

Exploration on the Teaching of Veterinary Microbiology under the Background of New Agricultural Sciences

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Abstract: With the development of the construction of New Agricultural Sciences, animal medicine majors have entered a new stage of educational reform. Colleges and universities should adhere to the basic goal of “fostering virtue through education and strengthening agriculture to revitalize agriculture”, conduct an in-depth analysis of the reform needs of the Veterinary Microbiology course in terms of interdisciplinary integration, practical reform, and the integration of ideological and political education into courses. On this basis, they should promote the update of teaching content, the innovation of teaching methods, the reconstruction of the experimental teaching system, and the optimization of the assessment and evaluation mechanism, to create favorable conditions for the cultivation of compound talents in animal medicine majors. Against this research background, this paper expounds the requirements put forward by New Agricultural Sciences for the teaching reform of Veterinary Microbiology, summarizes the reform dilemmas faced by the teaching of Veterinary Microbiology, and proposes the teaching reform strategies of Veterinary Microbiology under the background of New Agricultural Sciences, to provide support for colleges and universities to cultivate outstanding talents with both professional capabilities and feelings for agriculture, rural areas and farmers.

Keywords: New agricultural sciences; Veterinary microbiology; Teaching reform

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1. Introduction

Under the background of the construction of New Agricultural Sciences, the cultivation of talents in animal medicine majors emphasizes interdisciplinary integration, the integration of production and education, and the service for rural revitalization. Therefore, in the teaching reform of the Veterinary Microbiology course, teachers should rely on the background of the construction of New Agricultural Sciences to promote the reform and innovation in aspects such as course content, teaching methods, experimental activities, and assessment and evaluation, solve the problems existing in the current teaching model, and achieve the goal of coordinated development and in-depth integration of Veterinary Microbiology teaching with industrial needs, cutting-edge

scientific research, and ideological and political education.

2. The requirements of the new agricultural disciplines for the teaching reform of veterinary microbiology

The development of New Agricultural Disciplines has put forward new requirements for the cultivation of talents in animal medicine majors. As a core course for animal medicine majors, the teaching reform of Veterinary Microbiology must also follow the basic concepts of the development of New Agricultural Disciplines. Specifically, colleges and universities as well as teachers, should carry out innovation and optimization from the following aspects:

- (1) Adhere to the integration of interdisciplinary knowledge. The development of New Agricultural Disciplines adheres to the principle of “interdisciplinary integration between agriculture and engineering, and integration of agriculture and science”. Therefore, it is necessary to integrate knowledge such as bioinformatics, molecular biology, and big data analysis into the Veterinary Microbiology course, to achieve the goal of cultivating interdisciplinary talents through interdisciplinary integration^[1].
- (2) Adhere to the goal of cultivating practical and innovative capabilities. The New Agricultural Disciplines emphasize the cultivation of comprehensive talents with practical skills. This requires teachers to focus on the development of students’ experimental skills, scientific research thinking, and problem-solving abilities based on the concept of “learning by doing”.
- (3) Adhere to the principle of social service orientation. The New Agricultural Disciplines aim to promote the development of China’s agricultural industry and rural revitalization through talent cultivation. This requires teachers to base themselves on the actual needs of animal husbandry production and the development requirements of the regional agricultural economy, and promote the innovation of course content and teaching methods^[2].
- (4) Adhere to the reform and development of information-based teaching. Teachers should give full play to the advantages of information-based teaching methods, such as virtual simulation experiment platforms and online course platforms, break through the temporal and spatial limitations of traditional teaching, and create an open and independent learning environment for students.
- (5) Adhere to the orientation of the fundamental task of fostering virtue through education. Colleges and universities should take the cultivation of “feelings for agriculture, rural areas and farmers” as the foundation, integrate ideological and political elements such as “biosafety” and “ecological civilization” into curriculum teaching, to provide a platform for practicing the fundamental task of fostering virtue through education and promote the development of students’ professional quality, craftsmanship spirit and scientific research spirit.

