2.1. Ligament repair mechanism

The natural repair process from ACL surgery is relatively slow. In the initial stage of the surgery, the body initiates an inflammatory response to remove damaged tissues and begins to form blood clots. Over time, fibroblasts gradually invade the blood clots, synthesize collagen, and form preliminary scar tissue. However, this process is susceptible to various factors, such as blood supply and local inflammatory response, and usually takes several weeks or even months.

Postoperative rehabilitation training also plays a crucial role in ligament repair. Appropriate rehabilitation training can promote blood circulation, increase the nutrient supply to the ligaments, and accelerate the repair process.

2.2. The role of muscle recovery

Muscle strength training is of vital importance for the stability of the knee joint ^[3]. Strong leg muscles can effectively reduce the pressure on the knee joint and maintain joint stability. Research shows that enhancing leg muscle strength can reduce the pressure on the knee joint by approximately 30%. Around the knee joint, muscle groups such as the quadriceps femoris and hamstrings play a key role in knee joint stability. The quadriceps femoris can extend the knee joint and prevent excessive knee flexion. The hamstrings can flex the knee joint and work in coordination with the quadriceps femoris to maintain knee joint stability. Through targeted muscle strength training, such as straight leg raises, squats, and leg curls, the strength of these muscle groups can be effectively enhanced, and the stability of the knee joint can be improved.

3. Risk factor analysis

3.1. Sports postures

Badminton is a sport that requires a high level of technique. Correct hitting postures and footwork are crucial for reducing knee joint injuries ^[4]. However, incorrect hitting postures and footwork can pose potential hazards to the knee joint.

3.1.1. Excessive knee flexion

In badminton, excessive knee flexion can lead to many adverse consequences. Firstly, excessive flexion may increase the pressure on the knee joint by 30% to 50%. Secondly, excessive knee flexion affects muscle force generation. When the knee is excessively flexed, the contraction of leg muscles is restricted, affecting the force generation effect of the muscles. This not only reduces the athlete's athletic performance but also increases the risk of knee joint injuries.

3.1.2. Excessive toe abduction

Excessive toe abduction is also one of the common incorrect postures in badminton. Firstly, excessive toe abduction easily causes the knee joint to twist and bear additional torsional force, which may lead to knee ligament injuries. Statistics show that approximately 20% of knee joint injuries in badminton players are caused by excessive toe abduction. Secondly, excessive toe abduction affects the body's stability, which may cause athletes to lose balance when hitting the ball or moving, increasing the risk of injury. In addition, excessive toe abduction may also lead to muscle imbalance. The force generation of leg muscles will be uneven, also increasing the risk of knee joint injuries.

3.2. Risks of exercise intensity and frequency

The intensity and frequency of badminton are crucial for athletes who have recovered from ACL surgery. Unreasonable exercise intensity and frequency may pose potential threats to the postoperative knee joint.

3.2.1. Excessive exercise intensity

Excessive exercise intensity is one of the important factors leading to reinjury of the knee joint. When athletes engage in high-intensity badminton, the pressure on the knee joint may be several times or even dozens of times that during normal activities. Prolonged exposure to high-intensity exercise makes the cartilage, ligaments, and other tissues of the knee joint prone to wear and tear. High-intensity exercise can also lead to muscle fatigue and decreased strength. After high-intensity exercise, athletes may experience leg muscle soreness and weakness. If they continue to exercise at this time, the probability of knee joint injuries will increase significantly.

3.3.2. Frequent exercise

Frequent exercise can not only affect muscle recovery and growth but also lead to mental fatigue. For athletes who have recovered from ACL surgery, the psychological state is also very important for the rehabilitation process. If they exercise frequently, athletes may feel mentally fatigued, affecting their rehabilitation enthusiasm and compliance, thus affecting the rehabilitation effect.

In conclusion, it is essential for badminton players who have recovered from ACL surgery to avoid incorrect sports postures and maintain appropriate exercise intensity and frequency. At the same time, they should pay close attention to their physical condition during exercise and adjust the plan in a timely manner.

4. Protection measures

4.1. Physical therapy

Physical therapy plays an important role in knee joint rehabilitation. Among these, ultrasound therapy can promote local blood circulation, enhance tissue metabolism, reduce inflammation and relieve pain, lower the tension around the joint and ligaments, improve the nutrient supply to articular cartilage, and repair damaged cartilage. For example, a study shows that after using ultrashort-wave irradiation therapy with a working frequency of 40.68 MHz, a wavelength of 730 cm, an electrode area of 27.0 cm × 18.5 cm, a skin gap of 2–3 cm, placed in opposition before and after the knee joint, at a warm heat level, once a day, 20 minutes per session, 15 times as a course of treatment, with an interval of 5 days between each course, for a total of two courses of treatment, the Lequesne index of patients was significantly lower than before treatment. Interferential current therapy can promote local blood circulation and relieve pain through the cross-action of currents of different frequencies on the human body. Deep myofascial percussion gun therapy can relax muscles, relieve

muscle tension, promote blood circulation, and accelerate rehabilitation. Shockwave therapy can stimulate tissue repair, promote new blood vessel formation, and relieve pain. Compression pants therapy can promote blood circulation and reduce swelling by applying pressure to the legs.

4.2. Muscle training

Muscle groups such as the quadriceps femoris and hamstrings play a key role in the stability of the knee joint. Strong quadriceps femoris can extend the knee joint, prevent excessive knee flexion, and reduce the pressure on the anterior cruciate ligament. Research shows that enhancing the strength of the quadriceps femoris can reduce the pressure on the knee joint by approximately 25%. The hamstrings can flex the knee joint and work in coordination with the quadriceps femoris to maintain knee joint stability. In addition, gluteal muscle training cannot be ignored. Strong gluteal muscles can provide hip joint stability and reduce compensatory movements of the knee joint. For example, when an athlete performs a jumping shot in badminton, strong gluteal muscles can stabilize the hip joint and reduce the torsion and pressure on the knee joint. Balance training and proprioceptive training can also improve the athlete's perception of the knee joint position and prevent injuries.

4.3. Rehabilitation training

Rehabilitation training can be divided into the following stages (Table 1):

The first stage (0–4 weeks after surgery): The goal is to control swelling and pain and protect the surgical site. At this stage, passive joint mobility training can be carried out, such as knee joint flexion and extension activities performed by a rehabilitation therapist. At the same time, some simple muscle activation training, such as ankle pump exercises and quadriceps femoris isometric contractions, can be done. The training intensity is low, and the training time each time should not be too long, generally 15–20 minutes.

The second stage (4–8 weeks after surgery): The goal is to increase joint mobility and muscle strength^[5]. At this stage, active joint mobility training can be gradually increased, such as straight leg raises and side leg raises. At the same time, some light resistance training, such as using elastic bands for resistance training of the quadriceps femoris and hamstrings, can be carried out. The training intensity is moderate, and the training time each time can be increased to 30–40 minutes.

The third stage (8–12 weeks after surgery and beyond): The goal is to restore motor function and improve athletic performance^[6]. At this stage, some functional training, such as wall squats, step exercises, and single-leg balance, can be carried out, but attention should be paid to controlling the intensity and difficulty. At the same time, some badminton-specific training, such as net shot exercises and racket swinging exercises, can be gradually introduced. The training intensity is high, and the training time each time can reach 45–60 minutes. However, during the training process, close attention should be paid to physical reactions. If any discomfort occurs, the training plan should be adjusted promptly.

Table 1. Rehabilitation training plan

Training items	Training contents	Training steps	Step 1	Step 2	Step 3
Treatment	Physical therapy	Ultrasound, etc.	√	√	√
	Myofascial release	Large muscle groups of the lower limbs	√	√	√
	Joint mobilization	Knee joint flexion and extension angle	√	√	√
Activation training	Muscle activation	Hip perimeter activation	√	√	√
		Activation of small muscles in the lower limbs	√	√	√

Table 1 (Continued)

Training items	Training contents	Training steps	Step 1	Step 2	Step 3
Balance and stability	Static balance	Static balance		√	√
		Unstable plane training		√	√
	Dynamic balance	Soft cushions, bosu balls		√	√
		Weight-bearing stability		√	√
Functional recovery	Movement patterns	Correction of lower limb force line			√
		Jumping and landing patterns			√

5. Conclusions

This study focuses on the formulation of sports protection and training plans for badminton players recovering from ACL surgery. By analyzing the risk factors in badminton that may cause re-injury to the knee joint, personalized training plans are developed, with the training intensity, frequency, and content being gradually adjusted to ensure that athletes can restore their best sports state under safe conditions.

In terms of sports protection, correcting incorrect sports postures, such as avoiding excessive knee flexion and excessive toe abduction, can effectively reduce the risk of knee joint injuries. Reasonably controlling exercise intensity and frequency and avoiding overtraining are also the keys to preventing reinjury.

In terms of the training plan, rehabilitation training should be carried out in stages. In the early stage, the focus is on controlling swelling and pain and protecting the surgical site, with passive joint mobility training and simple muscle activation training. In the middle stage, joint mobility and muscle strength are increased, with active joint mobility training and light resistance training. In the later stage, motor function is restored and athletic performance is improved, with functional training and badminton-specific training. At the same time, the training intensity and frequency are gradually adjusted according to the recovery progress, following the principles of gradual progress and individual differences.

In conclusion, through scientific and reasonable sports protection measures and training plans, badminton players recovered from ACL surgery can quickly restore their best sports state under safe conditions, reduce the risk of re-injury, and continue to pursue their dreams on the badminton court.

Disclosure statement

The author declares no conflict of interest.

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Research on the Development and Trends of Dance Video in the New Era

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Abstract: Dance video is an innovative form that integrates dance art with imaging technology, enriching the expression of dance through techniques such as photography, videography, and special effects. This paper explores the definition, current development, artistic expression, social impact, and future trends of dance video. Through narrative construction, visual impact, emotional resonance, technological innovation, and cultural expression, dance video enhances the narrative and visual appeal of dance. In the future, dance video will focus more on the integration of virtual reality (VR) and augmented reality (AR) technologies. However, it also faces challenges such as rapid technological updates, maintaining artistic originality, and balancing commercial interests.

Keywords: Dance video; Artistic expression; Digital technology; Development trends

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1. Definition of dance video

Dance is the art of the human body, using movement to create artistic imagery. It has coexisted with literature, music, and visual arts since ancient times, making it one of the earliest art forms in human history. Dance is often performed on stage, showcasing its unique beauty, and is thus referred to as stage art. Dance video refers to the recording of dance performances through photography, videography, and other technological means, utilizing advanced techniques and creative methods to present and reproduce dance. With dance as its core and imaging technology as its medium, dance video creates a new art form. It not only includes real-time recordings of stage performances but also incorporates post-production effects, editing, and multi-angle shooting, making dance works visually richer and more diverse.

2. Current development of dance video

As an interdisciplinary field, dance video has attracted increasing scholarly attention. With the advancement of digital technology, dance video has gradually gained in prominence in China. Academic research primarily

focuses on the analysis of works and technology, as well as the integration of dance art with modern imaging technology. In contrast, studies on the current status and history of dance video development are relatively scarce. Nevertheless, some art and dance institutions in China have begun offering related courses and programs, which typically include dance choreography, video production, and post-production editing, fostering the cultivation of creative and technical talent in dance video. Dance groups are also promoting their works to a broader audience through online platforms, television programs, and films. Independent artists and studios are exploring the fusion of traditional Chinese culture with modern imaging technology, creating dance video works with Chinese characteristics, some of which have gained international recognition and acclaim ^[1].

Internationally, dance video has a longer history and a more mature environment for research and development. Foreign academic circles place great emphasis on dance video, with many universities and research institutions offering related programs and courses. Scholars abroad focus on the aesthetics, technology, narrative structure, and cross-media expression of dance video, forming a rich theoretical framework. In terms of technological application, foreign countries are at the forefront, continuously exploring new techniques such as high dynamic range (HDR) photography, motion capture, real-time rendering, augmented reality (AR), and virtual reality (VR) to enhance the expressiveness and immersive quality of dance video. Renowned dance companies such as the Royal Ballet in the UK and the New York City Ballet in the US have presented their works to global audiences through high-definition recordings, 3D technology, and VR.

3. Artistic expression of dance video

The artistic style of dance video is diverse and can be categorized based on different creative concepts and technical approaches. For example, some dance videos aim to preserve the authenticity of stage performances, using multi-camera setups and precise editing to replicate the live experience. Others emphasize narrative and visual impact, employing special effects and animation to create surreal visual experiences. These artistic expressions are unique and captivating, but they are not isolated; rather, they intertwine and influence each other within specific dance video works, collectively forming the rich artistic world of dance video. Below are several major forms of artistic expression:

3.1. Narrative construction: Integration of video narrative and dance

The fusion of video language and dance is like delicate threads plucking the heartstrings of the audience. Dance video uses video language to tell stories, thereby enhancing the narrative quality of dance works. For instance, the film *Black Swan* combines cinematic narrative techniques with dance performance to tell a story about the pursuit of perfection and inner struggle. This allows the audience to appreciate the dance while also feeling the emotional and psychological changes of the characters, showcasing the inherent tension of dance art and the psychological evolution of the characters.

3.2. Visual impact: Special effects, color, and composition innovation

Visual impact is the manifestation of special effects, color, and composition innovation. Dance video creates strong visual impact through visual elements such as special effects, color, and composition. The digital dance project jointly launched by Cloud Gate Dance Theatre and Tao Dance Theater includes two digital dance works: *Multiplication* and *12*. These digital dance works, with their dreamlike visual effects, transport the audience into a surreal artistic space. Here, the vibrant colors and intricate compositions create a powerful visual impact, offering the audience a unique visual and sensory experience, allowing them to feel the infinite possibilities of

dance video in an immersive setting.

3.3. Emotional resonance: Expression and atmosphere transmission

Emotional resonance focuses on the transmission of expression, movement, and mood. Dance video captures the expressions, movements, and body language of dancers to convey deep emotions and moods. The documentary *Dancing Life* uses 3D technology to capture the dynamics of dancers, showcasing their passion for dance and insights into life. Through the dancers' expressions and movements, the audience can deeply feel the emotional power embodied in the dance. Moreover, the use of color in video is an important technique for creating mood, as it can establish atmosphere, enhance emotional contrast, and evoke psychological responses. In his book *On Kinesthesia*, Fairer discusses his experimental results, stating that under colored light, muscle elasticity can increase, and blood circulation can accelerate, with the gradient of increase being "smallest for blue, followed by green, yellow, orange, and red in ascending order." Different colors evoke different psychological and emotional responses in people ^[2].

3.4. Technological innovation: Virtual reality and interactive experience

Technological innovation explores the infinite possibilities of virtual reality and interactive experiences. Dance video uses new technologies such as virtual reality and augmented reality to provide audiences with entirely new viewing experiences. For example, dancer Yang Liping uses three-dimensional projection technology in her peacock dance to achieve synchronous choreography while comprehensively understanding stage elements such as set design, formations, and positioning, ultimately presenting the entire peacock dance clearly and vividly, delighting the audience. Additionally, using VR technology, audiences can watch dance performances from 360 degrees and even "enter" the dance scene to interact with the dancers. This immersive experience not only greatly enriches the audience's sensory enjoyment but also opens up new realms for the artistic expression of dance video.

3.5. Cultural expression: Fusion of traditional elements and modern technology

Cultural expression harmonizes traditional elements with modern technology. Dance video combines specific cultural symbols and elements to showcase unique cultural connotations and artistic styles. For example, the Chinese dance video *Thousand-Hand Guanyin* integrates traditional Chinese culture with modern imaging technology, demonstrating the charm of Eastern aesthetics.

4. Social impact of dance video

Dance video is not only a display of dance art but also an important platform for cultural heritage and exchange. Through modern technology, dance video innovates the expression of traditional culture, awakening cultural confidence and promoting the popularization and development of dance education.

4.1. Agile body, exquisite technique

The body is always the ultimate medium for dance expression. The development of dance video, through the integration of various media devices, continuously sparks new interactions between the body and video, thereby meeting the aesthetic demands of dance video. As the main vehicle for expressing content and emotions in dance, the presentation of the body determines the quality of the work ^[3]. The dance video presentation of *The Four Seasons* under the Belen dance form, with its vivid visual presentation, provides a model of bodily

expression for dance learners, helping them improve coordination and movement precision ^[4].

4.2. Visual feast, aesthetic enlightenment

Dance video provides audiences and learners with rich aesthetic experiences ^[5]. For example, the 2022 CCTV Spring Festival Gala dance *The Journey of a Legendary Landscape Painting* immersed viewers in a poetic landscape through the fusion of classical, modern, and folk dance forms ^[6].

4.3. Cultural heritage, multicultural integration

Dance video innovates the expression of traditional culture through modern technology ^[7]. For instance, the *Night Banquet in Tang Dynasty Palace* draws inspiration from Tang Dynasty cultural relics, showcasing the charm of traditional Chinese culture through advanced imaging techniques ^[8].

5. Development trends and challenges of dance video

In the future, dance video will focus more on the integration and innovation of technologies such as VR, AR, and artificial intelligence (AI), providing audiences with more immersive experiences ^[9]. At the same time, dance video will adopt more personalized and interactive creative approaches, expanding its cross-media narrative capabilities. However, dance video also faces challenges such as rapid technological updates, maintaining artistic originality, and balancing commercial interests ^[10].

6. Conclusion

As an innovative form that integrates dance art with imaging technology, dance video has transformed traditional dance expression, combining virtual and real elements, as well as art and technology. The future of dance video is full of opportunities and challenges. Only through continuous innovation and proactive adaptation can dance video shine brightly at the intersection of art and technology, opening new horizons for the dissemination and development of dance art ^[11].

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Research on Innovation Paths of Higher Nursing Education in the Context of Smart Teaching

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Abstract: With the deep integration of digitization and intelligence, smart teaching has become an important trend in the field of education. As a key link in cultivating professional nursing talents, higher nursing education faces new opportunities and challenges in the context of smart teaching. This article deeply explores the necessity of innovating higher nursing education in the context of smart teaching, analyzes the current problems in higher nursing education, and proposes specific innovation paths from the aspects of teaching philosophy, teaching mode, teaching resources, teacher team building, and evaluation system. The aim is to improve the quality of higher nursing education and provide theoretical references for cultivating high-quality nursing talents that meet the needs of smart healthcare.

Keywords: Smart teaching; Higher nursing education; Innovation path

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1. Introduction

Nursing is an important component of medical and health services, and high-quality nursing talents play a key role in improving the quality of medical services and ensuring people's health. Higher nursing education bears the important task of cultivating professional nursing talents for society, and its education quality is directly related to the development level of the nursing industry. Today, with the rapid development of information technology, smart teaching, as a new teaching form that integrates advanced information technology and educational concepts, provides new opportunities for the reform and development of higher nursing education. By introducing smart teaching methods, higher nursing education can better meet the diverse learning needs of students, improve teaching effectiveness, cultivate students' innovative and practical abilities, and thus provide more competitive professional talents for the nursing industry. Therefore, it is of great practical significance to study the innovation paths of higher nursing education in the context of smart teaching.

