

Innovation and Practice Exploration of the “Three-Dimensional Integration” Training Model for Veterinary Master’s Students from the Perspective of New Agricultural Sciences

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Abstract: With the deepening advancement of the “Double First-Class” initiative and the New Rural Science and Technology Construction, the training of veterinary master’s students is facing a critical transition from scale expansion to quality enhancement. The quality of graduate education serves not only as a core indicator of high-level talent cultivation in universities but also as a comprehensive measure of institutional research innovation capabilities and social service capacity. Addressing current challenges in veterinary graduate education, such as weak research awareness, insufficient practical innovation skills, and a lack of academic rigor, this paper proposes a three-dimensional integrated training model of “research awareness—methodological system—academic spirit”, based on the teaching reform practices of the Department of Veterinary Medicine at Foshan University in recent years. The article elaborates on specific pathways to solidify academic foundations through a multi-dimensional research environment, enhance practical skills via a “dual-mentor” collaborative mechanism, and improve thesis quality through comprehensive academic training. Practical implementation has demonstrated that this model effectively enhances graduate students’ innovative capabilities and problem-solving skills for industry challenges, providing a theoretical basis and practical references for cultivating interdisciplinary, application-oriented, high-level veterinary professionals.

Keywords: Veterinary Master’s degree; New Rural Science; Research awareness; Practical innovation ability; Training model; Teaching reform

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1. Introduction

As the pinnacle of the national education system, postgraduate education serves as a crucial cornerstone for national development and social progress, acting as a pivotal convergence point for science and technology

as the primary productive force, talent as the foremost resource, and innovation as the driving force ^[1]. Currently, China's veterinary medicine discipline is undergoing a historic transition from traditional to modern veterinary medicine and from a single-discipline to an interdisciplinary approach. Under the New Rural Science and Technology Construction initiative, the training objectives for veterinary master's students have been redefined to encompass not only solid theoretical foundations but also practical innovation capabilities in addressing complex clinical issues, safeguarding public health security, and serving regional economic development ^[2]. However, with the continuous expansion of postgraduate enrollment, some deep-seated contradictions in the training process have gradually emerged. On one hand, some postgraduates exhibit cognitive biases of "emphasizing clinical practice over research" or "prioritizing theory over practice", demonstrating weak research awareness and difficulty in distilling scientific questions from real-world production practices. On the other hand, the traditional "apprenticeship-style" single-supervisor guidance model can no longer meet the interdisciplinary knowledge demands of professional degree candidates, resulting in shortcomings in students' research method selection and experimental design standardization ^[3]. Additionally, the cultivation system for academic ethics and thesis writing skills remains incomplete, directly impacting the academic value and application prospects of dissertations. Based on this, this paper, based on the actual construction of veterinary medicine department of Foshan University, combined with the author's years of experience in postgraduate guidance, from the awakening of scientific research management consciousness, the reconstruction of learning and research methods, the shaping of scientific spirit, three dimensions, systematically discusses the reform path of improving the quality of postgraduate training of veterinary medicine, in order to provide reference for similar institutions.

2. Systematic strategies for cultivating a favorable academic environment

Scientific research awareness refers to the acute perception, profound understanding, and conscious pursuit of scientific inquiry developed by graduate students through specialized learning and social practice. For veterinary master's students, this awareness is not only reflected in laboratory research but also in the in-depth analysis of clinical cases and the precise judgment of animal disease epidemic trends.

2.1. Establishing a hierarchical literature review system to cultivate critical thinking literacy

Literature review competence serves as the cornerstone of graduate research literacy. In traditional training models, literature reading often remains superficial, with students lacking in-depth critical thinking. To address this, the authors have established a three-tier progressive literature analysis framework: "broad reading, intensive reading, and critical analysis." During the course learning phase, the faculty team compiles mandatory reading lists for veterinary internal medicine, surgery, preventive veterinary medicine, and other specialized fields based on disciplinary frontiers and industry demands. The supervisor requires graduate students to not only summarize the paper content after reading, but also address key questions through writing a structured abstract, such as identifying the core scientific question of the paper, examining whether the experimental design contains logical flaws, assessing whether the data sufficiently supports the conclusions, and evaluating the guiding significance of the study for clinical practice ^[4]. Do the data sufficiently support the conclusions? What are the implications of this research for clinical practice ^[4]? By regularly organizing literature review salons, students are encouraged to challenge authoritative viewpoints,

fostering critical thinking and independent analytical skills, thereby maintaining clear judgment amidst complex academic information.

