



REVIEW ARTICLE

Comparative Analysis of Veterinary Education: China in Comparison to Global Systems

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ABSTRACT

This study explores the status and lessons learned from veterinary medicine and its One health perspective in academia, comparing the systems of China with the rest of the world. For this purpose, multiple databases, including PubMed, CNKI, Web of Science, etc., were used to analyze various aspects of veterinary education in China. The paper is structured into sections including veterinary medicine in academic institutions, the development of veterinary culture, the status of veterinary education in China, issues and challenges, international comparisons, and optimization suggestions. In this study, a simple approach to the historical evolution of veterinary education in different developmental stages is revealed through a retrospective analysis. The section on the status of veterinary education in China focuses on critical areas such as talent cultivation, practical teaching and internships, educational evaluation systems, professional education, and innovation and entrepreneurship. Through the analysis of challenges and issues in Chinese veterinary education, the paper reveals inadequacies in curriculum systems and imbalances in internship and practical opportunities. Comparing with Europe, America, and developing countries, this paper offers insights and inspirations to guide the 'future development of veterinary education in China. Finally, the paper proposes optimization suggestions, including improvements to the curriculum system, strengthening practical teaching, and promoting international cooperation and exchange. These measures aim to propel Chinese veterinary education towards a healthier, more diverse, and internationalized direction, enhancing the overall quality of veterinary professionals to meet better veterinary workers, nonhuman animals, and one health in societal development.

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INTRODUCTION

Animals play indispensable roles in human society, providing daily meat consumption to alleviate labor burdens and becoming a vital component of economic animal husbandry (Abbas *et al.*, 2023). The increasing numbers of companion animals and economic livestock, coupled with the development of modern production systems, transportation tools, and communication networks, have expanded the spread of animal diseases, posing serious challenges to human health and safety (Saeed and Alkheraije, 2023). The close contact between animals and humans facilitates the rapid transmission of diseases, especially zoonotic infections like canine infections caused by livestock parasites, which are widespread in Heilongjiang Province. In the context of

China's rural economy, livestock farming, as one of the pillar industries, not only provides economic income and employment opportunities for farmers but also enhances soil fertility through animal manure, increasing crop yield and quality. However, in modern intensive farming models, the rapid spread of animal diseases does not only cause direct economic losses for farmers but also poses potential threats to food safety (Luo *et al.*, 2023). For instance, the outbreak of the African swine fever virus spread quickly across the nation in China in 2018 despite prompt government measures, resulting in significant economic losses (Bajić, 2014). In addition to economic aspects, the health of animals also directly relates to ecological balance and environmental protection (Saeed and Alsayeqh, 2023). China boasts rich wildlife resources, including many nationally protected wild animals. Protecting wildlife and

maintaining ecological balance have become urgent tasks in contemporary China. The scarcity of talent in wildlife veterinary medicine, especially in nature reserves and animal and plant disease control departments, hampers these efforts (Hao, 2012). The evolution of veterinary medicine and one health education in China has a profound history, from ancient times in primitive societies to contemporary modernization. Ancient Chinese veterinary education dates back to the 22nd century BC (Wanzala *et al.*, 2005). From the late 19th century to the early 20th century, China embraced the introduction of Western medicine and veterinary science, officially establishing a veterinary education system that incorporated Western veterinary disciplines and teaching methods. In 1904, The College of Veterinary Medicine was the first institution to serve as a source of modern veterinary institutions founded in the Qing dynasty era (Yin *et al.*, 2006). This led to the coexistence of the Chinese veterinary academic system with the dual tracks of Western and traditional veterinary medicine.