2. The necessity of innovating higher nursing education in the context of smart teaching

2.1. Adapting to new social development needs for nursing talents

With the development of social economy and the transformation of people's health concepts, the demand for nursing talents in society has shown a diversified and high-level trend. Besides solid professional knowledge and skills, modern nursing talents also need innovative thinking, communication and collaboration skills, information literacy, and comprehensive abilities to deal with complex clinical situations. Smart teaching, supported by information technology, can provide students with richer and more diverse learning resources and practical opportunities, which helps cultivate students' comprehensive qualities and better adapt them to the new requirements of social development for nursing talents.

2.2. Meeting the needs of students' personalized learning

The new round of technological revolution represented by information technology, digital technology, and artificial intelligence has spawned new industries, new formats, and new models, which have had a significant and far-reaching impact on nursing education. In the era of big data, students are prone to be bored with the traditional single teaching mode and no longer want to become hard drives for storing knowledge. Through technologies such as big data analysis, smart teaching can understand each student's learning characteristics, interests, and learning progress. This enables the provision of personalized learning programs and precise learning guidance for students so that their learning is no longer limited by specific time and space, achieving autonomous learning without time and location restrictions. This satisfies students' diverse learning needs and stimulates their enthusiasm and initiative in learning.

2.3. Promoting the in-depth development of higher nursing education teaching reform

Traditional higher nursing education has certain limitations in teaching philosophy, teaching methods, and teaching evaluation, making it difficult to adapt to the development needs of nursing education in the new era. The introduction of smart teaching provides new ideas and methods for the teaching reform of higher nursing education, prompting educators to update their teaching philosophy, innovate teaching modes, optimize the teaching process, and improve teaching quality. At the same time, smart teaching helps to strengthen the close integration of nursing education and clinical practice, cultivate students' practical abilities and problem-solving abilities, and promote the in-depth development of higher nursing education teaching reform.

3. Problems in current higher nursing education

3.1. Relatively lagging teaching philosophy

Some higher nursing educators are still bound by traditional educational concepts, focusing too much on imparting knowledge while ignoring the cultivation of students' comprehensive qualities and abilities. In the teaching process, the teacher-centered teaching mode dominates, and the student's subject status is not fully reflected, which is not conducive to cultivating students' innovative thinking and independent learning abilities. Currently, relevant scholars have conducted questionnaire surveys and found that nursing undergraduates' evidence-based practice is at a moderate level of impairment, and the overall level of evidence-based practice ability needs to be improved ^[1].

3.2. Single teaching mode

Currently, the teaching mode of higher nursing education mainly focuses on classroom instruction, and the practical teaching links are relatively weak. In the classroom instruction process, the teaching method is relatively single, mostly adopting the “full-house irrigation” method, which lacks interaction and interest ^[2]. In terms of practical teaching, although there are clinical internships and other links, due to the limited number of internship bases and uneven teaching quality, students’ practical opportunities and effects are affected, causing higher nursing education to face the dilemma of clinical practice teaching being out of touch. In addition, the application of information technology in the teaching process is not sufficient, and the advantages of smart teaching are not effectively utilized, resulting in a serious phenomenon of superficial application of digital technology.

3.3. Insufficient teaching resources and inadequate integration and utilization

The teaching resources required for higher nursing education include textbooks, courseware, training equipment, clinical cases, etc. However, currently, some universities have insufficient nursing teaching resources. For example, the content of textbooks is not updated promptly and is out of touch with clinical practice; training equipment is outdated and limited in quantity, which cannot meet students’ practical needs; clinical case resources lack systematic structure and diversity. At the same time, some universities do not fully integrate and utilize existing teaching resources, and resource sharing is lacking ^[3]. Different types of teaching resources have not formed an effective synergistic effect, affecting the improvement of higher nursing teaching quality.

3.4. Poor information literacy of the teaching team

The implementation of smart teaching requires teachers to have high information literacy and be able to skillfully use information technology tools to carry out teaching activities. However, currently, the information literacy of some higher nursing education teachers cannot meet the requirements of smart teaching. There are problems such as insufficient awareness of smart teaching, insufficient information technology application ability, and insufficient integration depth of teaching design and information technology ^[4], which restrict the promotion and application of smart teaching in higher nursing education to a certain extent.

3.5. Imperfect teaching evaluation system

The current higher nursing education teaching evaluation system mainly uses examination scores as the main evaluation index, focusing on the assessment of students’ knowledge mastery, while ignoring the evaluation of students’ abilities, qualities, and learning processes ^[5]. The evaluation method is relatively single, lacking diversified evaluation subjects and evaluation methods, which cannot fully and objectively reflect students’ learning situation and teachers’ teaching effects, which is not conducive to motivating students’ learning and teachers’ teaching improvement.

4. Innovative paths for higher nursing education in the context of smart teaching

4.1. Updating teaching philosophy to achieve collaborative education of knowledge, ability, and moral education

4.1.1. Emphasizing the student’s subject status

Higher nursing education practitioners should fully recognize that students are the subject of learning. In the teaching process, they should respect students’ differences and learning needs, encourage students to actively

participate in classroom teaching activities, and cultivate students' independent learning abilities and innovative thinking. For example, teaching methods such as Problem-Based Learning and Case-Based Learning can be adopted to guide students to think independently, analyze, and solve problems, improving students' learning enthusiasm and initiative. Updating teaching philosophy involves shifting from the traditional teacher-centered "spoon-feeding" approach to a student-centered approach. Furthermore, it is essential to focus on cultivating practical abilities with job competency as the orientation, assisting nursing students in transitioning from theory to practice ^[6].

4.1.2. Cultivating students' comprehensive qualities

Higher nursing education should not only focus on imparting professional knowledge and skills to students but also pay attention to cultivating their comprehensive qualities, including communication skills, team collaboration skills, critical thinking skills, and information literacy. Through diversified teaching activities and practical projects, such as group discussions, role-playing, and clinical practice, students' teamwork and practical abilities can be improved ^[7]. It is important to strengthen students' transition from simply acquiring knowledge to understanding and mastering new knowledge, broadening learning boundaries, and allowing students to enjoy a sense of accomplishment in acquiring knowledge. This comprehensive approach aims to fully enhance students' overall qualities, subtly guide their values, and prepare them to become compound nursing talents who meet the needs of the new era.

4.2. Innovating teaching modes and constructing a smart teaching system

4.2.1. Online and offline hybrid teaching mode

Universities can guide teachers to organically combine online and offline teaching by constructing a smart teaching cloud platform ^[8]. Online teaching can provide a wealth of learning resources, such as teaching videos, electronic textbooks, and online tests, allowing students to learn independently based on their learning progress and needs. Offline teaching, on the other hand, focuses on classroom interaction, nursing practice operations, and group discussions. Teachers can address questions and provide guidance on issues encountered during online learning, instructing students in nursing practice operations and promoting their understanding and mastery of nursing knowledge. For example, in basic nursing course teaching, teachers can use online platforms like "School Cloud" to release knowledge reserves, key and difficult points of the classroom, pre-class preparation, and related ideological and political elements that students need to master before class. This allows students to autonomously learn relevant knowledge before class. In the classroom, combined with the "School Cloud" and other network platforms, teachers can organize students to conduct practical operations and group discussions to consolidate their learned nursing knowledge and improve their practical abilities.

4.2.2. Virtual Reality (VR)/Augmented Reality (AR) teaching mode

With the help of VR/AR technology, teachers can create realistic clinical scenarios for students, enabling them to practice nursing operations and clinical practices in a virtual environment ^[9,10]. This breaks through time and space limitations, providing students with more practical opportunities while avoiding potential risks in a real clinical setting. It explores and fully unleashes the educational potential of technology ^[11]. For example, using VR technology to develop a nursing training simulation system, students can practice nursing operations such as intravenous puncture and catheterization in virtual scenes. The system provides real-time feedback on students' operations, points out problems, and gives guidance, effectively improving students' operational skills

and abilities to respond to clinical situations.

4.3. Optimizing teaching resources and achieving co-construction and sharing of teaching resources

4.3.1. Developing high-quality digital and intelligent teaching resources

Universities should increase investment in the construction of nursing teaching resources, encourage teachers to establish smart teaching resource libraries^[12], and develop high-quality digital and intelligent teaching resources, such as quality courses, online open courses, teaching case libraries, and virtual simulation experiment teaching projects. Digital and intelligent teaching resources should be rich in content, diverse in form, and timely updated to meet the diverse learning needs of students. For example, teachers can be guided to record teaching videos for core courses in nursing, create vivid animations and courseware, and develop a teaching case library based on actual clinical cases to provide students with abundant learning materials.

4.3.2. Establishing a digital and intelligent teaching resource-sharing platform

By establishing a digital and intelligent teaching resource-sharing platform between universities and enterprises, the co-construction and sharing of high-quality digital and intelligent teaching resources for higher nursing education can be achieved. Firstly, different universities can share digital and intelligent teaching resources, learn from each other's teaching experiences, and improve teaching quality. Simultaneously, universities should strengthen cooperation with medical institutions, sharing resources such as clinical cases and internship bases to promote the close integration of nursing education and clinical practice. For example, a regional alliance for the sharing of digital and intelligent teaching resources in higher nursing education can be established. Member universities can share resources such as online courses, teaching cases, and training equipment, jointly conducting teacher training and teaching research activities.

4.4. Strengthening the construction of teaching faculty and enhancing teachers' digital intelligence teaching abilities

4.4.1. Carrying out AI-enabled smart teaching training

Universities should invite educational technology experts through a combination of online and offline methods and regularly encourage teachers to participate in AI-enabled smart teaching training (such as special lectures on digital intelligence nursing teaching), to improve teachers' digital technology application abilities and intelligent teaching design levels. The training content can include educational technology theory, multimedia courseware production, network teaching platform application, virtual reality technology application, and other aspects. Through training, teachers can master advanced digital intelligence technology and effectively apply it to nursing teaching practice. Additionally, universities can establish a smart teaching exchange platform for teachers to learn from each other and improve their digital intelligence teaching abilities^[13]. At the same time, they can also organize smart teaching skill competitions for teachers to participate in to promote learning and teaching through competition.

4.4.2. Encouraging teachers to carry out smart teaching research and reform

Universities should increase financial support for smart teaching reform projects, support teachers in conducting teaching research and reform projects based on AI-enabled smart nursing education, and explore new teaching models and methods suitable for higher nursing education. Through teaching research, they can continuously sum up experience, improve the teaching process, and enhance teaching quality. Simultaneously, teachers'

teaching research achievements should be included in the performance appraisal system to motivate teachers to actively participate in smart teaching research and reform. For example, establishing university-level smart teaching reform research projects, encouraging teachers to apply for related topics based on smart teaching, and providing certain financial support.

4.5. Improving the teaching evaluation system to promote continuous improvement of teaching quality

4.5.1. Establishing a diversified evaluation index system

The teaching evaluation of higher nursing education should comprehensively consider students' knowledge mastery, ability level, learning attitude, innovative thinking, and other aspects, establishing a diversified evaluation index system. For example, adopting a combination of regular grades (including attendance, classroom performance, online assignments), process grades (group projects, practical demonstrations), and final exam grades, focusing on evaluating students' learning processes. Additionally, the evaluation methods of higher nursing education should be diversified, including teacher evaluation, student self-evaluation, peer evaluation, and clinical internship unit evaluation. For instance, constructing and optimizing Mini-CEX (Mini-Clinical Evaluation Exercise) ^[14]. In clinical internship teaching evaluation, apart from teacher evaluation, internship hospital instructors and patients can be invited to evaluate students, comprehensively understanding students' internship performance through various evaluation results.

4.5.2. Utilizing big data for teaching evaluation and analysis

In higher nursing education, teachers can collect and analyze students' learning data, such as learning time, learning path, homework completion, and exam scores, with the help of big data technology, providing objective evidence for teaching evaluation. Through analyzing big data, teachers can understand students' learning characteristics and needs, discover problems in the teaching process, adjust teaching strategies on time, and achieve continuous improvement of teaching quality. For example, by analyzing students' learning data using a learning management system, teachers can identify students' learning difficulties in a certain knowledge point and provide targeted explanations and guidance to improve the effectiveness of nursing teaching and promote the integrated practice of "teaching, learning, and evaluation" ^[15].

5. Conclusion

In the context of smart teaching, higher nursing education faces unprecedented opportunities and challenges. A series of innovative pathways, such as updating teaching philosophies, innovating teaching models, optimizing teaching resources, strengthening the construction of teaching faculty, and improving the teaching evaluation system, can effectively enhance the quality of higher nursing education and cultivate high-quality nursing talents who meet the needs of the new era. The application of smart teaching in higher nursing education is still in the exploratory stage, requiring continuous practice and exploration by educators, summing up experience, addressing problems at different stages of nursing education, promoting the intelligent and modern development of higher nursing education, providing strong talent support for the development of the nursing industry, and making greater contributions to promoting healthy China.

Disclosure statement

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Digital Methods in Ideological and Political Education

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Abstract: With the rapid development of information technology, digitalization has become central to educational reform, especially in ideological and political education. Digital transformation revitalizes traditional models and offers opportunities for innovation. This paper explores key pathways for empowering ideological and political education through digitalization, including integrating digital resources, promoting blended learning, and enabling personalized education through data. It also addresses challenges like technology integration, students' digital literacy, and data security. To overcome these, the paper suggests strengthening teachers' digital skills, improving platform construction, and enhancing data security. Implementing these strategies can boost teaching quality and students' ideological literacy, supporting the high-quality development of ideological and political education. This paper offers theoretical and practical insights for advancing digital ideological education.

Keywords: Digital ideological and political education; Integration of teaching resources; Blended learning; Personalized education; Data security; Educational strategies

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1. Introduction

The rapid advancement of information technology has made digitalization a key trend in educational reform, particularly in ideological and political education. Traditional teaching models primarily rely on face-to-face instruction, with fixed content delivery, limited student engagement, and constraints on time, space, and resources. Digital technologies have transformed this by making content presentation more engaging and diverse, offering flexible, personalized teaching methods, and expanding opportunities for self-directed learning^[1].

The "Internet+" model has become a significant force in advancing higher education, enabling ideological and political education to transcend time and space limitations. Leveraging technologies like big data and artificial intelligence allows for more precise and personalized content, aligning better with students' needs. Additionally, digital tools provide teachers with new platforms, fostering innovation in teaching methods. Thus, digitalization is crucial for improving the quality and effectiveness of ideological and political education.

However, the digitalization process faces challenges, including technology integration, the need for updated educational philosophies and enhancing students' digital literacy ^[2]. These challenges hinder the full implementation of digital ideological education, making it a critical focus of current educational reform.

2. Digital pathways in ideological and political education

2.1. Integration and application of digital teaching resources

The integration of digital teaching resources is crucial for the digital transformation of ideological and political education. The development of digital tools has introduced high-quality resources such as electronic textbooks, online courseware, and video lectures, enriching educational content. These resources make teaching more engaging and visual, helping students connect complex political theories with social phenomena through interactive materials and video cases ^[3]. Additionally, big data allows teachers to track students' progress, providing personalized and precise guidance tailored to individual learning needs.

2.2. Application of the blended learning model

Blended learning combines online and offline teaching to overcome time and space constraints while enhancing student-teacher interaction. Online learning offers flexibility, allowing students to progress at their own pace, while offline activities like group discussions and social practices deepen their understanding of political theories. This model enriches the teaching format and boosts the effectiveness of ideological education by integrating theory with real-world application.

2.3. Data-driven personalized education

Data-driven education, powered by big data and AI, enables more personalized ideological and political instruction. By analyzing learning data, teachers can identify students' strengths and weaknesses, adjusting teaching strategies to address specific challenges ^[4]. This approach enhances teaching efficiency and customization, improving learning outcomes. Additionally, big data helps track students' ideological trends, offering timely adjustments to guide their learning and value formation effectively.

3. Challenges faced by digital ideological and political education

Despite the opportunities offered by digital ideological education, several challenges remain in its implementation. These challenges involve technology integration, students' digital literacy, and data security, which hinder the full realization of its potential.

3.1. Issues of information technology integration

While information technology has transformed ideological education, integrating these technologies with traditional teaching methods remains challenging. Many universities still rely on conventional methods, and the adoption of technologies like big data and cloud computing is limited in both scope and depth. Rapid technological advancements also lead to delays in updates and compatibility issues, raising costs for both educators and students and affecting teaching stability. A smooth integration of technology with traditional educational philosophies is essential for digital ideological education ^[5].

3.2. Disparities in students' digital literacy

Students' digital literacy significantly impacts the effectiveness of digital ideological education. While some students are proficient in using digital tools for learning, others struggle with tasks like information filtering and problem analysis, leading to unequal learning outcomes. These disparities not only affect student performance but also widen the information gap in ideological education. Addressing these gaps by improving digital literacy and critical thinking skills is crucial to enhancing educational equity and effectiveness ^[6].

3.3. Data security and privacy protection

The increasing use of digital technologies raises concerns over data security and privacy. Collecting and analyzing students' data exposes them to risks if not properly protected, threatening privacy and security. Educational institutions must prioritize data protection, establish strict policies, and balance digital education benefits with privacy concerns to ensure the smooth and trusted development of digital ideological and political education.

4. Strategies for digital ideological and political education

To address the challenges faced by digital ideological and political education, effective strategies must be implemented to ensure its smooth execution. Efforts in technological innovation, teacher capability enhancement, digital platform development, and data security management can overcome current difficulties and further improve the quality and effectiveness of ideological and political education. The following outlines several key strategies for digital ideological and political education.

4.1. Strengthening teachers' digital teaching abilities

Teachers play a crucial role in ideological and political education, especially during the digital transformation process, where teachers' digital teaching abilities directly impact teaching quality and effectiveness. To fully leverage digital tools, teachers must first enhance their own digital literacy. This includes mastering the use of modern educational technologies, such as big data analysis, online teaching platforms, virtual reality (VR) technologies, etc.

Universities should organize regular digital teaching training courses to help teachers become proficient with relevant technologies, while also allowing them to accumulate experience through practical teaching, gradually improving their teaching abilities. Furthermore, teachers should actively learn the latest digital education concepts and technologies, understanding how to effectively integrate these tools into ideological and political courses, thereby enhancing classroom interactivity and student engagement.

4.2. Optimizing digital teaching platform construction

Digital teaching platforms are the core infrastructure supporting digital ideological and political education. Universities need to increase investment in digital teaching platforms, building comprehensive online teaching systems that offer efficient and convenient learning resources and interactive functions. These platforms should feature rich course content, real-time interaction capabilities, and data analysis tools to help both teachers and students communicate and interact more effectively.

At the same time, the content on digital platforms should be diverse and targeted to meet the varying learning needs of different students. For example, virtual classrooms, online discussions, and video courses can be used to enrich the teaching methods of ideological and political education, making course content more vivid and engaging, thereby increasing students' interest in learning and ideological alignment. Additionally,

universities should establish cross-campus and cross-region educational resource-sharing platforms to promote the mobility and accessibility of educational resources, thereby increasing the reach of ideological and political education.