3. The dilemmas of veterinary microbiology teaching reform in the background of new agricultural sciences

3.1. Backward construction of the curriculum system

With the continuous upgrading of relevant technologies and research equipment, frontier research in the field of veterinary microbiology is developing rapidly. However, there is a lag in the veterinary microbiology textbooks currently used by colleges and universities. On the one hand, the curriculum content mainly focuses

on microbiology theories, lacking sufficient practical projects, experimental activities, and real scientific research cases. On the other hand, cutting-edge research achievements have not been integrated into the curriculum system. For example, there is a lack of detailed explanation and introduction to technologies such as gene editing and synthetic biology ^[3]. In addition, the experimental courses of veterinary microbiology also have certain defects. For instance, most of the experimental projects are “confirmatory” experiments, lacking comprehensive design-oriented experimental projects, and the introduction of clinical research cases is also relatively scarce.

3.2. Single and outdated teaching methods

In the teaching of veterinary microbiology courses, some teachers have formed fixed teaching habits and long-termly adopted the teaching mode of “lecture + confirmatory experiment.” On the one hand, they teach theoretical knowledge relying on PPT courseware; on the other hand, they require students to complete practical exploration step by step. This leads to a lack of platforms and opportunities for students to participate independently, practice cooperatively and express their subjective opinions in teaching activities. It not only results in insufficient interaction between teachers and students, but also affects students’ initiative and enthusiasm ^[4]. In addition, in the construction of ideological and political education in courses, teachers have not adopted scientific teaching methods either, leading to a weak connection between ideological and political cases and professional knowledge. Even resistance from students may arise in the implicit ideological and political education, making it difficult to achieve the goal and effect of implicit education.

3.3. Poor effect of industry-education integration

Industry-education integration is an important trend in the cultivation of animal medicine professionals in the background of New Agricultural Sciences, and also a key means for the reform of veterinary microbiology courses. However, at present, the measures taken by colleges and universities in industry-university-research collaboration have achieved poor results. On the one hand, university-enterprise cooperation mainly focuses on the construction of internship bases, and enterprises do not have sufficient space and platforms to deeply participate in links such as curriculum design, teaching content selection, and experimental project design, which makes industry-education integration lack practical effects ^[5]. On the other hand, colleges and universities have relatively few cooperations with relevant scientific research institutions, failing to connect the latest scientific research achievements with the existing curriculum system, and also unable to provide students with scientific research channels for independent experimental exploration.

3.4. Poor orientation of the evaluation system

In addition, there are also obvious problems in the construction of the evaluation system. Firstly, in the assessment and evaluation of veterinary microbiology, teachers mainly score based on students’ final exam results, failing to establish a diversified evaluation subject and process-oriented evaluation links ^[6]. Secondly, there is a lack of a sound evaluation system and index requirements, ignoring the development of students’ literacy in various aspects such as experimental design ability, scientific research thinking ability and teamwork ability. Thirdly, the guiding role of teaching evaluation is ignored, and suggestions for students’ improvement and optimization are not put forward based on the evaluation results, resulting in insufficient application effects of evaluation.

4. Teaching reform strategies for veterinary microbiology in the context of the new agricultural sciences

4.1. Optimizing the curriculum system to highlight the guiding role of the new agricultural sciences

Against the backdrop of the development of the New Agricultural Sciences, the core goal of the teaching reform for Veterinary Microbiology should be to cultivate students' interdisciplinary thinking, practical abilities, and innovative capabilities. Based on this goal, the curriculum system should be optimized and designed.