After the founding of the People's Republic of China, veterinary education received significant attention from the government. In 1950, prominent figures in the field, such as Professor Xiong Dashi, initiated and promoted society activities, gradually expanding membership and forming national branch organizations. This propelled the vigorous development of modern livestock veterinary practices in the new China and paved the way for the revival of traditional veterinary medicine. In the early years of the People's Republic of China, the government swiftly issued directives emphasizing the protection of animal husbandry and the prevention of animal diseases (Schiffeler, 1980). In September 1956, Beijing hosted the first "National Symposium on Folk Veterinary Medicine," officially outlining the strategic goal of "closely integrating Chinese and Western veterinary medicine, propelling the academic development of veterinary medicine in China into a new stage." Under the impetus of China's reform and opening-up policy in 1978, veterinary education moved towards internationalization and modernization (Willis, 2000). Concurrently, collaborative relationships with foreign universities facilitated academic exchanges and international talent cultivation. These measures gradually propelled China's veterinary education onto a fast track of development, producing a substantial number of outstanding veterinary professionals. Entering the 21st century, the continuous progress in scientific technology and the rapid growth of information technology have posed new challenges and opportunities for veterinary education in China (Ross *et al.*, 2001). Meanwhile, the wave of globalization has impacted domestic veterinary education, necessitating urgent alignment with international standards and the continuous enhancement of teaching quality and research capabilities. Consequently, many universities have actively introduced overseas study programs to elevate the international standing of veterinary education in China (Ding and Wang, 2020).

Veterinary culture: Veterinary culture in China has a long and rich history, dating back to primitive societies. In ancient times, the role of veterinarians was to treat animal diseases, ensuring the normal progress of agriculture and human life. This culture has inherited a wealth of medical knowledge and techniques, forming unique therapeutic

methods and theoretical systems that continue to play a crucial role today (Yi, 2022). Research indicates that herbal powders based on traditional Chinese veterinary practices not only improve the uterine condition of cows but also enhance the overall health of cows retaining placenta, positively impacting their subsequent reproductive capabilities (Huang *et al.*, 2018). The influence of Chinese veterinary culture extends beyond the domestic sphere and has gained recognition in English-speaking countries and other overseas nations. Literature suggests that acupuncture therapy is effective not only in treating various musculoskeletal and internal diseases in equine medicine but also in addressing issues such as neck and back pain, colic, lamellar inflammation, laryngeal hemiplegia, scapulohumeral neuropathy, and non-diagnostic lameness (Mangan and Xie, 2022). In ancient China, veterinarians were revered as the "physicians for animals," and their status and role were integral to society. In contemporary society, veterinarians not only serve as doctors treating animal diseases but also bear the crucial responsibility of ensuring public health and food safety. As veterinarians, prioritizing the well-being and health of animals and embodying compassionate medical ethics are paramount.

Current status of veterinary education in China

Veterinary talent cultivation system: In recent years, with the rapid increase in population and environmental changes, the growing interaction between humans, animals, and nature has highlighted the significant threat of zoonotic diseases to the health of both humans and animals, underscoring the crucial role of veterinary scientists in biomedical research and public health (Klauder, 1958). Veterinarians play a vital bridging role in connecting humans, animals, and the environment, leading to the flourishing development of veterinary education. The cultivation of veterinary talents, as the cornerstone of veterinary education development, increasingly emphasizes its unique position, especially with the establishment of a sound veterinary talent cultivation system becoming a new challenge. As a core element of talent cultivation, the curriculum in China's veterinary programs achieves an organic integration of general education, professional education, and clinical practice. In the initial two years, students undertake general courses such as mathematics, biology, chemistry, ideology and politics, and foreign languages, accounting for approximately 50% of the total study hours. In the third and fourth years, students specialize in foundational and major courses, engaging in clinical practice. Veterinary education places a strong emphasis on practical skills and operations, adopting a "2-2-1" plan, i.e., two years of general education, two years of professional education, and one year of clinical practice, resembling international five-year and six-year training programs (Yin *et al.*, 2006).

Universities balance the curriculum with traditional core courses and specialized courses, such as veterinary infectious diseases, veterinary surgery, internal medicine, veterinary pathology, and animal anatomy. Moreover, distinctive courses like equine medicine and wildlife epidemiology are introduced (Coffman, 2002). The core curriculum is well-structured and aligns with international standards with adjustments based on regional characteristics. International standards for veterinary talent

cultivation vary; for instance, the Netherlands emphasizes individual guidance and group learning to cultivate students with specific species qualifications (Matthew *et al.*, 2020). In the United States, the focus is on cultivating students' attention to market demand, collaborative research projects, and work-life balance, with an emphasis on providing more internship opportunities (Hodgson *et al.*, 2013; Bell *et al.*, 2018). However, in China, some abnormal phenomena have emerged in veterinary education because of societal and educational budget constraints. The prevalent issue of "heavy theory, light practice" is observed, with veterinary students lacking opportunities for hands-on experiments (Butler *et al.*, 2002). As a practical discipline, veterinary practitioners require extensive clinical experience (Vandeweerd *et al.*, 2012). Currently, teachers do not only engage in clinical work but also guide thesis projects, conduct classroom and laboratory teaching, and even participate in research activities, leading to a substantial research burden for veterinary educators (Gordon-Ross *et al.*, 2020). This situation has caused some teachers to feel uneasy about their teaching responsibilities. Adjusting the evaluation system, enhancing recognition for teaching, and moderately alleviating research pressure are effective measures to correct these issues.