4.3. Promoting deep integration of digitalization with ideological and political curriculum

Digitalization is not merely a transformation of teaching methods; it is also a deep integration of teaching content and approaches. In the implementation of digital ideological and political education, teachers should design more interactive and engaging activities based on students' needs and interests, integrating digital technologies. For example, virtual reality (VR) can be used to recreate historical scenes, allowing students to experience the background and significance of historical events, deepening their understanding and recognition of ideological theories.

Additionally, digital technologies can assist teachers in real-time monitoring of students' ideological dynamics and, based on their learning progress and shifts in thinking, adjust teaching strategies accordingly. For example, by using big data to analyze students' online learning behaviors, teachers can identify confusion or issues students encounter in ideological education and provide targeted guidance and support.

4.4. Strengthening data security management and privacy protection

During the digitalization of ideological and political education, ensuring the security and privacy protection of student data is crucial. Educational institutions should establish robust data security management mechanisms, using encryption, anonymization, and other technological measures to ensure the safety of student data. Additionally, there should be greater transparency in data usage, with clear guidelines on the collection, use, and storage of student data, ensuring that data is used legally and compliantly.

To this end, universities should formulate detailed privacy protection policies and widely publicize them among teachers and students to raise awareness about data protection. Only by ensuring that data security and privacy are fully protected can digital ideological and political education progress smoothly and gain broad acceptance from both teachers and students.

5. Conclusion

With the rapid development of information technology, the application of digitalization in the education sector has become increasingly widespread, especially in the fields of ideological and political education. Digital transformation has not only injected new vitality into traditional teaching models but has also provided unprecedented opportunities for the innovation and development of ideological and political education. Through digital means, ideological and political education has not only overcome the limitations of time and space but has also diversified educational content and methods, greatly enhancing interaction and student engagement.

However, the implementation of digital ideological and political education also faces a series of challenges. The complexity of technology integration, the disparity in students' digital literacy, and issues related to data security and privacy protection all impact the smooth execution of digital ideological and political education to some extent. Therefore, in promoting digital ideological and political education, universities should adopt a series of effective strategies, including strengthening teachers' digital teaching abilities, optimizing digital teaching platform development, fostering deeper integration of digital technologies with ideological and political curricula, and enhancing data security and privacy protection.

By implementing these strategies, digital ideological and political education can play a greater role in

improving teaching quality, enhancing students' ideological and political awareness, and promoting educational equity. In the future, with continuous technological advancements and the ongoing evolution of educational philosophy, digital ideological and political education will play an increasingly important role in improving educational effectiveness and driving the high-quality development of ideological and political education.

In summary, digital ideological and political education is not only an inevitable trend in the development of education but also a key pathway to enhancing the effectiveness and targeting of ideological and political education. As challenges are overcome and strategies are refined, digital ideological and political education will inject new momentum into the ideological and political education of the new era, helping to cultivate more individuals who embody the core values of socialism.

Disclosure statement

The authors declare no conflict of interest.

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Survey on Career Planning Awareness and Readiness Among Freshman Medical Students in the Context of Digital Medicine

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Abstract: *Objective:* To understand the current situation of career planning awareness and readiness of freshman medical students with a background in digital medicine, and to provide references for optimizing the medical education system and career guidance. *Methods:* A cross-sectional study was conducted on freshman medical students at a university in Yunnan Province using questionnaire survey. *Results:* A total of 272 questionnaires were distributed and 264 valid questionnaires were returned, yielding an effective response rate of 97.10%. The average score of digital medical awareness of freshman medical students was (70.50 ± 8.81) , and 63.63% of the students had a high awareness (score ≥ 70); The average score of career planning awareness and readiness of freshman medical students was (91.76 ± 14.87) , and 60.63% of students had high awareness and readiness (score ≥ 90). Pearson correlation analysis showed that the total score of digital medical awareness was positively correlated with the total score of career planning awareness and readiness ($r = 0.13, P < 0.05$). *Conclusion:* Freshman medical students' career planning awareness and readiness are generally good, but their practical application of digital medical-related skills still needs improvement. It is suggested that schools strengthen the integration of interdisciplinary curriculum, introduce digital vocational training modules, and formulate differentiated guidance strategies for different majors to enhance students' professional competitiveness in the digital medical era.

Keywords: Digital healthcare; Career planning; Medical students; Awareness; Preparedness

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1. Introduction

With the in-depth application of digital technologies such as artificial intelligence, big data, and cloud computing, the global medical industry is undergoing profound changes with digital transformation as the core. During the outbreak of COVID-19, digital medical technologies such as medical big data, telemedicine, and artificial intelligence-assisted diagnosis and treatment played an important role in virus screening, disease analysis, patient treatment, and vaccine research and development^[1]. In this context, medical education faces

the dual challenges of reconstructing knowledge systems and upgrading ability requirements. Digital literacy and technical ability will become the core competencies of future clinicians, including understanding and using digital medical systems, analyzing medical data, and the ability to work collaboratively with artificial intelligence systems^[2].

In response to this trend, various governments have also introduced corresponding policies, such as the European Union's "Health Data Space Plan" in 2022; Japan launched the "Digital Medical and Health Service Industry Cultivation Strategy" in 2022; China issued the "Opinions on Promoting the Development" of "Internet plus Medical and Health" in 2020, and the "14th Five-Year Plan for Digital Economy Development" in 2022^[3]. However, despite increased policy support, the popularization of digital healthcare still faces challenges, especially in terms of talent pool. The doctor-patient environment makes it difficult to effectively unify medicine and engineering. Doctors cannot solve problems after clinical discovery, and engineers who can solve problems are not proficient in relevant medical knowledge^[4]. In this context, the career planning cognition (that is, the understanding of future career roles and development directions) and readiness (including knowledge reserve and interdisciplinary collaboration ability) of medical talents are directly related to the training quality of digital medical talents. In particular, the knowledge gap between medicine and engineering essentially reflects the lack of interdisciplinary vision in the dimension of vocational cognition and the lack of compound abilities in professional preparation. Therefore, understanding the career planning cognition and readiness of freshman medical students is of great practical significance for breaking the bottleneck of digital medical talents.

This study used the Career Adapt-Abilities Scale (CAAS) and the Digital Health Literacy Instrument (DHLI) as the main measurement tools to explore the occupational adaptability of freshman medical students in the context of digital medicine, digital health literacy level, and the relationship between them. Combined with the questionnaire survey, this paper systematically analyzes the current situation of occupational cognition, provides an empirical basis for vocational enlightenment education and curriculum reform in medical colleges and universities, and helps the supply-side reform of medical talent training.

2. Data and methods

2.1. Information

From January 2025 to February 2025, the freshman medical students of a university in Yunnan Province were selected as the survey objects by convenience sampling. The inclusion criteria of the subjects were full-time students who voluntarily participated in the study.

The sample size was calculated according to the cross-sectional survey sample size calculation formula, $n = (Z^2 \times P \times (1-P))/e^2$, where Z is the Z value corresponding to the confidence level, P is the expected prevalence, and e is the tolerance error. Let $Z = 1.96$, $P = 0.5$, $e = 6\%$, then $n \approx 264$, and finally 264 copies are included. This study conforms to ethical principles and is reported to the school ethics committee.

2.2. Methods

2.2.1. Research methods

A cross-sectional survey method was used to conduct a stratified sampling of freshman medical students in colleges and universities in Yunnan Province who met the inclusion and exclusion criteria. The questionnaire star was used to conduct a questionnaire survey online, and descriptive statistics and correlation analysis were carried out according to the survey results of the questionnaire. The survey tools are as follows.

2.2.1.1. General Information Questionnaire

The content includes gender and specialty.

2.2.1.2. Digital Health Literacy Scale

This questionnaire is woven from the Chinese and revised Digital Health Literacy Instrument (DHLI) of the School of Nursing, Fujian Medical University ^[5]. Using the Likert 4-level scoring method, the items under the information navigation skill dimension and privacy protection skill dimension are assigned 1 ~ 4 points from “never” to “always,” and the items in the other dimensions are assigned 4 ~ 1 points from “very easy” to “very difficult.” It includes seven dimensions: operation skills, information navigation skills, information search skills, determining information relevance, evaluating information reliability, adding content, and privacy protection skills, with a total of 21 subheads. Cronbach’s alpha was 0.84 and construct validity was 0.87.

2.2.1.3. Career adaptation scale

This questionnaire is compiled from the (Career Adapt-Abilities Scale, CAAS) ^[6] international scale, including four dimensions: career attention, career control, career confidence, and career curiosity, with a total of 24 items. The questionnaire uses the Likert 5-scale scoring method. From 1 to 5, it represents very inconsistent, inconsistent, general, consistent, and very consistent respectively. The corresponding scores are 1, 2, 3, 4, and 5, with a total score of 120 points. The higher the total score, the stronger the career adaptability. Cronbach’s alpha was 0.97 and construct validity was 0.96.

2.2.2. Data collection method

In this study, the questionnaire star platform was used to distribute questionnaires. Before the implementation of the survey, the researcher explained the purpose, significance, and confidentiality principle of the research to the participants in detail, and filled out the questionnaire anonymously after obtaining informed consent. To ensure the authenticity of the data, all questionnaires are required to be completed independently on-site and collected immediately.

2.3. Statistical processing

SPSS 27.0 software was used for data analysis in this study. Measurement data are measured as mean \pm standard deviation (SD) indicates that the count data is described in frequency (*n*) and percentage (%). The correlation between the total score of digital medical cognition (a total score) and the total score of career planning cognition and readiness (b total score) was tested by Pearson’s *r*, and the significance level was set as two-tailed $\alpha = 0.05$. Categorical variables such as specialty and gender distribution were presented by descriptive statistics to reflect the structure characteristics of the sample.

3. Results

3.1. General situation of research objects

A total of 272 questionnaires were distributed by questionnaire star, and 264 valid questionnaires were returned. The effective rate of this questionnaire was 97.10%. The sample population of this questionnaire study is mainly medical students in the first year of undergraduate courses. Among them, there are 102 men and 162 women, and the proportion of women is higher than that of men. The majority of students majoring in nursing, accounting for 33.71% of the sample size, and the rest include comprehensive medical disciplines such as basic

medicine, clinical medicine, pharmacy, and traditional Chinese medicine. See **Table 1** for details.

Table 1. General situation of study subjects ($n = 264$)

Variable	<i>n</i>	%
Gender		
Male	102	38.64%
Female	162	61.36%
Profession		
Nursing	89	33.71%
Basic medicine	25	9.47%
Rehabilitation therapy	22	8.33%
Clinical medicine	51	19.32%
Pharmaceutical	32	12.12%
Medical technical inspection	22	8.33%
Chinese medicine	23	8.71%

3.2. Medical students' awareness of digital medicine

The highest score dimension is operational skills, with a score of 10.79 ± 1.40 points, and the lowest score dimension is privacy protection skills, with a score of 9.47 ± 2.61 points, with an average score of 70.50 ± 8.8 points. Assuming that the data distribution is ideal, it is about 63.63% greater than 70.50 ± 8.8 points. Among them, the operational skill dimension has the highest score, the privacy protection skill dimension has the lowest score and the most obvious differences among students. The specific scores of each dimension are shown in **Table 2**.

Table 2. Digital medical awareness scores of medical students

Dimension	Score
Operational skills	10.79 ± 1.40
Information navigation capabilities	10.31 ± 1.70
Information search capability	9.91 ± 1.96
Determine information relevance	10.21 ± 1.76
Assess information reliability	9.96 ± 1.94
Add content	9.83 ± 1.95
Privacy protection skills	9.47 ± 2.61
Total score	70.50 ± 8.81

3.3. Medical students' career planning awareness and readiness

The highest score is 120 points, the lowest score is 24 points, and the average score is 91.76 ± 14.87 points and 57.20% of the people are higher than the average score. The specific scores of each dimension are shown in **Table 3**.

Table 3. Scores of medical students' Career Planning Awareness and Readiness Questionnaire

Dimension	Score
Career concerns	22.79 ± 3.94
Career control	23.01 ± 4.01
Career confidence	22.93 ± 3.96
Career curiosity	23.00 ± 3.99
Total score	91.76 ± 14.87

3.4. Correlation

Pearson correlation analysis was used to explore the relationship between A total score (digital medical awareness score) and B total score (career planning awareness and readiness score), which was normally distributed, and Pearson correlation was 0.13, indicating that there was a weak positive correlation between them. At the significance level of 0.05, the correlation between A total score and B total score was not caused by random factors, and there may be differences in data records or special circumstances. See **Table 4** for details.

Table 4. Correlation between career planning score and digital medical score

		A total score	B total score
A total score	Pearson correlation	1	0.129*
	Significance (two-tailed)		0.036
	No. of cases	264.00	264.00
B total score	Pearson correlation	0.129*	1
	Significance (two-tailed)	0.036	
	No. of cases	264	266

*At grade 0.05 (two-tailed), the correlation was significant.

4. Discussion

4.1. Awareness of digital medical care

Freshman medical students' awareness of digital medicine is at an upper-average level, and the overall situation is good. However, there are still deficiencies in some dimensions (privacy protection skills, information search capabilities), with room for improvement. This result reflects that the current digital medical-related content in basic medical education has not been systematized, and there is still a disconnect between traditional curriculum settings and digital medical curriculum. Zhang and Wu ^[7] found in a study on the digital literacy of medical students that the extensive use of various digital technologies, resources, and platforms to manage and expand knowledge and abilities related to future careers is also one of the contents that medical students need to strengthen urgently to improve their digital literacy level. Among medical students' digital medical awareness scores, the operation skills score is the highest, followed by information navigation ability and determining information relevance. From the data, students can use digital medical tools well, and can locate and screen the required information more efficiently. However, students' privacy protection skills and information search ability scores are low, and students may have insufficient ability to screen and critically analyze digital medical information. This requires schools to set up professional courses to lead students to learn specialized laws (such

as the Personal Information Protection Law and the Medical Data Security Guide), intuitively understand the risks of medical data leakage, and teach students how to use professional medical databases (such as PubMed, CNKI, UpToDate) correctly and efficiently.

4.2. Awareness and readiness of career planning

According to the result, the career planning awareness and readiness of freshman medical students are at the upper-middle level, but there are significant individual differences. Nearly half of the students have lower scores than the average, which shows that nearly half of the students need to further improve their career planning abilities, especially in emerging fields such as digital medical technology applications and industry trend awareness. This echoes the results of a survey conducted by Cui *et al.* ^[8] on college students' employment cognition under the background of artificial intelligence. The survey shows that college students' professional employment direction cognition shows an obvious gradient distribution: only 51.65% of the students understand it, and the remaining 48.35% of the students are in a state of half-knowledge or completely ignorant. All show that students still have great shortcomings in career planning. Students can make career planning from the triple dimensions of "industry cognition + self-exploration + action landing." Industry cognition requires students to break the information gap. First, schools can offer career planning courses for college students, interpret the trends of the medical industry, and introduce medical policy interpretations (such as the impact of DRG reform on the doctor's profession). Secondly, students can use alumni resources to understand their future careers (if you can ask the teacher, senior, and senior sister), the school can also invite clinicians, nursing staff, scientific researchers, public health practitioners, and medical company executives to give lectures.

Self-exploration requires students to make scientific self-orientation. First, students can use professional evaluation tools (such as MBTI and Holland Career Interest Test) to make scientific self-orientation. Secondly, a special "career planning consultation room" is set up for teachers to provide one-on-one consultation according to the orientation.

Action requires students to set achievable goals in stages and adjust them in time to reduce blindness and determine the general direction of future career development. Therefore, students should set short-term career goals (clarify the goals to be achieved in freshmen, sophomores, juniors, and seniors) and long-term career goals, and use winter and summer vacations to practice in different hospital departments, accumulate clinical experience, and realize the integration of teaching and learning.

4.3. Correlation

There is a weak but significant positive correlation between "A" (digital medical awareness) and "B" (career planning awareness and readiness) between them. It can be concluded that the correlation between digital medical care and career planning is weak. This suggests that the improvement of digital healthcare awareness may indirectly promote the initiative and directionality of students' career planning by enhancing their understanding of industry technology dynamics. A survey shows that in the face of the professional competitiveness that AI brings to medical students, 68.65% of medical students are willing to work hard to improve themselves and learn AI-related technologies, 16.33% will look for positions that AI cannot replace within a certain time, and 15.02% of medical students will choose to maintain the status quo ^[9]. With the continuous development of digital technology and AI, this means that these 15.02% of medical students must make changes, or else their future career development will bring huge risks. These students can consult on the online psychological platform, reduce the negative mentality caused by psychological distress, and deal with

stress correctly. Secondly, it stimulates students' internal motivation and clarifies their professional identity. Teachers can help students disassemble long-term goals into actionable short-term goals, and reduce slack caused by ambiguous goals. Students can also participate in short-term practical activities to stimulate interest through real nursing scenarios, and at the same time realize the integration of nursing scenarios and digital medical care, to avoid the disconnection between what they have learned and reality, and at the same time experience the convenience brought by digital medical care.

4.4. Summary

4.4.1. Summary of digital medical awareness

Freshman medical students' awareness of digital medical care is at the upper-middle level, but there are still weak dimensions, which need to be optimized in combination with specific dimensions. The lack of information ethics and critical thinking is related to the incomplete system of digital medical care itself and the possibility of information leakage. In 2017, Patient Home Monitoring, a company that provides home medical care for patients in the United States, suffered a cloud configuration error, resulting in 47.5 G data leakage, exposing the medical records of 150,000 patients in the United States ^[10]. Studies have shown that nurses can understand their digital health literacy level through DHLI, improve online health information behavior, and use reliable information to guide clinical practice and improve nursing quality ^[11].

4.4.2. Summary of career planning readiness

The overall career planning readiness of freshman medical students is above average, but the individual differences are significant, and the skills and practical abilities related to digital medicine need to be strengthened urgently. Student source control and student source curiosity are dominant dimensions, while student source attention and student source self-confidence need to be continuously optimized in combination with industry dynamics. Career planning stays at the stage of "fuzzy interest," lacks specific path dismantling, fails to systematically analyze the matching degree between one's advantages and the target occupation, and lacks understanding of the integration opportunities of medicine and interdisciplinary occupations.

4.4.3. Correlation summary

There is a weak but significant positive correlation between digital medical awareness and career planning awareness and readiness. Career planning has strong autonomy, but its integration with emerging technologies is insufficient, which further shows that the current medical education has not yet fully realized the organic connection between digital skills and career development.

4.5. Countermeasures and suggestions

4.5.1. Strengthening the curriculum setting

For majors with low awareness and preparation (such as clinical medicine and pharmacy), the curriculum setting related to digital medicine can be strengthened to improve students' cognitive level. At the same time, students of nursing, traditional Chinese medicine, rehabilitation therapy, medical technology laboratory, and basic medicine will strengthen the popularization of digital medicine.

4.5.2. Interdisciplinary integration

Digital medical industry cases should be introduced into career planning courses, invite cross-disciplinary experts to give lectures, and broaden students' understanding of the career path of "integration of medicine and

industry”. Recently, Yang *et al.* ^[12] pointed out that interdisciplinary cooperation and teamwork are important means for medical students to improve their information literacy.