2.2. Enhancing the mechanism for establishing research topics based on industrial demands, and cultivating clear scientific research perspectives

Topic selection serves as the foundation of scientific research, determining its scope and depth. For veterinary master's programs, research topics must strictly adhere to the principle of "industry-based and practice-oriented." During the topic selection process, the authors implemented a "two-way interactive" mechanism. First, advisors guide students to conduct field research at livestock farms, veterinary clinics, or disease control centers to identify operational pain points and challenges. Subsequently, a proposal defense session is organized, requiring graduate students to thoroughly explain the rationale for their chosen topic, the current state of prior research, the technical implementation of their proposed methodology, and the anticipated application value of outcomes^[5]. This process encourages students to transcend experimental operations and adopt a holistic perspective across the entire industrial chain, thereby establishing a clear research logic framework from the outset. For instance, in response to the high incidence of pet tumors in South China in recent years, educators guided students to develop the topic "Research on the Correlation Between Environmental Endocrine Disruptors and Canine/Feline Tumors." This not only addressed the issue of tracing clinical diagnoses but also enriched the theoretical framework of veterinary public health.

2.3. Establishing a regular progress inspection and academic seminar system to develop logical analysis skills

The inherent uncertainty in scientific research serves as a crucible for honing graduate students' resilience and logical reasoning. To uphold rigorous standards, educators implement a structured management system featuring weekly progress reports, monthly discussions, and quarterly evaluations. The supervisory team reviews students' research updates weekly, focusing not only on experimental data acquisition but also on analyzing the root causes of failures and uncovering hidden value in anomalies. Mentors provide timely guidance, teaching students to employ logical methods like induction and deduction to process data, steering clear of blind experimentation. Furthermore, educators regularly invite external industry experts to participate in project discussions, where cross-disciplinary exchanges break through conventional thinking patterns and enhance students' multidimensional analytical capabilities for specific scientific challenges^[6].

3. Reconstruction of the scientific research methodology system

Scientific research methodology serves as a bridge to truth. In the training of veterinary postgraduate students, high-quality interaction between supervisors and students constitutes the core component for imparting research methodologies and enhancing practical competencies.

3.1. Implementation of "dual mentors + team" collaborative guidance to optimize research topic selection and design methods

Given the dual academic and professional nature of veterinary master's programs, single-campus mentors often struggle to achieve an optimal balance between clinical practice and basic research. Educators have fully implemented a dual-mentor system combining "on-campus academic mentors + off-campus industry

mentors”, leveraging team resources for collaborative guidance. During the topic selection phase, on-campus mentors focus on evaluating the theoretical innovation and scientific rigor of experimental designs, with emphasis on assessing the “significance” of the research—whether it represents breakthroughs in scientific concepts or methodologies. Off-campus mentors prioritize assessing the “practicality” and “feasibility” of topics, including their origin from real-world production scenarios, the viability of proposed solutions, and the potential for widespread application ^[7]. For graduate students with interdisciplinary backgrounds (e.g., those with a bachelor’s degree in biotechnology), the mentor team adopts a “targeted guidance approach” to help them rapidly supplement veterinary clinical knowledge while leveraging their molecular biology expertise. This enables students to assist mentors in drafting applications for National Natural Science Foundation grants or provincial/ministerial-level key research projects. This interactive model of “research-driven learning and learning-enhanced research” allows students to deeply understand the fundamental logic of research topic selection through practice, transitioning from passive topic acceptance to active topic design.

3.2. Strengthen standardized training in experimental skills and clinical diagnosis and treatment to master rigorous scientific research methods

The veterinary medicine discipline falls under the category of experimental science. Whether in basic research or clinical research, data acquisition must rely on standardized operational techniques and rigorous experimental design. The “Veterinary Graduate Experimental Skills Admission Standards” and “Veterinary Clinical Diagnosis and Treatment Procedures” were established, emphasizing that “experimental design objectives must be clear, operational processes must be thoroughly explained, experimental records must be detailed and reliable, and result analysis must be statistically rigorous” ^[8]. During the experimental implementation, the supervisor cultivates students’ independent experimental capabilities through on-site demonstrations and critical step oversight. Special emphasis is placed on developing their ability to abstract essential principles from observable phenomena. For instance, in constructing animal pathological models, students are guided not only to observe macroscopic pathological changes but also to integrate histopathological and molecular biological techniques to reveal the molecular mechanisms underlying disease progression. The supervisor regularly participates in students’ experimental analysis seminars, demonstrating how to extract patterns from complex data. Through both verbal instruction and practical demonstration, students master scientific data processing methods, thereby generating novel ideas and concepts that achieve the effect of “epiphany.”