Veterinary education evaluation system: It is a comprehensive assessment system designed to determine the quality and effectiveness of veterinary education. This system covers multiple aspects, including the allocation of educational resources, teaching content and methods, faculty composition, student skill development, and academic outcomes. As an equally crucial component of the talent cultivation system, the evaluation system for veterinary education has been an unavoidable topic. The evolving landscape of academic fields has shifted perspectives on quality assurance in higher education, making quality assurance and assessment critical to enhancing competitiveness in higher education (Noyes *et al.*, 2022). In European Union countries, educational assessment has become a key task for universities, whether as part of approval processes, accreditation, or ongoing evaluations (Crosier *et al.*, 2007).

Veterinary education should establish a robust, comprehensive assessment system to promote the

improvement of its quality. National standards for veterinary higher education that align with the practical situation should be developed, assessing professional proficiency to ensure the establishment of practice standards for professional service quality (Table 1). This would fundamentally verify the capabilities of teachers and provide a continuous quality assurance mechanism for the training of veterinary talents (Harman *et al.*, 2000). The Education Council of the American Veterinary Medical Association evaluates the implementation of courses in veterinary schools and implements a veterinary ranking system. This promotes the development of veterinary education practices through professional monitoring and the establishment of practice standards (Mossop, 2012). However, with the increasing number of new young teachers in China's institutions, while possessing certain foundational professional knowledge, there is a widespread imbalance between knowledge and practical skills, necessitating further improvement in clinical practice. From the teachers' perspective, some may feel uneasy about their teaching responsibilities. Nevertheless, this is not without reason, as many veterinary educators overly prioritize research, neglecting teaching. This is related to the one-size-fits-all approach used in the current evaluation system for teachers' abilities and title evaluations by the education department. To address this, there needs to be greater recognition from the education department and society for teachers' teaching achievements. In title evaluations and other aspects, teachers' achievements in teaching should be acknowledged to make teachers proficient in teaching feel the respect of society (Msellati *et al.*, 2012). Therefore, adjusting the current evaluation system appropriately and implementing a flexible, non-uniform evaluation system becomes crucial.

The veterinary education evaluation system is a crucial component of the higher education system, and its enhancement is vital to ensuring education quality and competitiveness. Additionally, students' perspectives play a significant role in evaluations (Palacios-Díaz and Mendoza-Grimón, 2023). To improve the student education evaluation system, it is essential to abandon traditional methods that primarily rely on exam scores and establish a diversified set of evaluation criteria. These criteria should include academic performance, comprehensive

Table 1: Steps and recommendations for the evaluation of the performance of veterinary students and institutions

Phases	Sectioning	Suggestions
Phase of Planning	Identification of objectives	The veterinary program's objectives can be the provision of a learning environment for nurturing fellowship among the teachers and professional veterinarians, focusing specifically on the ethics related to personal behaviors and professionalism.
	Specification of goals	Demonstration of the capacity for understanding the requirement of referrals or additional professional assistance for the services of animals, society, and clients can serve as a basic goal of the course.
	Identification of instructions	Communication between the veterinary instructor and trainee should be effective and positive according to Kaufman and Mann's principles (Kaufman and Mann, 2010).
	User need identification	Veterinary trainees (students) should respond to what they need from their teachers. A feedback system is assistive in it
	Inputs from the students	Students' ratings can be posted and discussed by the faculty to understand the value of students.
Phase of Implementation	Students are evaluated in multiple ways	A comprehensive system may be devised for the proper and fair evaluation of the quality of education.
	Support of consultant	A facilitator or consultant for practical or personal affairs may be provided by the faculty to students at their request (Beran <i>et al.</i> , 2012).
	Consultation of students	There is a continuous need for feedback from the students on whether they benefited from the evaluation systems or not.
	Improvement in the response rates	Various methods, like paper evaluation or electronic evaluation systems, may be used for a fair evaluation of the students and taking their feedback.
	Evaluation in the middle terms	A midway evaluation during a veterinary course may be more effective