4.5.3. Practicing strengthening

Students improved operational skills through virtual simulation platforms (such as digital diagnosis and treatment simulation) and at the same time combined professional role-playing activities to enhance their career confidence. Students need to fully understand the employment prospects of the selected major, carefully study the theoretical and practical skills that the major needs to master, learn more and practice more, be down-to-earth and be willing to work hard, constantly strengthen the contact with society, and enhance the sense of professional belonging and identity ^[13].

4.5.4. Long-term tracking mechanism

A longitudinal database of digital medical skills and career development should be established, with continuous evaluation of the effect of educational intervention, and provide an empirical basis for policy formulation.

4.5.5. Concerns about gender differences

Although girls’ cognitive readiness is slightly higher than boys’, it is still necessary to pay attention to boys’ career planning readiness and provide targeted guidance and support.

Disclosure statement

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Cultivation of the Educator Spirit among Mathematics Normal Students: Value, Dilemma, and Path

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Abstract: The cultivation of the educator spirit among normal university students provides dual guidance in theory and practice for higher education institutions to train future teachers with noble educational sentiments and professional qualities. This study elaborates on the essential connotation of the educator spirit from six perspectives: guiding philosophy, spiritual cultivation, internal requirements, essential requirements, the soul of teacher ethics, and sources of motivation. On this basis, it explains the three major dilemmas in cultivating the educator spirit among normal university students: the cognitive dilemma regarding the understanding of the value of the educator spirit and educational identity, the integration dilemma caused by the disconnection between educational curriculum design and the penetration of the educator spirit, and the alienation dilemma arising from improper connection between educational practice and the educator spirit. Therefore, it is proposed to incorporate the educator spirit into the evaluation system for normal university students, by deepening the understanding of values, optimizing curriculum design, strengthening practice orientation, and comprehensively motivating and evaluating normal university students' recognition and practice of the educator spirit, in order to promote the inheritance and innovation of the educator spirit.

Keywords: Educator spirit; Training of normal students; Value connotation; Dilemmas; Pathways

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1. Introduction

The educator spirit is the noble quality and professional competence manifested in educational practice, which has significant theoretical and practical implications for cultivating excellent teachers and enhancing educational quality. In 2024, the Central Committee of the Communist Party of China and the State Council issued the *Opinions on Promoting the Educator Spirit and Strengthening the Construction of a High-Quality and Professional Teacher Team in the New Era*, proposing to strengthen the ideological and political construction of the teacher team, cultivate noble teacher ethics and style, enhance teachers' professional competence, and vigorously promote the educator spirit, thereby advancing the construction of a high-quality and professional

teacher team in the new era and further creating a positive social atmosphere that respects teachers and values education ^[1]. As the backbone of future educational development, the professional competence and educational teaching ability of normal students will directly impact the improvement of educational quality and the advancement of educational reform. The training of normal students not only helps promote educational equity and balanced development but also meets the diverse needs for excellent teachers in different regions and schools by cultivating teachers with noble ethics, solid knowledge, and a compassionate heart. The educator spirit, as an important cultural asset, not only showcases the spirit of Chinese teachers who continuously improve their virtues and strive for self-improvement but also contributes Chinese spirit, wisdom, solutions, and strength to the world ^[2]. With the continuous development and reform of the normal student training system, research on the educator spirit from the perspective of normal students' professional development has gradually become a focus of academic attention. This study aims to conduct an in-depth discussion from the perspective of cultivating the educator spirit in normal students, providing dual guidance in theory and practice for training future teachers with noble educational sentiments and professional competence.

2. Value connotations of cultivating the educator spirit in normal students

2.1. Guided by the ideal belief of having a great heart and sincerely serving the country to strengthen the political stance of normal university students

The ideal belief of “having a great heart and sincerely serving the country” is the core political faith in cultivating the educator spirit of normal university students. This ideal belief is not only reflected in the patriotism and social responsibility of educators but also provides a continuous source of motivation for normal university students to strive tirelessly for the education cause of the country and the people.

In terms of patriotism, the educator spirit effectively inspires the patriotism of normal university students by inheriting and promoting excellent educational beliefs and culture. Educators should hold lofty beliefs, placing their own interests within the development of the country and society. The transmission and cultivation of this belief help normal university students deeply understand the national mission and social responsibility of education, forming a sentiment of “having a great heart.” Furthermore, regarding social responsibility, the educator spirit encourages normal university students to actively participate in social practice and public welfare activities, cultivating their sense of social responsibility and spirit of dedication. By engaging in various social practice activities, normal university students can personally feel the developmental needs of the country and society, enhancing their sense of responsibility towards the country and the people. This strengthening of responsibility helps normal university students form a firm belief in “sincerely serving the country.” Additionally, the educator spirit emphasizes the professional quality and innovative ability of educators. In the process of education, normal university students not only need to learn professional knowledge but also cultivate innovative spirit and practical abilities. The enhancement of this professional quality and innovative ability helps normal university students better serve the education cause of the country and the people, realizing the ideal belief of “sincerely serving the country.” The educator spirit plays an important role in cultivating the ideal belief of “having a great heart and sincerely serving the country” among normal university students through the inheritance of excellent educational traditions, cultivation of social responsibility, and enhancement of professional quality. The establishment and reinforcement of this ideal belief will lay a solid foundation for the future development of normal university students' educational careers and make a positive contribution to the education cause of the country and the people.

2.2. Using the moral sentiment of “words as the standard for scholars and actions as the model for the world” as spiritual cultivation to shape the moral standards of normal university students

The moral sentiment of “words as the standard for scholars and actions as the model for the world” is a distinctive character in cultivating the educator spirit of normal university students. The educator spirit is a spiritual quality that contains lofty educational emotions, adheres to educational concepts, and seeks the essence of education, which is concentrated in the cultivation of character, the nurturing of teacher ethics, and the enhancement of ethical qualities. It guides normal university students to follow the educational policy orientation of the country, regard moral education as the core task, view teaching and nurturing as their professional mission, actively practice the professional ethics of teachers, and aspire to become good teachers who embrace ideal beliefs, possess noble morals, have profound knowledge, and are filled with compassion.

In the cultivation of virtue and talent, the spirit of educators can inspire normal university students to establish correct educational concepts and career aspirations. Through literature review, it has been found that the humanistic quality of normal university students tends to be utilitarian, as most of them consider income and benefits more than personal professional development ^[3]. Normal university students become role models for scholars through their words and serve as societal exemplars through their actions, deepening their recognition and sense of belonging to socialism with Chinese characteristics on an intrinsic level. In the development of teacher ethics, teacher ethics is the core of the educator spirit ^[4], and the understanding of teacher ethics by normal university students is crucial. This understanding will prompt them to hold themselves to higher standards and strive to become excellent teachers who exemplify the ideals of scholars in their words and actions. Normal university students are committed to continuously enhancing their moral standards and personal charisma, influencing and inspiring students through their exemplary behavior, and becoming role models for students in learning, conduct, and character. In terms of building teacher ethics, the educator spirit encourages normal university students to hone their moral character, encompassing the courage to bear historical responsibilities, a broad and selfless love, an innovative mindset that dares to break through, a profound affection for the educational cause and students, a selfless dedication to professional ethics, and a relentless pursuit of excellence and an indomitable spirit. The spirit of being a scholar in words and a model in actions inspires normal university students to firmly uphold the basic positions, viewpoints, and methods of Marxism, guiding them to refine their moral sentiments, stimulate innovative spirit, and foster a pioneering consciousness.

2.3. Cultivating normal university students’ teaching abilities with a diligent and practical attitude of seeking truth and innovation as an internal requirement

The diligent and practical attitude of “seeking truth and innovation” is an internal requirement for cultivating the educator spirit in normal university students. The connotation of the educator spirit can inspire normal university students’ love and sense of mission for the educational cause. Under the guidance of this spirit, normal university students will cherish learning opportunities more and engage in the educational cause with a proactive attitude.

In terms of subject literacy, normal university students can better grasp the connotations and key points of curriculum standards, become familiar with teaching content, and clarify the focus and difficulties of teaching. Under the supervision of the educator spirit, normal university students should solidify their foundation and apply it flexibly, thus grasping the connotation and mastering theoretical knowledge and basic skills, which are essential abilities that normal university students should possess. Their training should encourage them to “diligently study and practice.” In terms of teaching foundation, they should be student-centered, conduct

diversified teaching, master subject knowledge, and guide students in the learning process. The diligent and practical attitude of seeking truth and innovation encourages normal university students to actively understand the realities of basic teaching reform and to possess certain teaching research capabilities. In terms of teaching innovation, the concept of seeking truth and innovation within the educator spirit encourages normal university students to maintain independent thinking and be brave in exploring and advancing. In the pursuit of truth and dissemination of knowledge, normal university students will gradually develop critical thinking, daring to question and challenge, continuously promoting innovation and development in education. In class guidance, class activities should adhere to the principle of prioritizing moral education and cultivating virtue. The diligent and practical attitude embedded in the educator spirit prompts normal university students to constantly reflect and practice in class management and home-school communication, forming good habits of integrating knowledge and action. Diligence emphasizes the continuous accumulation of knowledge and deepening understanding of education; practical action requires normal university students to transform learned knowledge into actual actions and apply it in educational practice. This diligent attitude can guide normal university students to form correct educational concepts and career aspirations, honing their teaching abilities and laying a solid foundation for future educational practice.

2.4. Emphasizing an educational attitude of enlightening the mind and nurturing the heart to inspire the educational philosophy of normal university students

The educational attitude of “enlightening the mind and nurturing the heart” is an essential requirement for cultivating the spirit of educators in teacher education students. Teacher education students should understand the educational value of their subjects and be aware of the physical and mental development patterns of students, thereby providing systematic education and guiding students’ healthy growth.

In terms of educational value, the concept of enlightening the mind and nurturing the heart within the spirit of educators emphasizes that education is not merely the transmission of knowledge, but also the enlightenment of wisdom and the nurturing of the soul. This concept guides teacher education students to focus on cultivating students’ thinking abilities, innovation capabilities, and practical skills in educational practice, while also paying attention to students’ emotional needs and spiritual growth. Influenced by the concept of enlightening the mind and nurturing the heart, teacher education students will pay more attention to the depth and breadth of education, striving to create an educational environment that is rich in both knowledge and emotion, providing strong support for the comprehensive development of students. In terms of teaching according to individual differences, the concept of teaching according to individual differences within the spirit of educators is an important manifestation of personalized education. It requires educators to tailor educational plans based on students’ individual characteristics, interests, and learning abilities, ensuring that each student receives the most suitable education for themselves. As teacher education students understand and practice teaching according to individual differences, they will gradually develop an educational attitude that respects individual differences and focuses on individual development. They will observe students more carefully and gain a deeper understanding of their needs, thereby formulating more scientific and reasonable educational plans to help students maximize their self-worth. This educational attitude can guide teacher education students to form correct educational concepts and philosophies, as well as enhance their educational practice abilities, making them truly excellent teachers who understand, love, and excel in education.

2.5. Taking the pursuit of love for teaching and caring for students, and a willingness to dedicate oneself as the soul of teacher ethics, to cultivate the educational sentiment of normal university students

The pursuit of benevolence characterized by “joy in teaching, love for students, and willingness to dedicate oneself” is the soul of teacher ethics that cultivates the spirit of educators among normal university students. The educational enthusiasm of normal university students possesses a strong aspiration to teach and a sense of professional belonging, fostering positive educational emotional tendencies, filled with love and a sense of responsibility. In the teaching process, they are committed to shaping students’ character, inspiring their patriotism and spirit of dedication, becoming guides in the shaping of students’ character, knowledge acquisition, innovative thinking, and service to the nation.

In terms of educational identity, the spirit of educators emphasizes the mission and responsibility of education, which is deeply rooted in love and care for every student. This spirit guides normal university students to maintain an attitude of joy in teaching and love for students throughout their educational work, viewing education as a noble cause and regarding the growth and development of students as their own mission. In terms of professional identity, as future teachers of the people, normal university students must possess a sense of social responsibility and professional ethics. They should have the correct attitude towards education, the right values, be willing to impart knowledge, and be adept at stimulating students’ interest in learning, accompanying students’ growth with love and patience. The quality of willingness to dedicate oneself to the spirit of educators is an important embodiment of normal university students’ pursuit of benevolence in the field of education. Regarding caring for students, the spirit of educators also emphasizes the role of teachers as role models. A teacher with the spirit of an educator will lead by example, influencing students with their words and actions, conveying positive values. This role model effect can inspire normal university students’ benevolence, making them pay more attention to their own cultivation and character in future educational practices, centering on students, and influencing and inspiring them with noble sentiments and a loving heart. Through practical actions, normal university students convey the warmth and power of education, allowing students to feel the beauty and hope of education. The spirit of educators plays an irreplaceable role in cultivating normal university students’ pursuit of joy in teaching, love for students, and willingness to dedicate themselves, nurturing their educational sentiments.

2.6. Using a broad vision and the pursuit of cultural enlightenment as a source of motivation to inspire the innovative development of normal university students

The pursuit of “broad vision and cultural enlightenment” is the source of motivation for cultivating the spirit of educators among normal university students^[5]. The concept of broad vision in the spirit of educators emphasizes a grand perspective that transcends the individual, focusing on national and social development. The concept of cultural enlightenment in the spirit of educators reflects the important value of education in inheriting and promoting culture.

In lifelong learning, educators have a global vision and a pursuit of profound principles. Guided by this spirit, normal university students should actively understand the development trends of basic education reform both domestically and internationally, adapt to the new requirements of the times and educational development, engage in learning and career planning, and enhance their comprehensive qualities and educational teaching abilities. In terms of innovation capability, educators are brave in exploring new educational concepts and teaching methods, daring to challenge traditional ideas, and have made significant contributions to the reform

and development of education. This spirit inspires normal university students to continuously pursue progress and innovation, courageously exploring new educational paths in practice, and contributing their strength to cultivate more talents with a global perspective and innovative abilities. In terms of international vision, this spirit guides normal university students in their growth process to not only focus on their professional development and personal growth but also to care about the future of the country and the nation, closely integrating personal development with the needs of the country and society. Under the influence of this spirit, normal university students gradually develop a strong sense of responsibility and mission, viewing education as an important force for promoting social progress and national rejuvenation. This process of cultural cultivation not only aids in the comprehensive development of students but also promotes the inheritance and innovation of culture. In practicing this concept, normal university students deeply understand the connotation and value of culture, cultivate a global vision, and nurture a sense of responsibility for cultural cultivation, making positive contributions to cultivating more outstanding talents and promoting social progress and development.

3. Dilemmas in cultivating the educator spirit of normal university students

3.1. Dilemma of normal university students' understanding of the value of educator spirit and educational recognition

The educator spirit is a complex and profound concept that encompasses various aspects such as educational philosophy, educational innovation, and educational enthusiasm. Currently, there is still a significant gap between the scale and quality of normal university student training and the high-quality development of the national economy, which stems from the limitations of social cognition ^[6].

The understanding of the spirit of educators among normal university students is superficial, lacking a comprehensive recognition of the spirit of educators. Many normal university students may have a rather simplistic understanding of the spirit of educators, merely staying at the level of love and dedication to the education profession, without deeply exploring the profound connotations contained in the spirit of educators, such as a noble sense of mission, a strong sense of responsibility, high moral character, and a spirit of innovation. The spirit of educators is a multi-layered and multi-dimensional concept that encompasses various aspects such as educational philosophy, educational innovation, and educational practice. However, some normal university students may only focus on one aspect, lacking a comprehensive understanding and recognition of the spirit of educators. In the current educational system, normal university students may pay more attention to the imparting of subject knowledge and the training of examination skills, receiving relatively less education in aspects such as the spirit of educators, educational philosophy, and educational practice, and instead being more exposed to educational theories and subject knowledge, which leads to a relatively weak understanding of the spirit of educators.

Normal university students face a crisis of professional identity and a conflict of educational values. Currently, normal university students in China are confronted with the reality of insufficient self-awareness and low professional identity. How to overcome these difficulties and help normal university students better clarify their self-concept, establishing a logical chain and diverse practical approaches from self-identity to teacher professional identity is the main challenge for their self-development ^[7]. The curriculum training and value education that normal university students receive can lead to some students encountering conflicts between ideals and reality during their educational internships or practices, resulting in a decreased sense of identity and belonging to the teaching profession. This identity crisis may lead them to doubt the value and significance of the education profession, which in turn affects their recognition and understanding of the spirit of educators.

In the current educational environment, the conflict between exam-oriented education and quality education still exists. This conflict may cause normal university students to feel confused and lost in educational practice, unable to clearly define their educational values, thereby affecting their recognition of the spirit of educators.

3.2. Dilemma of the disconnection between the curriculum setting for normal university students and the infiltration of the spirit of educators

Although the current normal education curriculum covers a wide range of educational knowledge, it often lacks specialized discussion and in-depth cultivation of the spirit of educators. This makes it difficult for normal university students to form a comprehensive understanding and profound experience of the spirit of educators during their education.

The cultivation of the educator spirit among normal university students is limited in terms of curriculum design. The curriculum is unreasonable, the teaching content is disconnected from reality, there is insufficient teaching staff, and the teaching model is outdated. Traditional normal university education courses often focus too much on the transmission of subject knowledge while neglecting the cultivation of the educator spirit ^[8]. This knowledge-centered curriculum often results in normal university students lacking a deep understanding and practical experience of educational concepts. First, the curriculum is singular. Traditional teacher training models often emphasize subject knowledge and teaching skills training, leading to a relatively narrow curriculum design that lacks interdisciplinary and comprehensive course offerings. This results in normal university students having difficulty accessing broader and deeper educational theories and practical knowledge during their education, making it challenging to fully understand and cultivate the educator spirit. Second, there is a lack of in-depth interpretation of the educator spirit. Even when the curriculum includes content related to the educator spirit, it is often only briefly mentioned or summarized, lacking in-depth interpretation and elaboration. The insufficient strength in subject teaching leads to significant difficulties in advancing teacher education reform projects ^[9]. Third, the individual differences of normal university students are overlooked. For example, ideological and political education and the education of teachers' ideals and beliefs have not adequately addressed the personal experiential needs of students in their learning, primarily focusing on knowledge explanation while lacking attention to students' learning experiences ^[10]. Each normal university student has differences in learning background, interests, and cognitive abilities. The current curriculum design often ignores these individual differences and does not provide personalized learning paths and development space for normal university students.

The neglect to cultivate the educator spirit among normal university students leads to a deviation in the orientation of teacher education. Some normal universities place too much emphasis on exam-oriented and employment-oriented education, resulting in normal university students lacking the pursuit and practice of the educator spirit in educational practice. The structure of the professional knowledge system in education is imbalanced, and the development level of teachers' teaching abilities urgently needs improvement ^[11]. This orientation issue makes it difficult for normal university students to form correct educational values and professional pursuits during their training. The educator spirit emphasizes care, love, and respect for students, focusing on their emotional experiences and mental health. However, if normal university students lack the cultivation of the educator spirit, they may lack humanistic care for students during teaching, neglecting students' emotional needs and psychological changes, leading to a distant teacher-student relationship and poor educational outcomes. The practicality needed in the curriculum system design must be improved ^[12].