3.3. Establishing a comprehensive academic writing training system to enhance research communication skills

Academic papers serve as both carriers of research achievements and a key indicator of graduate education quality. To address the common challenge of “producing abundant research output but struggling with paper writing”, educators integrate academic writing training throughout the entire training process. Core courses, including research paper writing, information retrieval and intellectual property, research ethics, and academic integrity, systematically cover paper structure, figure and table creation, statistical software usage, and reference formatting standards. During the writing phase, supervisors implement a “three-step mentoring approach”: First, guiding students in conceptualizing an outline to ensure logical coherence;

Second, assisting in result analysis and discussion by encouraging in-depth analysis of experimental findings within disciplinary frontiers, avoiding superficial data accumulation; Third, refining language to ensure clarity, accuracy, and logical flow while preventing academic misconduct^[9]. For manuscript submission, supervisors guide students in selecting appropriate journals and interpreting peer review comments. When facing rejections or major revisions, students are encouraged to view these as opportunities for academic growth, using written responses to clarify research perspectives. Additionally, a detailed “Graduate Academic Planning Table” outlines key milestones such as proposal initiation, mid-term reviews, manuscript submission, and thesis defense. Supervisors conduct periodic assessments and provide feedback based on this schedule, ensuring students deliver high-quality outputs through structured and timely training.

4. Deep integration of moral education and innovative culture

The cultivation of postgraduate students is not merely the transmission of knowledge and skills, but also the shaping of scientific spirit and professional ethics. In the veterinary field, reverence for life, care for animals, and service to public health security constitute the foundation of industry development.

4.1. Integrating ideological and political elements into the curriculum to strengthen professional ethics and social responsibility

The Master of Veterinary Medicine program emphasizes identifying ideological and political elements within veterinary disciplines. In courses such as Veterinary Public Health and Animal Disease Prevention and Control, the “One Health” concept is introduced to guide students in reflecting on veterinarians’ responsibilities in safeguarding human health, food safety, and ecological environments. By sharing inspiring stories of veteran veterinary scientists who dedicated themselves to grassroots work and rural development, students are motivated to cultivate patriotic sentiments and professional honor. In research practices, the strict implementation of experimental animal ethics review systems fosters students’ respect for life and ethical compliance in scientific research.

4.2. Cultivating an open and inclusive innovation culture

To unlock students’ innovative potential, educators actively foster an open and inclusive academic ecosystem. Graduate students are encouraged to participate in cross-departmental academic collaborations, such as developing veterinary medical devices in partnership with the School of Engineering, or conducting animal-derived food safety testing with the School of Food Science. A graduate innovation fund supports students’ self-initiated “creative ideas” projects, allowing for failure and embracing exploration. Through this cultural immersion, educators cultivate a scientific spirit of critical thinking and bold exploration, equipping students with the intrinsic motivation for continuous innovation in their future careers.

5. Practical outcomes

Through the implementation of the aforementioned reform measures, the postgraduate training quality in the Veterinary Medicine Department of Foshan University has achieved remarkable results. Over the past five years, the quantity and quality of SCI-indexed papers published by postgraduates have shown consistent annual improvement, with multiple students receiving National Scholarships and Guangdong Provincial

Outstanding Thesis Awards. In terms of practical skills, postgraduates have won two-thirds of the prizes in the National Veterinary Professional Degree Postgraduate Innovation and Entrepreneurship Competition. Graduates have received high praise from employers, with most becoming key figures in the veterinary industry in South China.

Certainly, the teaching reform process also faces certain challenges. For instance, with the further expansion of enrollment scale, the per capita number of students supervised by mentors has increased, raising questions about how to ensure the precision of guidance and how to institutionalize mechanisms to further motivate off-campus mentors' participation in mentoring. In the future, educators will further explore the application of digital education tools in graduate training, develop virtual simulation experimental teaching projects, and improve the benefit-sharing mechanism for university-enterprise joint training, thereby advancing veterinary master's education to a higher level.

6. Conclusion

In summary, under the dual priorities of "Double First-Class" initiatives and the New Rural Science and Technology Development, veterinary master's education must transcend traditional training models and proactively address the industry's demand for high-level interdisciplinary professionals. The three-dimensional cultivation framework of "research awareness, methodological system, and academic ethos" developed in this study, grounded in Foshan University's Department of Veterinary Medicine pedagogical reforms, has effectively addressed critical challenges, including weak research awareness, insufficient practical innovation capabilities, and inadequate academic rigor. Through establishing multidimensional research environments, optimizing dual-mentor collaboration mechanisms, and implementing comprehensive academic training programs, this model has successfully transitioned from knowledge transmission to holistic competency development. Looking ahead, as the urgent needs for veterinary public health security and livestock industry upgrading grow, educators will deepen industry-education integration, further integrate ideological education with professional training, and explore new digital empowerment pathways for graduate education. The mission is to cultivate more outstanding veterinary professionals who can "go where needed, stay where needed, and be put to use" across Guangdong Province and nationwide, thereby contributing university expertise to advancing agricultural and rural modernization.

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Disclosure statement

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