qualities, skill levels, innovation capabilities, and social practices, among other aspects, to comprehensively reflect students' development. Simultaneously, the evaluation system should clearly define the evaluation objectives to measure students' performance in veterinary professional knowledge, skills, practical abilities, and professional ethics. These evaluation criteria should be based on the core competencies and requirements of the veterinary industry to ensure consistency with industry demands (Brush and Artz, 1999). Moreover, the student education evaluation system is an ongoing process of improvement. Regularly collecting feedback from teachers, students, and industry professionals allows for continuous optimization and enhancement of the evaluation system. Currently, China has constructed a comprehensive system of standards for evaluating the quality of veterinary professional teaching, including national standards for animal medicine, three-level professional certification standards, and national first-class professional construction standards (MacArthur Clark and Sun, 2020). This has driven the core development process focused on improving teaching quality and laid a solid foundation for establishing a sound internal quality evaluation system. However, there are still deficiencies in external evaluations. The current level of assessment of undergraduate teaching in ordinary higher education institutions in China is conducted by experts from the Higher Education Teaching Evaluation Center of the Ministry of Education. The principle is to promote and improve undergraduate teaching quality through assessment. It is an administrative measure. Veterinary education in China needs to establish an external quality evaluation system with industry participation (Bayne *et al.*, 2018). In summary, the improvement of the veterinary education assessment system needs to be approached from various aspects. This includes clarifying assessment goals and standards, designing scientifically rational assessment indicators, adopting diversified assessment methods, reinforcing formative assessment and feedback, introducing industry participation in assessments, establishing an information-based assessment platform, and continuously improving the assessment system. Through the implementation of these measures, the quality and level of veterinary education can be more effectively enhanced, leading to the cultivation of a greater number of outstanding veterinary professionals.

Veterinary professional education: In January 2017, China introduced a new higher education policy, the national "Double First-Class" strategic plan (Liu *et al.*, 2019). Building on the achievements of the 985 Project and the 211 Project, this strategy aims to establish world-class universities and disciplines. By September 2017, the veterinary programs at two universities, China Agricultural University and Huazhong Agricultural University, successfully joined the disciplines targeted for "first-class" development (Lu, 2024). Currently, the veterinary industry is undergoing rapid development, extending along the industrial chain, undergoing structural transformation, and upgrading, focusing on production ecological safety, and pursuing improvements in quality and efficiency (Smith and Kelly, 2008). Nevertheless, the industry faces various challenges. Globally, the prevention

and control of animal diseases remain a persistent issue, and the uneven distribution and inconsistent quality of veterinary services hinder animal husbandry development (Van Rooyen, 2016; Arvidsson *et al.*, 2022). With the continuous advancement of technology, many new technologies have been applied in the veterinary industry, effectively alleviating its challenges. Consequently, differentiated instruction and personalized course offerings are of paramount significance in nurturing students. Nanotechnology, considered one of the key technologies of the 21st century, has provided numerous benefits for both humans and animals, directly promoting human well-being. Nanotechnology is a multidisciplinary approach involving physics, chemistry, material science, biology, engineering, and medicine (Omran and Omran, 2020). In the veterinary industry, nanotechnology finds wide application in areas such as antimicrobials, drug delivery, diagnostics, vaccine formulations, feed additives, reproductive assistance, animal growth, and animal production (Abbas *et al.*, 2022).

Advancements in molecular biology techniques have led to significant progress in the development of third-generation vaccines, enabling veterinarians to make substantial strides in developing vaccines targeting various pathogens. In some cases, veterinary vaccine technology even surpasses human vaccine technology by several years, leading the way in the field of vaccinology (Possas *et al.*, 2021). Compared to first and second-generation vaccines, third-generation vaccines can immunize individuals with compromised immune functions more safely, have the potential to combine multiple plasmids into broad-spectrum combination vaccines, and are relatively more straightforward to engineer (Aida *et al.*, 2021; Lu *et al.*, 2024). Veterinary vaccine technologies play a pioneering role in the field of human medical vaccines. Organoid technology, widely applied in human biomedical research, has gained increasing attention in veterinary research (Gabriel *et al.*, 2024). Stem cells cultured *in vitro*, in the presence of extracellular matrix, can proliferate while maintaining their "stemness," the ability for self-renewal, and generate self-organizing three-dimensional structures, i.e., organoids (Yan *et al.*, 2019). As an invaluable tool for *in vitro* research, organoids hold enormous potential in various research areas such as animal nutrition, host-microbe interactions, animal breeding, genomics, and animal biotechnology.