3.3. Dilemma of the disconnection between the educational practice of normal university students and the educator spirit

The cultivation of the educator spirit requires normal university students to continuously hone and enhance themselves through educational practice. Currently, normal university students have limited opportunities for educational practice, often finding it difficult to integrate the theoretical knowledge they have learned with actual teaching, and even more challenging to experience and comprehend the educator spirit in practice.

In the training process of normal university students, the disconnection between theory and practice is a common issue. Theoretical learning often focuses on the imparting of educational concepts and methods, while teaching practice emphasizes specific teaching operations and skills. This disconnect makes it difficult for normal university students to effectively integrate the spirit of educators into their actual teaching, resulting in a loose connection between theory and practice. Educational internships, as an important link for normal university students to apply theoretical knowledge in practice, should serve as a key to bridging this gap. However, due to limitations such as short internship duration and insufficient guidance, normal university students often struggle to fully experience and practice the spirit of educators. They may focus more on completing teaching tasks, neglecting core elements of the educator's spirit, such as attention to individual student differences, the creation of educational contexts, and innovation in educational methods.

Moreover, the current educational environment and societal expectations have a profound impact on the teaching practices of normal university students. The educational environment generally emphasizes students' exam scores and schools' enrollment rates, which leads normal university students to prefer traditional teaching methods in their practice, overlooking the innovation, practice, and holistic development of students emphasized by the spirit of educators. At the same time, societal expectations of education often focus on students' academic achievements, and this utilitarian orientation makes it difficult for normal university students to uphold the spirit of educators in practice and to pursue the essence and value of education. Therefore, the training of normal university students not only needs to establish a closer connection between theoretical learning and teaching practice but also requires a re-examination and reinforcement of the inheritance and practice of the spirit of educators in the context of the educational environment and societal expectations.

4. Cultivation path for the spirit of educators in normal university students

Improving the cultivation path for the spirit of educators in normal university students requires the joint efforts of higher education institutions, primary and secondary schools, and all sectors of society to build a comprehensive, multi-level, and three-dimensional cultivation system, guiding normal university students to internalize the spirit of educators in their hearts and externalize it in their actions, striving to become good teachers with the "four qualities" in the new era.

4.1. Deepening the understanding of values and strengthening educational identity

The cultivation of the spirit of educators is not achieved overnight; it requires a long process of stimulation, formation, consolidation, and enhancement^[13]. By offering specialized courses, organizing discussions, and practical activities, we comprehensively guide teacher education students to engage in immersive learning and practice the contemporary value and practical significance of the spirit of educators from both China and abroad. Specialized courses on the spirit of educators will systematically explain the life stories, educational thoughts, and spiritual connotations of famous educators, such as Confucius, Tao Xingzhi, and Sukhomlinsky, and will incorporate case analyses to guide teacher education students in understanding the contemporary value and

practical significance of the spirit of educators; thematic discussions on the spirit of educators will be organized, focusing on topics such as “What is the spirit of educators?” and “How to practice the spirit of educators?,” encouraging teacher education students to share their understanding and insights based on their own experiences and reflections; practical activities themed around the spirit of educators will be conducted, organizing visits to memorial halls of educators, watch films related to educators, and read biographies of educators, allowing them to experience the charm of the spirit of educators through immersive experiences.

Outstanding teachers lead teacher education students to excel. Excellent teachers are invited to share their educational stories and insights, using relatable individuals and events to inspire and motivate teacher education students; establish growth profiles for outstanding teachers, collecting and organizing their growth journeys, educational philosophies, and teaching achievements to set examples for teacher education students and inspire them to pursue their educational ideals of excellence; conduct the “Walking with Educators” activity, encouraging teacher education students to pair with outstanding teachers for on-the-job learning, allowing them to closely experience the practical power of the spirit of educators.

4.2. Optimizing curriculum design to promote the permeation of spirit

The effectiveness of curriculum construction, especially the implementation of the curriculum by teachers, is directly related to student learning outcomes^[14]. It mediates the teaching and learning of the curriculum, forming the basic process of education and teaching, and directly affects student development. The spirit of educators is integrated into the curriculum system for teacher education, leading to a reconstruction of the curriculum system. The spirit of educators is incorporated into general education courses, integrating the content of the spirit of educators into courses such as ideological and political theory and teacher professional ethics, guiding teacher education students to establish correct educational values and professional ideals. The spirit of educators is also integrated into subject-specific courses, where elements of the spirit of educators are explored in subject teaching methods and curriculum and teaching theory courses, guiding teacher education students to incorporate the spirit of educators into subject teaching practice. Additionally, specialized courses featuring the spirit of educators are developed, such as “The Spirit of Educators and Teacher Professional Development” and “The Spirit of Educators and Educational Reform,” to deeply explore the connotation, value, and practical paths of the spirit of educators.

Innovations in teaching methods guide teacher education students to deeply understand and effectively practice the spirit of educators. Case-based teaching is introduced, selecting typical cases that embody the spirit of educators, guiding teacher education students to analyze the educational concepts, teaching methods, and educational wisdom contained in the cases, and to reflect and summarize. Situational simulations are conducted to create authentic educational teaching scenarios, allowing teacher education students to take on the role of teachers, experience the application of the spirit of educators in actual teaching, and engage in reflection and improvement. Action research is encouraged, guiding teacher education students to combine their own educational teaching practices with action research to explore effective ways and methods to practice the spirit of educators.

4.3. Strengthening the practice-oriented approach to promote the connection of spirit

Integrating the spirit of educators into teaching practice is a progressive process of internalizing the spirit, generating intentions, and transforming behaviors^[15]. Strengthening educational practice platforms by building internship bases, conducting volunteer services, and constructing educational practice communities provides

teacher education students with multidimensional practical paths to practice and inherit the spirit of educators. Enhancing the construction of educational internship bases involves selecting primary and secondary schools with good educational traditions and distinctive school characteristics as educational internship bases, providing teacher education students with practical platforms to practice the spirit of educators. Conducting educational volunteer services for students to participate in educational volunteer activities such as teaching assistance and support for education, allowing them to experience the significance and value of educational work in practice, thereby enhancing their sense of social responsibility and mission. Establishing educational practice communities involves forming communities composed of university teachers, primary and secondary school teachers, and teacher education students to jointly conduct educational research, promoting the inheritance and innovation of the spirit of educators.

The evaluation mechanism is complemented, through the establishment of practical archives, award activities, and other measures, to comprehensively motivate and evaluate normal students' recognition and practice of the spirit of educators. The spirit of educators is incorporated into the evaluation system for normal students, and the understanding, recognition, and practice of the spirit of educators by normal students are included in the comprehensive quality evaluation system for normal students, serving as an important basis for awarding and recognizing excellence; an archive of the practice of the spirit of educators is established to record the specific performances and achievements of normal students in practicing the spirit of educators during educational and teaching practices, serving as an important reference for evaluating their professional development; themed award activities for the spirit of educators are carried out, regularly conducting award activities such as "Practitioners of the Spirit of Educators" to commend normal students who excel in practicing the spirit of educators and to establish advanced models.

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A New Interpretation of “Unity of Knowledge and Action”: A Theoretical Model of Integrating Traditional Cultural Ecological Wisdom into STEAM Education

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Abstract: This study constructs a theoretical model integrating traditional cultural ecological wisdom into STEAM education, exploring a new interpretation of the “unity of knowledge and action” concept in modern education. Research shows that incorporating traditional ecological wisdom, such as the harmony between humanity and nature and following the laws of nature, into STEAM education's curriculum, teaching methods, and practical activities can significantly enhance students' interdisciplinary knowledge, practical abilities, and environmental awareness. Through data simulation and empirical analysis, the model's effectiveness is confirmed, demonstrating its significant advantages in improving students' overall quality and cultivating talents with global perspectives and local sentiments. Innovatively, this study bridges traditional cultural ecological wisdom and STEAM education with “unity of knowledge and action,” offering new insights for educational reform.

Keywords: Traditional cultural ecological wisdom; STEAM education; “Unity of knowledge and action”; Interdisciplinary education; Environmental awareness

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1. Introduction

1.1. Research background and significance

In the 21st century, globalization and informatization have spurred educational reforms, giving rise to STEAM education. It integrates science, technology, engineering, art, and mathematics to cultivate students' comprehensive literacy and innovation capabilities by transcending disciplinary boundaries. However, current implementations often emphasize hard skills in science, technology, engineering, and mathematics while overlooking the integration of traditional cultural ecological wisdom. China's traditional culture is rich in

ecological wisdom, which is crucial for fostering environmental awareness, ecological consciousness, and social responsibility in students. Incorporating this wisdom into STEAM education can help preserve cultural heritage, deepen students' understanding of natural laws and social responsibilities, enrich STEAM education, align with Chinese students' cultural backgrounds, spark students' interest in learning and a sense of national pride, promote local cultural identity and inheritance, drive innovation in educational models, and cultivate talent with a global perspective and local sentiment.

1.2. Current research status of STEAM education at home and abroad

STEAM education is well-established overseas with mature theoretical and practical frameworks. It focuses on interdisciplinary integration, cultivating scientific literacy and innovation in real-world contexts, advocates student-centered and practice-oriented teaching, and has robust evaluation systems. However, it falls short of incorporating local cultural elements and leveraging cultural diversity. In contrast, domestic interest in STEAM education has grown recently. Driven by educational reforms, scholars and educators recognize its role in nurturing innovation and practical skills. Domestic research spans curriculum design, teaching models, and teacher training, aiming to develop a Chinese-oriented STEAM education system. For example, in curriculum design, traditional cultural elements like Majiayao pottery are incorporated to foster higher-order thinking and cultural identity. In teaching models, concepts like the 6C model from C-STEAM education are applied to activities such as flower arrangement and penjing to enhance innovation and aesthetics. Despite these efforts, China is still in the early stages, especially in deeply integrating traditional cultural ecological wisdom with STEAM education ^[1]. Future work should focus on infusing deeper cultural elements to cultivate environmental awareness, innovation, and humanistic literacy while strengthening international cooperation for the advancement of global STEAM education.

1.3. Research methods and innovations

This paper employs a mix of literature reviews, case analyses, and empirical surveys to explore the integration of traditional cultural ecological wisdom into STEAM education. The literature review uncovers the intrinsic connections between the two, laying a theoretical foundation for model building. Case analyses of successful domestic and international practices yield valuable insights, while empirical surveys of educators and students provide practical feedback for model refinement ^[2].

The paper's innovation lies in proposing a theory model that uses the "unity of knowledge and action" concept as a bridge to connect traditional cultural ecological wisdom with STEAM education. This model values both knowledge and practical skills, promoting holistic student development. "Unity of knowledge and action" aligns with STEAM education's emphasis on combining theory and practice. By embedding cultural wisdom into practical activities, students grasp cultural essence and develop problem-solving skills, elevating their overall quality. Moreover, the use of diverse research methods ensures a comprehensive and in-depth study, offering theoretical and practical guidance for the organic integration of traditional cultural ecological wisdom and STEAM education. This aids in driving educational reforms, and preserving cultural heritage, and holds theoretical and practical significance.

2. Integration of traditional cultural ecological wisdom with STEAM education

2.1. Core concepts of traditional cultural ecological wisdom

Traditional Chinese culture offers valuable insights for modern education through its ecological wisdom,

embodied in concepts like “unity of heaven and humanity,” “following the laws of nature,” and “harmonious coexistence.” The “unity of heaven and humanity” highlights the interdependence of humans and nature, urging respect for and protection of the natural world. In STEAM projects, students observe and experiment to uncover nature’s mysteries, fostering reverence for the environment. “Following the laws of nature” advocates for minimal human interference, encouraging students to study and mitigate the environmental impact of human activities. “Harmonious coexistence” underscores the balance and interdependence of living beings, inspiring collaborative problem-solving in STEAM education to tackle environmental issues, thereby enhancing teamwork and social responsibility ^[3]. These principles not only cultivate environmental awareness and interdisciplinary literacy but also deepen students’ understanding of nature and society.

2.2. Core philosophy and objectives of STEAM education

STEAM education is rooted in interdisciplinarity, innovation, and problem-solving, breaking down subject barriers to foster creative and holistic skill development. It aims to produce well-rounded talents proficient in science, technology, engineering, art, and mathematics, enabling them to thrive in a fast-paced society and drive progress through adaptability and innovation. Real-world projects with complex problems encourage collaborative and independent learning, nurturing critical thinking, creativity, and lifelong learning skills. Aligned with global education trends and China’s reform goals, an increasing number of Chinese schools and institutions are integrating STEAM education into their curricula, exploring the incorporation of traditional cultural elements, such as traditional arts, crafts, and scientific inventions to enrich educational content and delivery, allowing students to experience the charm of traditional culture through inquiry-based learning.

2.3. Pathways and methods for integration

To infuse traditional cultural ecological wisdom into STEAM education, a multi-faceted approach involving curriculum design, teaching methods, practical activities, campus culture, and family education can be adopted. In curriculum design, incorporate traditional ecological concepts to create courses on environmental protection and ecological balance, stimulating interest in and understanding human-nature coexistence. For teaching methods, employ project-based and inquiry-based learning to encourage student-led exploration and application of knowledge, with teachers guiding knowledge connections and skill development. Practical activities can include environmental projects and community service, translating classroom learning into real-world actions that boost comprehensive literacy and social responsibility. Additionally, organizes cultural festivals and themed events on campus, and encourages family involvement in exploring ecological wisdom, to cultivate an atmosphere supportive of traditional culture and its integration with STEAM education ^[4].

3. Construction of the theoretical model and empirical analysis

3.1. Construction of the theoretical model

The theoretical model presented in this study is grounded in the concept of “unity of knowledge and action,” aiming to achieve a balance between knowledge transmission and the cultivation of practical abilities. Traditional cultural ecological wisdom is integrated into all aspects of STEAM education as a knowledge source to help students understand the relationship between nature and society and to foster environmental awareness and social responsibility. The model incorporates traditional ecological concepts into curriculum design, focusing on interdisciplinary integration and the inheritance of wisdom. It adopts student-centered teaching methods that encourage active exploration and discovery. Practical activities are organized to engage

students in environmental projects, transforming knowledge into action and developing problem-solving skills. The evaluation system is diversified and comprehensive, tracking students' development in knowledge, skills, attitudes, and values to accurately reflect their overall quality and growth.

3.2. Data simulation and analysis methods

To evaluate the effectiveness of the theoretical model, this study combines data simulation with empirical analysis. Data simulation employs computer technology to create a virtual educational environment, simulating the learning process of students under different teaching modes. By setting learning scenarios and tasks, and observing and recording students' learning performance data, the feasibility and effectiveness of the model are experimentally verified. On the empirical analysis side, questionnaires are conducted to collect primary data on student learning outcomes and teacher feedback, covering knowledge acquisition, skill enhancement, and emotional attitudes. In-depth interviews and case studies are also performed to gain direct insights and suggestions from students and teachers on the new teaching model. Data analysis combines both quantitative and qualitative approaches. Statistical software is used for detailed analysis of quantitative data, while qualitative data from interviews and case studies are systematically categorized and summarized. This comprehensive analysis validates the model's effectiveness and provides references for educational reform and practice.

3.3. Empirical analysis results

The empirical analysis shows that the theoretical model has achieved significant results in teaching applications. In terms of knowledge acquisition, students' average knowledge retention rate increased by 18.7% through STEAM courses infused with traditional cultural ecological wisdom, with their understanding of ecological and environmental knowledge deepening by 26.4%. A paired-sample *t*-test on knowledge test results before and after learning revealed significantly higher post-learning scores ($t = 12.32$, $P < 0.001$), indicating a statistically significant promotive effect of the model on students' knowledge retention.

Regarding skill enhancement, students' hands-on and problem-solving abilities rose by 15.2% and 21.5%, respectively, through practical activities and project-based learning. An analysis of variance (ANOVA) on skill assessments before and after project implementation showed a significant increase in post-implementation skill levels ($F = 8.67$, $P < 0.01$), indicating a statistically significant promotive effect of the model on students' skill development.

In emotional attitudes and values, students' level of identification with environmental awareness grew from 73.2% to 91.5%. Observations and records of students' environmental behaviors before and after learning indicated a significant increase in post-learning environmental behavior frequency ($\chi^2 = 9.81$, $P < 0.01$), showing a statistically significant impact of the model on cultivating students' environmental awareness.

From teacher feedback, 90.5% felt the STEAM education with integrated traditional cultural ecological wisdom sparked student interest; 85.3% saw significant improvements in student participation and interaction; and 79.7% reported enhanced teaching effectiveness.

In summary, the theoretical model of integrating traditional cultural ecological wisdom into STEAM education has proven effective and practical, yielding significant results in knowledge acquisition, skill enhancement, and emotional attitudes and values.

4. Conclusion and prospects

4.1. Research conclusions and summary of innovations

This study has revealed a strong connection between traditional cultural ecological wisdom and STEAM education, and through the concept of “unity of knowledge and action,” it has developed an integration model that has been empirically validated as effective and practical, showing broad prospects for application. The results indicate that STEAM education integrated with traditional cultural ecological wisdom enriches students’ interdisciplinary knowledge, enhances their problem-solving abilities, deepens their understanding of nature and society, and strengthens their environmental awareness and sense of responsibility. The innovation of this study lies in its pioneering use of the “unity of knowledge and action” concept to bridge traditional cultural ecological wisdom and STEAM education, thereby enriching educational content, offering new ideas and methods for educational reform, and providing theoretical and practical guidance for educational practice. This approach holds significant implications for advancing educational reform, improving student quality, and promoting the inheritance and development of traditional culture ^[5].

4.2. Suggestions and prospects for future research

Future research should delve deeper into traditional cultural ecological wisdom, analyzing and interpreting more ecological ideas to uncover their alignment with modern education. This will enrich the theoretical model and practical resources. Additionally, the scope of empirical research should be expanded to include schools from diverse regions and socioeconomic backgrounds to test the model’s universal applicability. It is also important to strengthen international educational exchanges and collaborations, learn from successful overseas experiences, and broaden research perspectives. Furthermore, attention should be paid to the application of new technologies, such as virtual reality and augmented reality, in education, and efforts should be made to explore their specific applications within the theoretical model. This will drive theoretical and practical innovation, refine the theoretical model and practical approaches, and cultivate composite talents who are globally competitive and well-versed in their culture.

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An Empirical Analysis of the Final Examination Papers in Educational Psychology Course for Undergraduates in Different Educational Majors under the Background of Teaching Reform

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Abstract: In the context of the continuous advancement of teaching reform, the optimization of the curriculum evaluation system has become a key issue in the field of education. This study focuses on the course of educational psychology, using the final examination papers and scores of the 2022 Physical Education Major and 2024 Early Childhood Education Major undergraduate students at Yunnan Technology and Business University as samples. Basic statistical analysis methods are employed to conduct an in-depth investigation. The results show that the overall difficulty of the exam papers is moderate (0.7), with acceptable reliability (0.78) and good validity (0.7–0.8). However, the failure rate among students reaches 21.3%, reflecting learning difficulties. There is no significant difference in scores between students from different majors, attributed to the same teaching conditions and equal emphasis on the course by both majors. This study provides data support for the teaching of educational psychology courses, assisting teachers in improving their teaching based on the results, meeting the demands of teaching reform for precise teaching evaluation and quality enhancement, and promoting the development of educational psychology course teaching.