In recent years, the pet industry, as an emerging force within the veterinary sector, has experienced rapid growth driven by supply-demand dynamics and capital investments. The issue of supply-demand balance in the pet industry has become one of the challenges facing the veterinary profession. As a rapidly emerging and relatively young field, particularly in the domain of pet medical care in China, its development is still deemed insufficiently mature (Thrusfield, 2018). The medical industry places high demands on professionals, requiring exceptional expertise and good professional ethics. Professional ethics are the foundation for ensuring the continuous improvement of medical service levels. Despite dealing with animal patients, veterinarians, like their human medical counterparts, are bound by the same professional ethics and competence standards. Therefore, setting high standards for oneself is imperative for veterinary professionals (Fogle *et al.*, 2021).

Veterinary innovation and entrepreneurship education: With the expansion of graduate education in China, the lack of innovation capabilities among graduate students has gradually become a primary concern in the education sector. Enhancing the quality of graduate teaching hinges on igniting students' subjective initiative and cultivating both their research interests and capabilities. To achieve this, encouraging students to extensively read literature, actively participate in academic conferences, observe the research experiments of senior students, and engage in active discussions with peers is crucial for identifying and nurturing their interests. During research projects, mentors should not only provide appropriate guidance but also encourage graduate students to autonomously navigate the research process, developing their problem-solving skills and growing into individuals sensitive to and passionate about research (Hunt *et al.*, 2022). Practical experience is one of the best ways to cultivate students' research capabilities and innovative thinking. Through industry and education integration, students can immerse themselves in authentic veterinary work environments, acquire practical skills, experience the research process firsthand, and engage in discussions with professionals, fostering independent thinking and problem-solving skills. Therefore, collaboration with relevant institutions is essential to expand internship programs and provide more practical opportunities.

Sustainable development education aligns with the United Nations' Sustainable Development Goals. Cultivating students' innovative thinking is crucial, especially in the veterinary profession, where guiding students to think across disciplines is essential. Modern veterinary practice extends beyond animal healthcare to encompass areas such as environmental protection and public health (De Paula Vieira and Anthony, 2020). Therefore, guiding students to transcend disciplinary boundaries, cultivating a broad knowledge base and the ability to analyze problems comprehensively are imperative.

Courses on creative and innovative thinking have become a future trend. The 21st century recognizes creative thinking as an essential core competency; therefore, as educators, offering innovative courses to promote students' comprehensive development is crucial.

Issues and challenges in current Chinese veterinary education: Veterinary science, as a highly specialized discipline, often experiences delays in updating its professional knowledge. The updating of knowledge in the veterinary field typically relies on the latest research and clinical practices. However, integrating this information into the curriculum often takes a considerable amount of time. Veterinary science spans multiple disciplines, including biology, medicine, and environmental science. The fusion of knowledge from these disciplines may face challenges and necessitate collaboration and communication among interdisciplinary experts.

Various limitations impact animal experimentation teaching, preventing the execution of many experiments and significantly affecting the cultivation of hands-on practical skills for students in related fields such as animal science and veterinary medicine. There are two main reasons for this limitation. Firstly, most experiments in

veterinary science involve manipulating pathogenic microorganisms, posing significant risks to the personal safety of both teachers and students, as well as the surrounding environment (Dyson *et al.*, 2017). Secondly, the procurement of experimental animals for some animal teaching experiments is challenging and expensive, leading to high experiment costs. Additionally, the use of experimental animals is constrained by principles of animal protection, animal welfare, and animal ethics.

A comparative analysis of veterinary education in China and abroad: There are significant differences between veterinary education in China and abroad. The main characteristics of both are compared below.

In terms of the educational system for veterinary education, China follows a model inherited from the former Soviet Union. Veterinary education in China comprises diploma, undergraduate, master's, and doctoral stages. Currently, most undergraduate programs in China have a duration of 5 years, with a few lasting 4 years. They offer specializations in animal medicine, animal pharmacy, veterinary public health, animal husbandry and veterinary science, and laboratory animal science, among others. The first year primarily focuses on general courses, and from the second year onwards, students delve into specialized classes for 2 to 3 years. A half-year period is allocated for external internships, such as on farms or in pet hospitals, with the final half-year dedicated to completing the graduation thesis. Graduate programs include academic and professional master's degrees. The academic master's program encompasses basic veterinary science, clinical veterinary science, and preventive veterinary medicine, lasting for 2 to 3 years, including 1 to 2 years of coursework and the remaining time for internships and thesis work.

In contrast, veterinary professionals enjoy a higher status abroad, sometimes surpassing human medicine. However, the difficulty of veterinary studies is incredible, and some countries have extremely high admission requirements (Haldane *et al.*, 2017). Taking Australia as an example, veterinary education is divided into undergraduate and graduate levels (McClelland *et al.*, 2022). Undergraduate programs typically last five years, requiring students to complete pre-professional and professional courses to obtain a bachelor's degree in veterinary science. The graduate stage includes master's and doctoral levels, usually not accepting applications from Chinese veterinary undergraduate graduates and requiring them to start from the undergraduate level. In the United States, veterinary education is divided into pre-veterinary education and veterinary education. Students need to have completed 3 years of pre-veterinary education or hold a bachelor's degree in a related field (4 years) or a professional technical qualification from a regional technical college (2 to 3 years). The program duration is mostly 4 years, and due to the high social status and income of veterinarians in the United States, competition for admission to veterinary schools is intense, with an application-to-admission ratio greater than 10:1. Many elite individuals are eager to switch to veterinary studies, and most students have some clinical work experience before enrollment (Barton, 2017).

Veterinary postgraduate students are divided into academic and professional categories at the graduate level

in China. The duration of doctoral programs is generally 3 to 8 years, with a fundamental duration of 3 years, although some schools, such as China Agricultural University, have extended the basic duration to 4 years. In the case of a direct Ph.D. program, the fastest completion time is within 5 years. Veterinary doctoral degrees abroad mainly fall into two categories: DVM and the traditional Ph.D. In the United States, DVM is a professional doctorate, belonging to a professional degree and is relatively rare. In Europe, only a few countries offer professional doctoral degrees. Students need to undergo 4 years of professional learning and clinical training to pass the veterinary practitioner examination for the award of a DVM degree (Varnum *et al.*, 2020). On the other hand, a Ph.D. focuses basically on laboratory research, and a Ph.D. is a research-based degree that depends on the duration of the research. Although the bestowal standards and curriculum settings may vary among different universities, applicants generally need a relevant bachelor's degree in biological science, animal science, or a related field. Applicants also need to pass a series of entrance exams and interviews to demonstrate their academic competence and professional background to cope with the challenges of the DVM program. DVM programs typically last 4 to 5 years, depending on the university's rules and the local education and practice authorities. Veterinarians obtaining a DVM degree possess advanced professional capabilities for clinical work in various veterinary hospitals, clinics, research institutions, or government departments, contributing to the health and welfare of animals. In Australia, a Ph.D. in veterinary science is a research-based doctoral degree focusing on in-depth research and academic exploration in veterinary science or related fields. Compared to DVM, a Ph.D. emphasizes the cultivation of research skills and innovative thinking rather than clinical skills training. The duration of Ph.D. programs varies depending on individual research progress and academic requirements but generally takes 3 to 5 years, culminating in obtaining the degree through thesis writing and defense (McClelland *et al.*, 2022).

Teaching modes, examination formats, and implications of differences in veterinary education between China and abroad: In terms of teaching modes and examination formats, traditional veterinary education in China involves instructors delivering course content from the podium, with students passively taking notes and listening, resulting in limited interaction between teachers and students. Even with the support of modern technology, such as computer-assisted teaching, it remains challenging to stimulate active student engagement.