Keywords: Educational psychology course; Teaching reform; Examination papers analysis

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1. Introduction

Educational psychology course (EPC), as a core teacher education course for undergraduate students in educational majors, plays a foundational role in cultivating students' teaching and educational capabilities^[1]. In the current wave of teaching reform, the transformation of the educational evaluation system has become one of the core drivers for improving teaching quality^[2]. The traditional single-exam evaluation model can no longer meet the comprehensive assessment needs of modern education for students' overall quality and capability

development. Strengthening examination management, enhancing process assessment, and reasonably adjusting its proportion in the total course score have become important directions for teaching reform. However, in the current implementation process, accurately and objectively evaluating students' daily learning status still faces many challenges. It is urgent to build a scientific, comprehensive, and reform-oriented evaluation system that meets the needs of teaching reform. Given the high consistency in the teaching of EPC at Yunnan Technology and Business University (YTBV) for the 2022 Physical Education Major (PEM) and 2024 Early Childhood Education Major (ECEM), including the same teaching plan, content, class hours, textbooks, instructors, and exam papers, this study takes this opportunity to conduct an in-depth analysis of their final exam papers and scores. It aims to explore the commonalities and differences in the learning of EPC among students from different educational majors, providing strong data support and practical references for precisely optimizing the teaching of EPC under the background of teaching reform.

2. Materials and methods

2.1. General materials

This study selected the final examination papers in EPC from 94 undergraduate students of the 2022 PEM and 2024 ECEM at YTBV as the research subjects. During the grading process, a flow grading method was employed to ensure that the scoring criteria for each question were unified and objective. The total score for the exam paper was 100 points, with question types divided into two major categories: objective and subjective questions. The objective questions included single-choice questions (10 questions, totaling 15 points), multiple-choice questions (5 questions, totaling 15 points), and true-or-false questions (10 questions, totaling 10 points). The subjective questions consisted of term explanations (5 questions, totaling 20 points), short-answer questions (4 questions, totaling 20 points), and analysis questions (1 question, totaling 20 points). Both objective and subjective questions were designed to assess students' memory, understanding, and comprehensive application of knowledge, covering the core knowledge points and competency requirements of the EPC.

2.2. Test paper analysis methods

This study analyzed the final examination papers in EPC, scientifically evaluating aspects such as difficulty, reliability, and validity.

- (1) Difficulty: Refers to the level of difficulty of the test questions, which is a very important indicator for evaluating the examination papers^[3]. In this study, the classic difficulty classification standard was followed: 0.75–1 indicates an easy test paper, 0.6–0.74 is defined as a test paper of medium difficulty, and below 0.59 is judged as a difficult test paper. By analyzing the scoring situation of each question type, the overall difficulty coefficient of the test paper and the difficulty coefficient of different question types were calculated. This assessment judged the appropriateness of the test paper in terms of students' knowledge mastery level and provided a basis for subsequent teaching adjustments from the perspective of difficulty.
- (2) Reliability: Reliability was quantitatively measured using Cronbach's Alpha coefficient, which reflects the consistency of the scores for the test questions and is an important statistical representation of the reliability of the examination. Generally, a Cronbach's Alpha value greater than 0.9 indicates excellent consistency; 0.8–0.9 represents good consistency; 0.7–0.8 is within the acceptable range; and 0.6–0.7 means that the test paper requires significant revision^[4]. During the analysis, the Cronbach's Alpha value was further calculated after removing a specific question type (Question N). If the reliability of

the entire test paper significantly improved after removing the question, it indicated that the question might have issues affecting the overall quality of the test paper, such as ambiguous wording, and repetitive or off-topic knowledge points. This analysis helped identify areas for test paper optimization.

- (3) **Validity:** Validity was primarily determined by examining the correlation coefficients between the scores of each type of question and the total score of the test paper. Since the total score can comprehensively reflect students' overall mastery of the course, ideally, the scores of each question type should show a significant positive linear correlation with the total score. If a question type had a very low or negative correlation with the total score, it might indicate serious problems in the difficulty setting of the question, such as being too difficult and causing widespread student failure, or too easy to effectively distinguish student levels, or even having incorrect answers. This study categorized validity into three levels based on the validity coefficient: validity greater than 0.7 is considered good, 0.4–0.7 is fair, and less than 0.4 is considered poor. This classification comprehensively evaluated the effectiveness of the test paper.

2.3. Statistical analysis of scores for different majors

A comprehensive and in-depth analysis and comparison of the EPC exam scores between students of the PEM and ECEM were conducted, covering key indicators such as failure rate, pass rate, excellence rate, average score, subjective question scores, and objective question scores. The analysis not only intuitively presented the differences and commonalities in the overall score distribution between the two majors but also provided insights into the professional characteristics of students' knowledge mastery and ability application by examining the scores of different question types. This analysis offered data-driven insights for formulating cross-major teaching strategies.

2.4. Statistical methods

IBM's Statistical Package for the Social Sciences (SPSS) V.23 software (<https://www.ibm.com/analytics/spss-statistics-software>) was used to conduct statistical analyses of the relevant data. For quantitative data, the mean \pm standard deviation (SD) was used to represent the results, and *t*-tests were employed to assess the significance of differences between groups. For count data, rates (%) were used, and chi-square (χ^2) tests were conducted to determine statistical differences in score distribution between the two majors. A significance level of $P < 0.05$ was set to ensure the reliability and scientific nature of the research findings.

3. Results

3.1. Analysis of the EPC exam papers

The overall average difficulty of the exam paper was 0.7, falling within the range of 0.6–0.74, indicating that the overall difficulty was moderate. Further analysis of the different question types revealed that the average difficulty of objective questions was 0.72, while that of subjective questions was 0.68. Among the subjective questions, short-answer questions and analysis questions posed a greater challenge to students, resulting in a relatively higher overall difficulty for subjective questions. This may be due to these types of questions requiring students to have a strong ability to integrate knowledge and express it logically. Students often struggle to accurately extract key points of knowledge and present them in an organized manner, reflecting their weaknesses in knowledge application and thinking expansion. This finding provides a clear direction for adjusting future teaching priorities.

The reliability of the exam paper was 0.78, which falls within the range of 0.7–0.9, indicating an acceptable level of reliability (as shown in **Table 1**). After removing different question types, the reliability values of the exam paper fluctuated slightly, suggesting that the various question types in the exam paper have relatively stable internal consistency and the overall structure is reasonable. However, compared to the high-reliability standard (e.g., above 0.9), there is still room for improvement. Future efforts could focus on optimizing question-wording and enhancing the relevance of knowledge points to further refine the exam paper and improve reliability, ensuring that the exam results more accurately reflect students’ true abilities.

Table 1. Reliability analysis of the EPC exam paper

Item	Cronbach’s Alpha value
Entire exam paper	0.78
After removing [Single-choice questions]	0.72
After removing [Multiple-choice questions]	0.71
After removing [True-or-false questions]	0.76
After removing [Term explanation questions]	0.77
After removing [Short-answer questions]	0.76
After removing [Analysis questions]	0.71

The validity of each question type relative to the total score of the exam paper ranged from 0.7 to 0.8, indicating good validity (as shown in **Table 2**). This means that there is a strong positive correlation between students’ scores on each question type and their total scores, suggesting that the exam paper effectively measures students’ overall mastery of EPC knowledge.

Table 2. Validity analysis of the EPC exam paper

Question type	Validity
Single-choice questions	0.86
Multiple-choice questions	0.86
True-or-false questions	0.82
Term explanation questions	0.72
Short-answer questions	0.71
Analysis questions	0.85
Total score	1.00

3.2. Statistical analysis of exam scores for different majors

Overall score distribution: In this exam, a score of 90 and above was defined as excellent, with an overall excellence rate of only 5.4% (5 out of 94 students). Scores between 60 and 90 were considered passing, with a total pass rate of 73.3% (69 out of 94 students). Scores below 60 were considered failing, with a total failure rate of 21.3% (20 out of 94 students). The overall score distribution indicates a low excellence rate and a relatively high failure rate, reflecting that students’ performance in the EPC needs improvement. There are many deficiencies in knowledge mastery and application, and the teaching process requires deeper explanations and reinforcement training for key and difficult knowledge points to enhance students’ learning outcomes.

Comparison of scores between majors: A detailed comparison of scores between students of the PEM and ECEM revealed no statistically significant differences in pass rate, excellence rate, total scores, objective question scores, or subjective question scores ($P > 0.05$). This suggests that under the same teaching conditions, students from both majors have a similar level of knowledge mastery and ability in EPC. Further analysis indicates that this similarity is due to the shared teaching resources and assessment standards, which effectively eliminate the interference of teaching-related factors on scores. Additionally, as students in educational majors, both groups face the requirement of Teacher Qualification Exams and have a similar level of emphasis on the EPC, resulting in comparable learning motivation and engagement, and thus no significant difference in scores between the two majors.

4. Discussion

4.1. Analysis of the EPC exam papers

In summary, the analysis of the difficulty, reliability, and validity of this exam paper indicates that its overall design is scientifically sound and rational. The moderate difficulty ensures effective differentiation of students' knowledge levels, the acceptable reliability guarantees the relative stability and credibility of the exam results, and the good validity confirms that the exam paper accurately reflects students' mastery of the course content. However, in the face of the higher demands of teaching reform for student capability development, the exam paper still has room for improvement in guiding students to enhance their higher-order thinking and innovative application abilities. Future efforts should focus on strengthening the assessment of students' analysis, synthesis, and evaluation skills in exam question design, thereby promoting deeper development in teaching and evaluation.

4.2. Statistical analysis of exam scores

Reflection on learning status: The exam scores and question type distribution reveal that students currently rely heavily on rote memorization to cope with exams in EPC, especially obtaining scores in single-choice questions through extensive practice. However, they perform poorly in short-answer and analysis questions, which require deeper understanding and comprehensive application of knowledge. This learning approach is significantly different from the goals of teaching reform, which advocate fostering students' ability for autonomous learning, deep thinking, and problem-solving in real-life situations. In future teaching, instructors should actively change their teaching strategies by introducing diverse teaching methods, such as case-based teaching and project-based learning, to stimulate students' interest and guide them to actively construct their knowledge systems and enhance their ability to apply knowledge.

Impact of major differences: Although there is no significant difference in scores between students from different majors, the potential impact of major background on the learning process should still be considered. Students majoring in PEM may tend to understand EPC from the perspective of sports training and physical education practice, while those in ECEM may focus more on the application of knowledge in early childhood education scenarios. In teaching, instructors should fully explore the integration points between major characteristics and educational psychology knowledge to conduct targeted teaching activities, thereby promoting the organic combination of theoretical knowledge and professional practice among students and improving teaching effectiveness.

5. Conclusion

Exam paper analysis, as an important means of evaluating teaching effectiveness, plays an irreplaceable role in the process of teaching reform. Through a systematic analysis of the EPC exam papers and statistical analysis of the scores, teachers can gain precise insights into the quality of the exam papers and a deep understanding of students' knowledge mastery. This process also helps identify weak links in the teaching process and pain points in students' learning. In future teaching, teachers should closely follow the concepts of teaching reform, center on the students, and develop personalized teaching plans based on their learning situations. They should strengthen formative evaluation and feedback, guide students to change their learning methods, and gradually improve the quality of EPC teaching. This approach will lay a solid foundation for students' professional growth and career development, and contribute to the achievement of educational major talent cultivation goals.

Disclosure statement

The authors declare no conflict of interest.

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Analysis of the Construction of the Internal Governance Model of Colleges and Universities Based on the Theory of Flat Management

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Abstract: The flattening of the internal governance of colleges and universities needs to follow the principles of democratic participation, equivalence of rights and responsibilities, and efficiency priority. The structural design should be comprehensively optimized and adjusted. The power distribution should follow the principle of coordination and balance between academic power and administrative power. The operation mechanism should focus on the scientificity and democracy of decision-making. The construction of supporting systems requires the improvement of the performance appraisal system as well as the incentive and supervision mechanisms.

Keywords: Flat management; Internal governance of colleges and universities; Academic power

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1. Introduction

Flat management initially entered the research field as a management reform phenomenon of modern enterprise organizations and is regarded as a new management structure that can improve organizational efficiency and market competitiveness ^[1]. Its core features include fewer management levels, a larger management span, a networked structure, decentralized power, an emphasis on efficiency, and people-oriented management ^[2]. This new management model that effectively solves efficiency problems has quickly been applied to the discussion of the management models of other organizations. In the process of internal governance of colleges and universities, implementing the theory of flat management can fully and effectively solve the drawbacks of the traditional governance model of colleges and universities, strengthen the management efficiency of colleges and universities themselves, and improve their management level. It is a good idea for colleges and universities to formulate their internal governance models at this stage ^[3].

2. Determination of the objectives and principles of the flattening of internal governance in colleges and universities

Constructing the internal governance model of universities based on the theory of flat management aims to achieve scientific, democratic, and highly efficient school management to meet the new situations and requirements of the development of higher education, and to enhance the comprehensive competitiveness and social influence of universities ^[4]. That is, in specific work, by reducing the number of levels, optimizing the allocation of power and functions, and scientifically refining rights and responsibilities, etc., the effectiveness of school decision-making and management is improved, enabling the school to more promptly respond to changes in the external environment and adjust its own construction and development strategies. At the same time, it also fully stimulates the subjective initiative, initiative, and creativity of grassroots teaching and research personnel and students, so as to promote academic development, improve the quality of talent cultivation, and create a good academic atmosphere and educational environment. Some principles need to be followed in the construction process of this governance model.

2.1. Principle of democratic participation

The principle of democratic participation emphasizes that school governance should respect the dominant position of teachers and students, and protect their right to know, right to participate, and right to supervise. A democratic management system such as the Faculty and Staff Congress and the Student Congress should be established and improved to widely listen to the opinions and suggestions of teachers and students. School decisions should fully reflect the will and interests of the majority of teachers and students. For example, major decisions such as school plans and teaching reform plans should be demonstrated by teachers and students' representatives and their reasonable suggestions should be absorbed; such as formulating talent cultivation quality standards and education and teaching quality evaluation mechanisms.

2.2. Principle of equivalence of rights and responsibilities

Under the management model of flat management, the responsibilities and rights among all levels, departments, and positions should be clearly defined, ensuring that there are corresponding powers for each position. Decentralize power to grassroots teaching and research organizations and personnel, enabling them to have independent decision-making power and organizational behavior power. At the same time, clearly define the responsible persons and the responsibilities they should bear to prevent irresponsibility and abuse of power. For example, in scientific research project management, the project leader is given the right to allocate scientific research funds and the right to deploy members of the scientific research team, etc. At the same time, the project leader is required to be responsible for the implementation progress of the project, the quality of the project results, etc., so that the scientific research project can be carried out smoothly.

2.3. Principle of efficiency priority

The key purpose of flat management is to improve management efficiency. In the construction of the governance model, the management process should be optimized, management approvals and cumbersome procedures should be reduced, and the efficiency of information circulation, transmission, and decision-making implementation should be improved ^[5]. By building an information management platform, real-time sharing and rapid transmission of information are realized, and work efficiency is improved. For example, through the online office system, online document approval and instant information communication are realized, avoiding the waste of time caused by the transmission of paper documents and meetings, and improving the management

efficiency of the school.

3. Structural design of the flattening of internal governance in colleges and universities

Under the flat management model, the internal governance structure of colleges and universities should be comprehensively optimized and adjusted to meet the requirements of flat management and achieve efficient and scientific school management.

3.1. Reducing management levels is a key measure of flat management

The multi-level characteristics of the traditional management model of colleges and universities lead to high management costs and reduce the speed of information transmission and the timeliness of decision-making. Therefore, the middle management levels of colleges and universities should be streamlined, and the traditional “pyramid”-type hierarchical management system should be broken, making the entire management structure simpler and more efficient. For example, merging several departments with similar management functions, streamlining unnecessary management levels, merging the Academic Affairs Office and the Teaching Quality Monitoring Center into the Teaching Management and Quality Monitoring Office, and carrying out teaching management and quality monitoring functions together to avoid the phenomena of function intersection, function overlap, and work duplication and improve the management level. At the same time, it is necessary to reduce the management levels of secondary colleges, and grassroots teaching and research organizations should have more direct management rights, enabling the grassroots to make quicker adjustments to teaching, scientific research, and other work ^[6].

3.2. Expanding the management span is an important feature of flat management

On the basis of reducing management levels, appropriately expanding the management span of managers allows them to directly manage more subordinate units or personnel ^[7]. That is, managers can directly manage more subordinate units or more subordinates, which requires managers to possess higher management levels and comprehensive qualities and be able to reasonably and effectively organize and coordinate the work of subordinates. For example, school leaders establish direct face-to-face contacts with multiple grassroots teaching and research units to understand the teaching and research work situation at the front line and provide timely guidance, coordination, and assistance; use information technology means, such as building a network communication platform and using project management software, etc., to improve the communication management efficiency and management effect of managers on subordinates, and ensure that managers can effectively manage and supervise subordinates under the condition of expanding the management span.

3.3. Constructing an organizational structure centered on the work process is the core requirement of flat management

The traditional management model of colleges and universities is oriented towards department function management, resulting in poor communication and coordination among departments and low work efficiency. However, flat management is oriented towards the work process, breaking the closedness among departments, optimizing resources, and carrying out work efficiently. For example, in scientific research project management, a cross-departmental scientific research team is established and oriented toward scientific research projects. Team members come from different disciplines and departments and are composed of scientific research

personnel, managers, technical support personnel, etc. Around the project objectives, tasks, and processes, team members jointly take charge of the project implementation, quickly communicate around the project implementation process, optimize and share project resources, and improve the efficiency and quality of scientific research project work. In teaching management, around the talent cultivation process, we integrate the links of enrollment, teaching, student management, employment, etc., form integrated teaching management, achieve efficient docking of each link, and complete each link of talent cultivation.

4. Power allocation and operation mechanism of the flattening of internal governance in colleges and universities

When constructing the internal governance model of colleges and universities based on the theory of flat management, a scientific and reasonable power allocation and operation mechanism is crucial, which is directly related to the efficiency and effect of school governance.

4.1. Power allocation should follow the principle of coordination and balance between academic power and administrative power

In the governance of colleges and universities, academic power and administrative power are the two most important types of power, and both are essential for the development of colleges and universities. Academic power includes the decision-making and management power of academic affairs, academic institutions, and academic personnel in school management for academic affairs, such as discipline construction, major setting, academic evaluation, etc. Its subjects are academic personnel and academic organizations, based on academic levels, professional knowledge, etc. Administrative power includes the power to manage school administrative management, resource allocation, logistics support, etc., and to play a protective management function. Its subjects are administrative management personnel, based on administrative positions, administrative rules, etc. However, influenced by traditional school-running habits, in the governance of colleges and universities, administrative power occupies a dominant position, and academic power is in a relatively disadvantaged state, resulting in a lack of sufficient academic participation in the decision-making of school academic affairs, weakening the driving force for academic development and reducing the quality of academic development.