In practical teaching, clinical education in Chinese veterinary programs often involves students observing and learning by standing behind the teacher, with limited hands-on opportunities. In contrast, foreign teaching models are more innovative, integrating relevant knowledge from basic disciplines and covering cutting-edge research developments. Due to the frequent updates in teaching content, most foreign countries do not have standardized textbooks. Instead, course materials are derived from published literature and instructor summaries. Active interaction between teachers and students is encouraged, fostering students' enthusiasm for learning. Foreign veterinary education emphasizes developing

students' case analysis ability and strongly emphasizes cultivating independent work, practical skills, and hands-on experience (Uscanga Aguirre, 2021). In the United States, students can independently handle sick animals, conduct clinical examinations, report their findings, and propose further diagnostic methods and treatment plans.

Regarding assessment, the Chinese veterinary examination system follows a traditional model, including mid-term and final exams. Evaluation components include class attendance, assignments, papers, and exam performance. Exams primarily test students' rote memorization of textbook knowledge. In contrast, foreign assessment methods are more flexible. For example, the grading system in American veterinary courses comprehensively assesses various aspects of student performance, with each subject adopting distinctive examination formats (Ryan *et al.*, 2009).

The differences between Chinese and foreign veterinary education offer several insights for veterinary education in China. Firstly, foreign veterinary education emphasizes practical skills and comprehensive qualities, while China leans towards imparting theoretical knowledge. China can draw from foreign veterinary education models to enhance practical teaching and develop students' practical and innovative capabilities. Secondly, foreign veterinary education emphasizes heuristic and case-based teaching, focusing on student initiative and engagement, whereas, in China, there is more focus on traditional lecture-style teaching methods. Therefore, China can explore more diverse teaching methods and approaches, such as case-based teaching and simulated practices, to stimulate student interest and engagement. Thirdly, veterinary education experts in China should learn from foreign colleagues by focusing on interdisciplinary collaboration and integration, expanding the students' perspectives and innovation capabilities, and enhancing their comprehensive qualities and adaptability (Blum *et al.*, 2012). Fourthly, collaboration and exchange with international veterinary education institutions can strengthen China's veterinary education by introducing advanced educational concepts and technologies, enhancing its international standing (Fang, 2012). Finally, it is crucial to consider all aspects of veterinary training to train competent veterinarians, ensuring that veterinarians can integrate all knowledge and make professional judgments. In the context of a shortage of veterinary professionals, educational institutions should not only focus on enrollment quantity but also prioritize education quality. This is essential to ensure that the veterinarians trained in China can meet societal needs, preventing a widespread phenomenon of individuals switching professions.

Experiences and lessons from veterinary education in China

Optimization of curriculum system: The veterinary education system in China can be significantly improved through various optimizations to enhance educational quality and cultivate outstanding veterinary professionals. It is imperative to discard traditional views on veterinary education to align veterinary education with the demands of animal husbandry and societal development. Instead, a new teaching philosophy emphasizing "solid foundation,

broad perspective, practical experience, and strong capabilities" should be established. In the construction of the curriculum system, interdisciplinary courses should be introduced, and the proportion of elective courses should be increased appropriately, enabling versatility and integration between veterinary sciences and other disciplines. Interdisciplinary education facilitates the integration of diverse knowledge and perspectives, effectively addressing complex professional issues. Furthermore, the introduction of cutting-edge knowledge and the inclusion of courses related to advanced technologies and research fields should be prioritized. This ensures students have exposure to the latest scientific knowledge and technologies. Simultaneously, strengthening the construction of the teaching staff by attracting experts with cutting-edge research capabilities and experiences to share their latest research findings and technological application experiences is essential, guiding students to delve into frontier knowledge (Hao, 2012; Yang *et al.*, 2013). Improving the caliber of veterinary education necessitates the implementation of a diverse array of pedagogical methods including case-based learning, virtual simulations, flipped classroom models, modular lectures, the integration of science and education, and blended online and offline instruction.

Enhancement of practical teaching

Rational allocation of internship resources:

Collaboration between educational institutions and animal medical facilities allows for convenient personnel scheduling from the perspective of medical institutions. From a student perspective, this collaboration provides more internship opportunities, allowing students to learn and master practical skills through hands-on experience. Schools should also allocate student internships reasonably based on geographical location and internship base conditions. Given that veterinary education is a profession with high technical requirements, emphasis should be placed on educating students in practical aspects, fostering their laboratory research capabilities, clinical practice skills, and hands-on abilities. Traditional practical teaching models, including teaching internships, production internships, and graduation internships, are relatively independent and temporally separated, hindering systematic training in professional skills. In recent years, universities have focused on supplementing existing teaching, production, and graduation internships by promoting undergraduate research training programs and innovative experiments. This enhances students' research, innovation, and practical hands-on capabilities. The existing practical teaching system is singular, dominated by independent experimental approaches of single courses, with experiment content detached from practical production. Reforming the current practical teaching model is therefore significant for improving the veterinary talent training program and enhancing comprehensive qualities and abilities.