To straighten out the relationship between academic power and administrative power, it is necessary to position and rationally divide their functions. Academic power should mainly play a role in school affairs, and academic organizations such as the Academic Committee and the Professors' Committee should be given more and broader rights and decision-making and management powers^[8]. For example, in discipline construction, academic organizations formulate discipline development plans, determine discipline research directions, and approve discipline construction projects, etc.; in major setting, the opinions of academic organizations should also be respected, and majors should be set scientifically and reasonably according to discipline development and the needs of the times. At the same time, administrative power should actively participate in the exercise of academic power, provide necessary support and guarantee for the exercise of academic power, give priority to academic development in resource allocation, ensure the smooth progress of academic research work, streamline administrative procedures in administrative management, improve service efficiency, and create a good working environment for academic personnel^[9].

4.2. The power operation mechanism should focus on the scientificity and democracy of decision-making

Flat management requires the formation of multi-level and diversified management subjects for decision-making so that decisions can fully consider the interests and demands of all parties. For major decision-making matters such as the school development strategic plan, after full investigation, demonstration, and listening to the opinions and suggestions of teachers' representatives, students' representatives, management personnel, etc., more groups can be involved in the decision-making through various ways such as holding the Faculty and Staff Congress, the Student Congress, and symposiums. At the same time, use information technology, and collect various information through the online decision-making platform to make the decision-making process more open and transparent.

When implementing decisions, it is necessary to clarify the division of labor, implement responsibilities, strengthen the mutual connection, cooperation, and communication among various departments and personnel, and ensure the implementation of decisions. It is also important to establish and improve the supervision system for decision implementation, conduct supervision and inspection of the decision implementation situation, and rectify problems in a timely manner. For example, the supervision department sets up full-time positions or establishes a supervision organization to conduct supervision and inspection of the implementation of various decisions of the school and hold the departments and relevant personnel with ineffective implementation accountable to ensure the authority and effectiveness of decision implementation.

5. Construction of supporting systems for the flattening of internal governance in colleges and universities

5.1. Improving the performance appraisal system is a key link to ensure the effective operation of the flat management model

In the construction of the performance appraisal index system, attention should be paid to focusing on the work achievements in teaching, scientific research, social services, etc. Teaching performance should not only use the evaluation of teaching style and learning style as performance indicators, but should set evaluation indicators around multiple aspects such as teachers' teaching effects, curriculum quality, teaching workload, curriculum construction, and teaching reform. For example, set corresponding indicators such as whether teachers' teaching courses or the teaching content in and out of class are innovative. Scientific research level should not use the number of publicly published papers and the level of scientific research projects undertaken as performance appraisal indicators but should focus more on the achievement level and actual transformation benefits of scientific research projects, such as whether the project results are transformed and whether they generate economic or social benefits, etc. At the same time, in terms of social services, it is also necessary to consider teachers' contributions to serving economic and social development, such as the actual achievements of teachers' scientific research work in serving society. For example, serving as a technical expert or professional instructor for an enterprise's R & D project, carrying out product production, installation, and commissioning operations on the spot in the factory, or providing professional consulting, technical guidance, solving specific technical problems in production, as well as conducting popular science or special lectures. After being recognized, corresponding performance points can be added.

In the performance appraisal process, it is necessary to ensure fairness, justice, and openness. We standardize and establish a perfect performance appraisal procedure, clarify the time and procedure of the appraisal work, and promote the orderly and organized development of the appraisal work. We should also

establish a supervision mechanism to do a good job in the supervision of performance appraisal and prevent problems such as personal subjective factors and favoritism and malpractice in the appraisal process. The performance appraisal results should be announced on time, and the supervision of the appraised personnel should be done well. For those who have doubts about the appraisal results, a timely appeal channel should be provided to ensure the protection of the interests of faculty and staff.

5.2. The incentive mechanism plays an important role in stimulating the enthusiasm and creativity of faculty and staff

It is important to link the performance salary with the assessment results, link the salary with the actual work performance contributions of the faculty and staff, and improve the salary treatment of the faculty and staff with outstanding work performance contributions. High salary treatment and good rewards are offered to the faculty and staff with outstanding performance, such as performance bonuses, scientific research achievement awards, teaching achievement awards, etc.; appropriately reduce the salary treatment such as performance salary income to establish a salary incentive and restraint mechanism for the working faculty and staff. In addition to setting material rewards, by giving play to the role of spiritual incentives, honorary awards such as the Teaching Master Award, the Outstanding Scientific Research Contribution Award, and the Excellent Service Award are also set up to commend the outstanding achievements and contributions of the faculty and staff emerging in various fields, so as to enhance the sense of honor and accomplishment of the faculty and staff; provide the faculty and staff with more career development opportunities, such as education and training, academic exchanges, job promotions, etc., to enhance the professional value of the faculty and staff and stimulate their work enthusiasm by providing attention and care ^[10].

5.3. The supervision mechanism is an important guarantee for ensuring the healthy operation of the flat management model

In terms of internal supervision, we give full play to the role of the discipline inspection and supervision department, strengthen the inspection and supervision of various school work, focus on supervising the operation of various school powers, resource allocation, financial management, etc., and put an end to the abuse of power and corruption; establish and improve the internal audit system, strengthen the internal audit work of the school's financial revenue and expenditure, economic activities, etc., and effectively ensure the safety and reasonable use of school funds; vigorously encourage the faculty and staff to carry out internal supervision, set up reporting mailboxes, reporting and complaint hotlines, etc., so that the faculty and staff can timely reflect the problems and suggestions in the school work. In terms of external supervision, we actively accept external supervision from government departments, the public, parents, and students. Government departments should regularly conduct inspections such as detection and evaluation of the school-running and management situation of colleges and universities and put forward rectification suggestions for schools with problems; the public, parents, students, etc. can conduct supervision and evaluation of the relevant work of the school through the Internet, media reports, etc. The school should respond positively to social concerns, continuously enhance its work ability, and strive to improve its level.

Disclosure statement

The authors declare no conflict of interest.

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Practical Exploration and Optimization Path of Teaching Supervision Mechanisms in Colleges and Universities: Analysis of Teaching Quality Data in the Autumn Semester of 2024 at School A, University Z

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Abstract: Teaching quality is the core guarantee for universities to achieve their talent cultivation goals, and teaching supervision, as an important means of monitoring teaching quality, runs through the entire process of teaching management. Based on the teaching quality report of School A at University Z for the autumn semester of 2024, this paper systematically analyzes the current situation, problems, and causes of the teaching supervision mechanism through multi-dimensional data analysis of expert classroom observation, peer evaluation, and classroom feedback. On this basis, combined with the application prospects of artificial intelligence technology, it proposes paths to optimize the teaching supervision mechanism, including improving the classroom observation feedback mechanism, increasing supervision coverage, and strengthening the linkage between feedback and teaching reform, providing practical experience and theoretical support for improving teaching quality in universities.

Keywords: Teaching supervision; Teaching supervision mechanism; Multi-dimensional quality evaluation; Teacher classification development

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1. Introduction

The continuous improvement of teaching quality in universities is an important guarantee for achieving talent cultivation goals. Teaching supervision is a professional work process that standardizes teaching management, maintains teaching order, inspects, monitors, evaluates, and guides teaching. It is an essential component of teaching quality management, monitoring, and assurance systems in universities^[1]. As the core mechanism of quality monitoring, teaching supervision plays an irreplaceable role in providing feedback on teaching,

promoting reform, and leading innovation. Zhao and Yao pointed out through big data analysis of Z University that teaching supervision is an indispensable link in the teaching quality assurance system of universities, and proposed suggestions such as innovating supervision work models and optimizing feedback mechanisms [2]. Qiao and Shang explored the importance of improving the digitization and intelligence level of teaching supervision under the concept of digital intelligence through data analysis of Liaoning Vocational College of Light Industry. They proposed the realization of dynamic quality monitoring and precise feedback through intelligent supervision to further improve teaching quality [3]. Meng *et al.* noted that teaching supervision plays a significant role in improving the teaching ability of young teachers in universities, and resource enhancement and organizational support can effectively improve the quality of higher education teaching [4]. However, in practice, the current teaching supervision mechanism in universities still faces many challenges. Zhang believed that there are deficiencies in teaching supervision positioning, teaching supervision methods, and teaching supervision teams in higher vocational colleges [5]. Ou found that although higher vocational colleges have established a three-level dual-track teaching supervision system, there is still a significant need to improve operational mechanisms and management capabilities [6]. Xu *et al.* pointed out that university teaching supervision encounters bottlenecks in terms of system and organizational structure in high-quality development, and the unscientific evaluation system hinders the effectiveness of teaching supervision [7]. In addition, Liu's analysis showed that teaching supervision still has insufficient execution in promoting teachers' professional development and students' ability training, and these structural difficulties need to be solved by optimizing the framework and enhancing teaching data support [8].

This paper takes the teaching quality report of School A at University Z for the autumn semester of 2024 as the core data source, systematically analyzes the multi-dimensional perspectives of its teaching quality supervision, and provides a reference for universities to construct a scientific, efficient, and practical teaching supervision mechanism through problem diagnosis and path optimization.

2. Analysis of the current situation of teaching supervision in School A of Z University

2.1. Levels and coverage of classroom observation supervision

The teaching supervision system of School A at Z University is mainly divided into three levels (**Table 1**): expert supervision, peer evaluation, and internal course team evaluation, forming a multi-level quality monitoring network of “experts-peers-course team.” Each level of supervision has its own focus in terms of coverage, evaluation priorities, and scoring characteristics, jointly building a comprehensive teaching quality assurance system (**Table 2**).

2.1.1. Expert classroom observation supervision

Expert supervision covers all professional courses within the school, with a coverage rate of 98% and an average score of 87.3. The focus is on the academic value of the teaching content, the achievement of course objectives, and teaching standardization. The low scores in classroom interaction and teaching innovation reflect that teaching methods and innovation abilities still need improvement.

2.1.2. Peer evaluation

Peer evaluation covers full-time teachers and most part-time teachers, with a coverage rate of 91%. Peer evaluation pays more attention to classroom teaching skills, teacher-student interaction, and teaching

organization abilities. The average score is 84.6, with a relatively balanced distribution and comprehensive evaluation dimensions, but slightly lacking in academic depth.

2.1.3. Internal course team evaluation

The coverage rate of internal course team evaluation is 85%, and the evaluation content focuses on course resource sharing and teaching progress coordination. The average score is 82.5, which is lower than expert supervision and peer evaluation, and there is less innovative evaluation.

Table 1. Coverage and scores of teaching supervision in School A of Z University

Types of supervision	Number of supervised courses/Total number of courses	Coverage rate	Scoring composition	Average score
Expert supervision	139/142	98%	Above 90 points: 15% 85–90 points: 65% Below 85 points: 20%	87.3 points
Peer evaluation	129/142	91%	Above 90 points: 25% 85–90 points: 55% Below 85 points: 20%	84.6 points
Internal course team evaluation	121/142	85%	Above 90 points: 30% 85–90 points: 50% Below 85 points: 20%	82.5 points

Table 2. Distribution of evaluation focus across supervision levels

Supervision levels	Main evaluation contents	Evaluation characteristics
Expert supervision	The academic value of teaching content; The achievement of course objectives; Teaching standardization.	Strict scoring; Low scores for classroom interaction; Low scores for teaching innovation.
Peer evaluation	Classroom teaching skills; Teacher-student interaction; Teaching organization abilities.	Balanced scoring distribution; Comprehensive evaluation dimensions; Insufficient academic depth.
Internal course team evaluation	Coordination of teaching progress; Sharing of teaching resources; Diagnosis of teaching problems.	Less innovative evaluation; Relatively low scores.

2.2. Analysis of teacher group performance

2.2.1. Statistical distribution analysis of teacher scores

Based on the teachers' situation upon entering the school, the college divides them into three groups: those who have worked for more than two years, those who have worked for less than two years, and part-time teachers. As shown in **Table 3**, there are significant differences in the score distribution among different teacher groups: (1) The score distribution of teachers who have worked for more than two years is relatively stable, with only 0.6% scoring below 85, reflecting their strong teaching standardization and stability. (2) For teachers who have worked for less than two years, the proportion scoring below 85 reaches 12%, indicating a lack of teaching experience. However, although their proportion scoring above 95 is low (4.0%), it shows considerable room for growth. (3) Part-time teachers have a high proportion of 18.4% scoring below 85, with the main issues focusing on teaching plan execution and classroom coherence.

Table 3. Statistical table of teacher classroom observation supervision score distribution for the fall semester of 2024

Types of teachers	Above 95 points	90–94 points	85–89 points	Below 85 points	Average score
Teachers with more than two years of experience	10.5%	50.0%	38.9%	0.6%	90.67 points
Teachers with less than two years of experience	4.0%	44.0%	40.0%	12.0%	89.23 points
Part-time teachers	10.5%	44.7%	26.3%	18.4%	88.73 points

2.2.2. Analysis of teaching ability supervision and evaluation for teachers

From the perspective of teaching ability scores, significant differences are observed among different teacher groups in terms of teaching design, classroom organization, and innovative teaching (**Table 4**): (1) Teachers with more than two years of experience excel in teaching design and classroom organization but show a lower willingness to innovate, particularly in adopting new teaching technologies. (2) Teachers with less than two years of experience demonstrate strong classroom interaction skills and actively try new methods, but they have room for improvement in the systematic aspect of teaching design and time management. (3) Part-time teachers possess strong practical teaching abilities, but they need to enhance their execution of teaching plans and the coherence of theoretical explanations.

Table 4. Average scores of teaching ability supervision and evaluation for teachers in the fall semester of 2024

Evaluation dimensions	Teachers with more than two years of experience	Teachers with less than two years of experience	Part-time teachers
Teaching design ability	92.5 points	88.3 points	86.7 points
Classroom organization ability	91.8 points	87.5 points	85.9 points
Innovative teaching score	85.2 points	88.1 points	83.5 points

2.2.3. Statistics of teachers' teaching effectiveness

From the perspectives of student satisfaction and achievement of teaching objectives, different teacher groups exhibit the following performances (**Table 5**): (1) Teachers with more than two years of experience have higher student satisfaction and a higher degree of achievement of teaching objectives, reflecting their strong teaching standardization and stability. (2) For teachers with less than two years of experience, students express higher satisfaction with classroom interaction, but there are slight deficiencies in knowledge imparting and the achievement of teaching objectives. (3) Part-time teachers receive high satisfaction ratings for practical guidance, but there is still considerable room for improvement in theoretical teaching and the achievement of teaching objectives.

Table 5. Student evaluation data table of teachers' teaching effectiveness for the fall semester of 2024

Evaluation indicators	Teachers with more than two years of experience	Teachers with less than two years of experience	Part-time teachers
Overall satisfaction	89.5%	87.2%	85.8%
Interaction satisfaction	86.4%	92.3%	88.1%
Knowledge imparting satisfaction	91.2%	85.7%	82.5%
Practical guidance satisfaction	88.7%	84.5%	90.2%
Achievement of teaching objectives	93.2%	87.6%	85.4%

2.3. Analysis of the current situation of feedback mechanisms

2.3.1. Timeliness of feedback

The proportion of feedback completed within two weeks after class observation is 67.8%, and some feedback is delayed for more than a month. Delayed feedback affects teachers' ability to implement suggestions, resulting in a weakened improvement effect.

2.3.2. Quality of feedback content

Feedback opinions are mostly focused on conventional issues such as the fluency of teaching language and teaching progress control, while substantive improvement suggestions targeting the achievement of teaching objectives and student engagement are insufficient, accounting for only 28% of the total feedback.

2.3.3. Connection between feedback and teaching reform

Although multiple improvement suggestions have been made in the feedback, the implementation is poor, with approximately 45% of teachers indicating that they have not received timely resource support.

3. Problems in the teaching supervision mechanism

3.1. Issues with class observation coverage and evaluation standards

3.1.1. Incomplete coverage

Despite the high coverage rate of the teaching supervision system in School A of Z University, there are still issues of inadequate coverage. Data shows that the class observation coverage rate for part-time teachers is only 74%, which is much lower than that of full-time teachers. This may result in teaching problems of part-time teachers not being identified and improved in a timely manner, affecting the overall teaching quality.

3.1.2. Single evaluation standard

The current teaching supervision evaluation standards are mainly focused on teaching standardization, such as the completeness of teaching content and the reasonableness of teaching progress. However, there are still the following deficiencies: (1) Neglect of teaching innovation: The evaluation standards pay less attention to teaching innovation, leading to insufficient innovation motivation of teachers in classroom teaching methods and technology application. (2) Lack of comprehensive evaluation of students' learning effects: The evaluation system pays less attention to students' learning effects, failing to fully reflect the achievement of teaching objectives and students' actual learning outcomes.

3.2. Insufficient effectiveness of feedback mechanisms

3.2.1. Feedback lag

The insufficient timeliness of class observation feedback is one of the main issues of the current feedback mechanism. Data shows that the proportion of feedback completed within two weeks after class observation is only 67.8%, and some feedback is even delayed for more than a month. This lag directly affects the implementation effect of improvement suggestions, resulting in teaching problems not being resolved in a timely manner. Firstly, the transmission cycle and effect of teaching supervision are not guaranteed, and improvement suggestions for teaching and teaching management cannot be timely communicated to the supervised objects. Exemplary teaching and management materials also cannot be timely distributed for learning within the school ^[9]. Secondly, the class observation feedback process is relatively cumbersome and lacks efficient feedback tools.

3.2.2. Lack of targeted feedback content

The current feedback content is mostly focused on superficial issues such as teaching language fluency and teaching progress control, while there is less in-depth analysis of teaching objective achievement and classroom interaction effects. Only 28% of the feedback involves substantive improvement suggestions. Such untargeted feedback is difficult to provide effective guidance for teachers. There are two reasons for this: firstly, the focus of supervision evaluation is biased towards teaching standardization, ignoring in-depth analysis of teaching effects; secondly, supervisors may lack a comprehensive understanding of teaching objectives and students' learning effects.

3.3. Inadequate support for teacher capacity development

3.3.1. Inadequate support for new teacher growth

New teachers have significant deficiencies in controlling teaching objectives and classroom management, especially in the systematicity of teaching design and time management. However, the current support provided by the school to new teachers is mainly focused on induction training, lacking targeted and continuous teaching ability improvement plans.

3.3.2. Large room for improvement in part-time teachers' teaching abilities

Part-time teachers demonstrate strong performance in practical teaching but have significant room for improvement in teaching plan execution and classroom interaction abilities. Currently, the school's support for part-time teachers is mainly focused on teaching task allocation, lacking systematic training and incentive mechanisms.

4. Paths to optimize the teaching supervision mechanism

To further enhance the teaching quality of School A at Z University and optimize the teaching supervision mechanism, it is necessary to build a systematic and scientific teaching supervision system by improving the class observation feedback mechanism, enhancing class observation coverage and evaluation effectiveness, strengthening the linkage between feedback and teaching reform, reinforcing support for teacher capacity development, and promoting the application of AI technology. The following are specific optimization paths:

4.1. Improving the class observation feedback mechanism

4.1.1. Enhancing feedback timeliness

Currently, there is a lag in class observation feedback, affecting the implementation of improvement suggestions. To address this, it is necessary to standardize the feedback process and improve feedback efficiency: (1) Standardizing feedback deadlines: Supervisors are required to complete feedback summaries and transmissions within one week after class observation to ensure timely feedback. (2) Establishing an online feedback platform: An online feedback system is developed, which records classroom performance in real time, automatically generates feedback reports, reduces manual operations, and improves feedback efficiency.

4.1.2. Optimizing feedback content

Feedback content often focuses on superficial issues and lacks specificity and operability. To address this, it is necessary to optimize the depth and breadth of feedback content: (1) Introducing AI-assisted tools: AI technology is utilized to provide specific and actionable improvement suggestions from dimensions such as

teaching objective achievement and classroom interaction effectiveness. (2) Enriching feedback dimensions: Analysis of teaching innovation and student learning effects are incorporated into feedback to help teachers more comprehensively understand teaching improvement directions.

4.2. Enhancing class observation coverage and multi-dimensional evaluation effectiveness

4.2.1. Achieving full coverage of class observation

Insufficient class observation coverage is one of the main issues in the current teaching supervision mechanism, especially for elective courses and part-time teachers. To address this: (1) Increasing the frequency of class observation: Ensuring the coverage of marginal and elective courses reaches over 90% by increasing the frequency of internal course team evaluations and peer reviews. (2) Focusing on covering part-time teachers: A special class observation plan is developed to improve the coverage of part-time teachers and ensure that teaching problems can be timely identified and improved.

4.2.2. Enriching evaluation dimensions

The current evaluation standards are biased towards teaching standardization, ignoring comprehensive evaluations of teaching innovation and student learning effects. To address this: (1) Diversifying evaluation methods: Classroom behavior observation, student focus group interviews, and other methods are combined to make evaluation results more comprehensive and objective. (2) Optimizing the evaluation index system: The system is optimized by increasing the weight of teaching innovation and student learning effects in evaluation standards, establishing differentiated evaluation index systems, and conducting personalized evaluations for different course types and teacher groups.

4.3. Strengthening the linkage between feedback and teaching reform

4.3.1. Establishing an improvement measure tracking mechanism

The inadequate linkage between feedback and teaching reform is a weak link in the current teaching supervision mechanism. It is important to designate a person responsible for tracking feedback implementation, regularly inspecting the execution of feedback suggestions, and ensuring the implementation of improvement measures. Teachers are provided with necessary resource support (such as teaching equipment, training opportunities, etc.) to help them implement improvement suggestions from feedback.

4.3.2. Building a teaching reform resource library

Teaching reform requires drawing on excellent cases and innovative solutions. It is necessary to organize and share excellent teaching cases from both inside and outside the school to provide teachers with referential teaching innovation plans. A teaching reform resource library is constructed to facilitate teachers' access to and learning from excellent teaching practices.

4.4. Reinforcing support for teacher capacity development

4.4.1. Customized teacher training

Teacher capacity development is key to enhancing teaching quality. Tiered training plans are designed based on the characteristics of different teacher groups: (1) For new teachers, we focus on basic teaching ability training, including teaching design, classroom management, and goal achievement. (2) For veteran teachers, we provide innovative teaching method training, encourage them to try new technologies and methods, and enhance their teaching innovation abilities. (3) For part-time teachers, we design special improvement plans focusing on

strengthening teaching plan execution and classroom interaction abilities.

4.4.2. Incentivizing teaching innovation

Incentive mechanisms are important tools to promote teachers' active participation in teaching reform. Teachers are incentivized to actively try innovative teaching methods through performance rewards, demonstration course competitions, etc. Teaching innovation and student learning effects are incorporated into the teacher evaluation system to promote continuous improvement in teaching quality.

4.5. Promoting the application of AI technology in teaching supervision

4.5.1. Intelligent management of class observation data

AI technology can significantly improve the efficiency and accuracy of teaching supervision. We utilize AI technology to record classroom performance in real time, automatically generate feedback reports, and reduce biases in manual evaluations. Class observation data are classified and analyzed through intelligent systems to provide scientific evidence for teaching decision-making.

4.5.2. Teaching behavior prediction

AI technology can also be used for long-term data tracking and prediction of classroom teaching behaviors. A teaching behavior database is established by analyzing teachers' teaching behavior patterns through long-term data accumulation. AI technology is used to predict the impact of teaching behaviors on student learning effects, providing data support for teaching reform.

5. Conclusion

Through a systematic analysis of teaching supervision data from School A at Z University, this study revealed the main problems in current teaching supervision work and proposed targeted optimization suggestions. These suggestions consider the characteristics of different teacher groups and focus on implementation feasibility. By systematically optimizing the supervision mechanism, it is expected to achieve an overall improvement in teaching quality, providing a referential experience for other universities.

Research shows that establishing a scientific and effective teaching supervision system is an important guarantee for enhancing teaching quality. Future teaching supervision work should focus more on systematicity, pertinence, and effectiveness, promoting the comprehensive enhancement of teaching quality in higher education through continuous improvement and innovation.

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Research on the Multiple Collaborations in the Teaching Community of Undergraduate Professional Introduction Course

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Abstract: Through the empirical research on the teaching of undergraduate professional introduction courses, the teaching experience of similar high-quality courses is refined. Based on modern educational technology, the innovative thinking of similar course teaching is explored. By establishing a teaching community to facilitate multi-dimensional collaboration, this approach overcomes the constraints of time and space, effectively integrates teaching resources, and enhances the scientific rigor, standardization, and effectiveness of course instruction. As a result, the educational impact of professional introduction courses is continuously optimized.

Keywords: Common problems; Teaching community; Multiple collaboration; Exploration

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1. Research significance

The necessity of offering an Introduction to Specialty course can primarily be examined from the perspective of education's fundamental objectives^[1]. This undergraduate introduction course helps students build an understanding of their discipline from the ground up—progressing from basic to advanced knowledge and from a fragmented to a comprehensive perspective^[2]. It serves as a highly instructive, broad, and emotionally engaging course. By systematically enhancing students' professional and industry-related cognition, it provides essential guidance for their four-year academic journey, aligning with the educational goals of undergraduate teaching.

In the digital era, students can access information about their major's characteristics, coursework, career prospects, and employment trends through online resources. However, this information often remains at a superficial level. College freshmen need to quickly familiarize themselves with critical aspects such as program structure, course content, academic planning, and employment analysis. Developing a genuine interest in their field and fostering professional self-confidence requires deeper learning and critical thinking, which can be

effectively facilitated through professional introduction courses.

2. Relative concepts

2.1. Teaching community

“Community,” the English word for community, can be traced back to the Latin “communis,” which means “universal” and “common.” “Community” means a living organism connected by a common bond ^[3]. Ferdinand Tönnies was the first one who discussed the “community” ^[4]. Karl Marx believed that “only in the collective, individuals can obtain the means to fully develop their talents” ^[5].

Accordingly, the course “teaching community” ^[6] should point to a group composed of professional teachers and other teaching-related personnel. Group members should have common educational goals and educational visions, cooperate, communicate, and support each other, jointly promote the implementation of professional teaching activities, and realize the common growth of members. It is a dynamic and innovative curriculum team organization form.

2.2. Multiple collaboration

“Multi-coordination” belongs to the theory of social science. It refers to the mutual cooperation and joint action among different subjects, elements, or systems to achieve common goals. This concept emphasizes that “it is not enough to rely on the power of a certain actor alone” ^[7], and reflects the relationship between different aspects that complement and promote each other. It aims to achieve a more efficient and optimized effect by integrating the resources and forces of all parties.

3. Overview of research

3.1. Research object

Based on the 2016 Guangxi regional excellent video course “Introduction to Tourism Management” approved by Nanning Normal University, according to the curriculum teaching activities from 2019 to 2024, taking the curriculum teaching community as the specific research object, this paper investigates, analyzes, and summarizes the whole process of curriculum teaching cooperation and sharing.

3.2. Research process

Since 2019, the teaching work of the “Introduction to Tourism Management” course (including similar courses) in 12 undergraduate colleges and universities inside and outside the Guangxi Zhuang Autonomous Region has been investigated and tracked. Through on-the-spot investigation, telephone survey, online survey, personal interview, and other methods, 28 professional teachers who are engaged in the teaching of undergraduate professional introduction courses in relevant colleges and universities are investigated, and some common teaching problems that need to be solved urgently are summarized and analyzed. At the same time, combined with the multi-collaborative teaching practice of “Introduction to Tourism Management” at Nanning Normal University, this paper analyzes its collaborative measures and effects and provides references for the solution of similar teaching problems.

4. Common problems in the teaching of introduction course of the tourism management major in colleges and universities

4.1. The problem of textbook suitability

At the beginning of 2022, a market survey was carried out on the teaching materials of relevant courses in domestic universities in conjunction with the relevant departments of Tsinghua University Press. It was found that although the undergraduate major of tourism management in China has set up the course “Introduction to Tourism Management,” there are generally problems with the correspondence and consistency of teaching materials.

Among the 28 professional teachers surveyed, there are 22 teachers (78.6%) use non-adaptable textbooks such as “Principles of Tourism,” “Introduction to Tourism,” “Basics of Tourism,” “Introduction to Tourism,” and “College Students Career Planning” as the main teaching materials or teaching aids. The teachers compile the teaching content according to the non-adaptive teaching materials, with different standards, emphases, contents, and levels, which greatly affects the teaching effect of the course “Introduction to Tourism Management.”

4.2. The problem of class transfer

Five colleges and universities (41.7%) in the survey face the problem of avoiding non-adaptable textbooks. The professional introduction course is directly set as a number of lectures in the freshmen’s educational activities, and the important task of guiding the freshmen’s professional concept is assigned to teachers and even administrative department personnel with different positions and levels. It is separated from the key teaching work links such as student learning situation analysis, teaching effect evaluation, and learning achievement assessment. All kinds of teaching personnel carry out teaching activities with great subjectivity, and the construction of a teaching resource library corresponding to curriculum teaching is even more impossible. There is a lack of basic support for the continuous and effective construction of the curriculum. From the perspective of educational effect, such teaching activities often fail to achieve the educational purpose of college freshmen advocated by the curriculum, cannot effectively stimulate students’ enthusiasm for learning, cannot awaken students’ professional emotions, and it is difficult to establish freshmen’s professional identity and guide their learning career.

4.3. The problem of teaching mode innovation

In this survey, 8 universities (66.7%) of the respondents still adopt the traditional teaching mode, and the course “Introduction to Tourism Management” is set up as a full-line offline course, which is taught in a theoretical way. The students’ attention is low and the classroom teaching effect is poor.

According to the learning situation tracking and teaching effect evaluation of this course over the years, although students’ praise of online or mixed mode is higher than that of traditional offline teaching mode, the effect of high-quality information teaching resources on the exploration of collaborative sharing is not ideal. The main reason is that some teachers lack multi-party collaboration channels and resource exchange channels, and lack interest in foreign exchange and cooperation.

4.4. The problem of professionalism and sustainability of teachers

From the perspective of the full-time teachers of tourism management undergraduate majors in various colleges and universities, there are obvious differences in the characteristics of cascade teams, hierarchical structures, and disciplines. The source channels, professional backgrounds, and industry experiences of some teachers are separated and complex and fail to form a complementary member structure^[8]. At the same time, teachers’

professional understanding and professionalism are different, and there are considerable differences in teaching performance.

In the course “Introduction to Tourism Management,” 9 colleges and universities (75%) of the respondents have different standards for the arrangement of teachers, which is mainly reflected in the randomness of the arrangement of teachers. There are both new teachers with insufficient teaching experience and non-tourism professional teachers, and the mobility of teachers in each semester is very strong.

5. An empirical analysis of the multiple collaborative exploration and practice of teaching community

The course team of “Introduction to Tourism Management” at Nanning Normal University has been set up since 2014, emphasizing that double-qualified professional teachers are the core of teaching activities. In 2015, the course completed the development and construction of various tasks on the “Chinese University MOOC” platform. In 2016, the course was opened. In the same year, it was awarded the Guangxi district-level boutique video course. In 2019, it was recognized as the first-class undergraduate course of Nanning Normal University. In the same year, it was awarded the second prize of the undergraduate group of the 19th Guangxi University Education and Teaching Information Contest. The construction of information-based teaching resources in this course has a long history. Up to now, a total of 16 open courses have been successfully operated on “Chinese University MOOC” platform, and continuous and effective construction has been carried out in various dimensions, showing a process of curriculum construction from disorder to order, from relative chaos to relative stability.

The practice process and effectiveness of the multiple collaboration of the “Introduction to Tourism Management” course teaching community of Nanning Normal University include the following aspects.

5.1. Joint cooperation for the construction of new forms of textbooks in the new era and solving the problem of textbook adaptation of the “Introduction to Tourism Management” course

Textbooks are the main scripts for talent training ^[9]. Nanning Normal University led the establishment of the “Introduction to Tourism Management” (micro-course version) textbook development group. The editors are from three undergraduate colleges, including Nanning Normal University, Yulin Normal University, and Guilin University of Technology. They are all backbone teachers of tourism management and full-time teachers of the “Introduction to Tourism Management” course in three undergraduate colleges. The textbook was specially supported by the key professional construction funds of Nanning Normal University. In order to ensure the publishing quality and promotion effect of the textbook, Tsinghua University Press, one of the top 100 publishing houses in China, included it in the series of “Applied New Form Textbooks for Colleges and Universities.”

The textbook closely focuses on the freshmen’s education objectives and professional training objectives of the undergraduate major of tourism management in colleges and universities, carefully designs the teaching content, deeply combines the current development trend of the tourism industry and the situation of tourism higher education, and covers the core contents of college students’ attention. For example, the development of modern tourism industry, the composition of tourism industry, the policy and environment of tourism industry, the demand for tourism talents, the higher education of tourism, the undergraduate major setting and teaching arrangement of tourism management, the way of professional learning, the employment situation

and employment concept of tourism talents, career planning, and tourism career exploration, so as to serve the teaching of the introductory course of the undergraduate major of tourism management. The content of the textbook keeps pace with the times according to the changes of the situation, with complete structure, clear logic, rich content, detailed data, and vivid cases. Professional textbooks with adaptability, timeliness, and scientificity can effectively solve the problem of adaptability between professional courses and undergraduate textbooks, help to consolidate the foundation of curriculum teaching, standardize the content of curriculum teaching, promote the continuous construction of curriculum, improve the effect of curriculum education, and become a good help to promote the continuous optimization of curriculum construction.

5.2. Joint collaboration strengthens the information construction of curriculum teaching resources, promotes multi-school sharing of high-quality information teaching resources, and implements the collaboration effect of members of the curriculum teaching community

Based on the construction achievements of tourism management major (national first-class undergraduate major construction point) of Nanning Normal University, the members of the course teaching community have cooperated with many teachers to jointly develop and design the information-based teaching resource library supporting the course, and form high-quality digital teaching resources, including book supporting two-dimensional code, ideological and political series micro-course video, electronic courseware, electronic exercise library, learning situation analysis system, online interactive community, etc. Through the continuous updating of digital resources on the course platform, the intelligent construction and promotion of professional courses are continuously realized.

Second, set up the MOOC on high-quality platforms, form a multi-school sharing mechanism, promote more students to enjoy high-quality curriculum education resources, and sum up the experience in the practice of curriculum operation at different times and under different student conditions, and constantly optimize. The interactive integration of information-based teaching resources under the background of collaboration can greatly promote the common progress of curriculum construction in relevant colleges and universities, continuously improve the performance of curriculum teaching, and optimize the effect of curriculum education.

5.3. Joint cooperation channel leveraging the digital intelligence channel to break through the limitation of time and space

We open a multi-school, multi-point, multi-person “cloud” teaching collaboration channel, jointly improve the professionalism of curriculum teaching, ensure the scientific nature of teaching methods, and maintain the sustainability of the teaching echelon. At present, the relevant courses have completed the teaching operation practice of the “cloud” course teaching exchange platform under the background of multi-school cooperation by collecting the “Introduction to Tourism Management” teaching team of four universities in the region through two periods of “cloud” teaching cooperation.

The teaching synergy between the members of the curriculum teaching community emphasizes interaction and complementarity is an organized behavior^[10]. Its purpose is to maximize the teaching objectives through team strength. From the perspective of empirical analysis, the introduction course teaching community is driven by collaboration to improve the quality of teaching. By means of communication, interaction, guidance, and assistance among members, it realizes the remote interaction of classroom teaching, sharing and discussion of teaching experience, guidance of teaching technology, standardization of teaching content, sharing and co-construction of teaching resources, and promotion of curriculum teaching, research, and teaching reform among

members of the community. It can effectively break through the bottleneck of relevant teachers in some colleges and universities, break the time and space constraints of teaching cooperation, effectively help relevant teachers to improve their teaching experience, improve the teaching ability of professional courses, and form a mature theoretical system of curriculum teaching.

According to the development needs of the new situation, the course teaching community invites different off-campus industry experts to join the “cloud” classroom in each issue through “MOOC classroom,” “live connection,” “online discussion,” and other ways. It carries out special theme teaching activities such as industry concept, career development, scientific attitude, inquiry spirit, etc., and promotes the whole teaching quality of the introduction course through intelligent means to improve and optimize the effect of curriculum education.

6. Conclusion

According to the survey, most colleges and universities face some problems in the teaching activity organization, teaching content control, teaching resources, and teacher team building of professional introduction courses. The professionalism and sustainability of the professional teachers of the course cannot be solved. Effectively improving the guiding significance of the “Introduction to Tourism Management” course for undergraduate freshmen has become an empty talk, which cannot achieve the learning effect of the course education.

The exploration and practice of the teaching community of the introduction course in colleges and universities to carry out the exploration and practice of the multi-cooperation mechanism is to collect the textbook users (teachers) in the process of the application and promotion of the new form of teaching materials and information-based teaching resource library and professional MOOC. Through the establishment of a multi-college “cloud” teaching exchange and cooperation platform, the establishment of a professional course teacher consortium across time and space is realized, and the interaction between curriculum exchange and teaching activities is continuously carried out through the platform. It is important to continuously and effectively promote the construction of relevant courses in cooperative colleges and universities, and scientifically improve the effectiveness of the teaching activities of the introduction course. The “Internet+” teaching community across time and space can also greatly help teachers in schools to improve the teaching quality of the whole process from lesson preparation, teaching, and grinding, improve the teaching ability of professional courses, optimize the effect of curriculum education, and continuously realize the all-round improvement of curriculum construction, team building, teaching effect, and curriculum quality.

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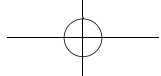
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