Strengthening clinical practice training: Veterinary schools should provide more practical opportunities for students, including involvement in research projects and internship experiences. Practical experience is crucial for translating theoretical knowledge into practical skills and

enhancing problem-solving abilities. While graduates in veterinary medicine only need to pass the veterinary licensing examination to practice, increasing evidence suggests that recent graduates often feel insufficiently equipped for this transition. This indicates that despite the industry moving towards outcome-based training, more efforts are needed to help students prepare for the transition from education to clinical practice. Professional skills such as ethical behavior, professional conduct, and communication, which were once considered time-consuming and potentially detrimental to scientific and technical competence, are now recognized as crucial for cultivating successful graduates. Graduates possessing these traits are more likely to secure employment (Zhang *et al.*, 2011).

International cooperation and exchange

Drawing from international veterinary education experience:

Facilitating collaboration and exchange between domestic and international veterinary education institutions is essential for absorbing advanced teaching concepts and technologies, ultimately elevating the overall education standards. Establishing partnerships with leading universities and research institutions allows for global academic exchanges and collaborative research endeavors. Cooperation with cutting-edge research units enables prompt access to the latest research findings and technological advancements, providing additional resources and support for teaching. From the perspectives on veterinary education and practice in Asia, lifelong learning, shared educational resources, and the trend toward international collaboration offers sustainable pathways for enhancing veterinary education and practice in the region. Notably, improvements in veterinary education and services in key Asian countries have brought about positive transformations (Tian *et al.*, 2022).

Enhancing international competitiveness: To remain abreast of developments, it is imperative to expedite the internationalization of postgraduate education in veterinary professional degrees. Recognizing that China started later in veterinary education compared to developed countries like Europe and the United States, there exists a certain gap in the quality of education. To ensure that the quality of veterinary education meets or exceeds international standards, efforts should focus on deepening open collaboration while enhancing the internationalization of students. This involves adhering to a dual approach of "going out" and "bringing in". "Going out" involves strongly supporting teachers in pursuing further education and engaging in exchange programs at high-level overseas universities. Establishing mechanisms for joint graduate student supervision and exploring models such as co-supervision and dual-degree programs with top-tier international universities are vital steps. Encouraging students to participate in overseas academic exchange activities is also crucial. On the other hand, "bringing in" entails importing advanced educational concepts, training models, curriculum frameworks, and faculty expertise from internationally renowned veterinary education institutions. By implementing these strategies, the internationalization of postgraduate education in veterinary professions in China can rapidly progress (Cheng *et al.*, 2017).

Strengthening communication and exchange with international counterparts not only ensures that veterinary education in China remains current but also enables the adoption of advanced education models and methodologies, comprehensively enhancing the overall standards of veterinary education in the country, and thus bolstering international competitiveness.

Veterinary education and one health concept of diseases: Modern global medical education institutions including veterinary teaching institutes are focusing on one health approach to control the disease. One health is a simultaneous strategy to control the disease spread in the animals and humans simultaneously involving the environment also as a factor to be considered. The environment and humans are also part of a chain that links the transfer of diseases between humans and animals. China needs to move along with global education trends by making one health approach as a part of teaching institutions for the control of diseases. Veterinary educational institutes need to update their curricula according to an advanced scheme that not only teaches the veterinarians to pay their share in controlling the diseases of animals but also stops the animals as a source of diseases spread to humans and the environment. This will make the ultimate goals of health education at veterinary institutions achievable.

Conclusion: Animals are the major shareholders of the modern lifestyle, such as pets and farmed animals. Veterinary education is an essential part of modern living in China. China is focusing on this vocational training from its existence and making advancements in the veterinary medical facilities at the educational institutes of China. China has considerably moved forward in global veterinary medical facilities and education compared to the modern world. China still needs improvement in multiple aspects, including teaching, professional and vocational facilities, work environments, and research and practice facilities. In the modern world, there is a severe need for improvement in veterinary education in China to meet global trends.

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