- (1) Colleges and universities should keep pace with the development of cutting-edge technologies and establish three curriculum modules: “Fundamentals”, “Cutting-edge”, and “Application”. The Fundamentals Module focuses on classic microbiological knowledge such as bacteria and viruses, aiming to consolidate students' theoretical foundation. The Cutting-edge Module sets up key knowledge topics related to the frontier of veterinary microbiology development, such as “microbiome technology” and “gene editing and microbial modification”, to broaden students' cognitive horizons^[7]. The Application Module should align with the development needs of regional industries and develop project cases for students' practical learning based on the actual situations of enterprises, such as practical projects like “surveillance of antimicrobial resistance in pathogenic microorganisms of livestock and poultry” and “development of fermentative microbial resources”.
- (2) Colleges and universities should adhere to the concept of interdisciplinary development, with “the integration of agriculture and engineering, and the combination of agriculture and science” as the basic guiding principle. They should integrate knowledge from disciplines such as bioinformatics, molecular biology, and big data analysis into the Veterinary Microbiology course. For example, in the teaching module of animal disease prevention and control, relevant content such as microbiome technology and gene sequencing data analysis can be introduced, and based on this, extended learning modules like “the mechanism of interaction between microorganisms and hosts” and “genomics of microbial antimicrobial resistance” can be developed^[8].
- (3) Colleges and universities should also insist on the in-depth integration of ideological and political education into professional education, and highlight the infiltration and guiding role of ideological and political elements in the existing curriculum system. For instance, in the relevant courses of “immunological prevention”, teachers can explain the basic ideas and strategies adopted by China in the fight against the epidemic to students, so as to strengthen students' awareness of the “community with a shared future for life”^[9].

4.2. Improving teaching models and developing diversified teaching methods

Against the backdrop of the construction of the “New Agricultural Sciences”, universities should further implement the fundamental educational principles of “student-centeredness” and “teaching students in accordance with their aptitude”. On this basis, they should promote the application and implementation of diversified teaching methods in the teaching of Veterinary Microbiology, to create an open and independent learning space for students.

First of all, teachers should promote the development and application of information-based teaching. On the one hand, they should promote the construction of the flipped classroom model and implement teaching tasks through both online and offline channels. Before class, basic theoretical teaching guidance can be provided through resources such as MOOCs (Massive Open Online Courses) and micro-courses; during class, these

platforms can be used for student discussions, experimental design, and collaborative exploration, thereby enhancing the interaction between teachers and students and fostering students' practical abilities^[10]. On the other hand, teachers should leverage the auxiliary teaching advantages of tools such as virtual simulation technology and computer equipment. For example, the KoPaWiFiEDU microscopic digital system can be used to share the observation results of bacterial morphology in real time, and animation technology can be employed to visually present the physiological structure and life activities of viruses, helping students gain a better understanding and comprehension^[11].

Secondly, teachers should promote the popularization of teaching methods such as problem-driven teaching, project-based teaching, and task-based teaching, and introduce real scientific research problems or enterprise work tasks into the classroom. For instance, project activities like "Tracking the Mutation of Avian Influenza Virus" and "Optimizing the Detection Technology of African Swine Fever Virus" can be carried out. By organizing students to conduct group-based literature research, collaborative discussions, and comprehensive presentations, their independent learning abilities can be strengthened^[12].

In addition, teachers should also improve experimental teaching strategies. Based on traditional confirmatory experiments, more design-oriented experiments should be developed to cultivate students' scientific research capabilities. For example, an experimental project titled "Investigation on Toxoplasma Gondii Infection in Stray Cats on Campus" can be designed. All experimental steps, including sample collection, PCR detection, and data analysis, are assigned to student teams for independent design and completion, so as to achieve a better educational effect through experiments^[13].

4.3. Adhere to collaborative education and deepen the university-enterprise-research institute cooperation mechanism

Against the background of the integration of industry and education, universities should also promote the teaching reform of Veterinary Microbiology from the perspective of university-enterprise-research institute cooperation, so as to provide students with more diversified learning resources and practical platforms.

Firstly, universities should actively cooperate with veterinary drug enterprises, livestock farms, and other relevant entities. On one hand, they can jointly establish cooperative laboratories, where senior university teachers and corporate researchers collaborate to develop new technologies and create opportunities for students to participate in related projects. On the other hand, based on the actual conditions of enterprises, universities can build an "Enterprise Real Case Resource Library".

Secondly, universities can also cooperate with vaccine manufacturers and develop specialized content, such as "Avian Influenza Vaccine Production Technology" into experimental teaching projects. This enables students to engage in the entire vaccine production process, from "strain cultivation to finished product quality inspection"^[14].

Furthermore, universities should promote the training of "dual-qualified teachers" (teachers with both academic expertise and industry experience) through university-enterprise-research institute cooperation. On one hand, they can hire corporate technical experts and researchers as part-time course instructors, who will participate in educational activities such as experimental teaching, practical projects, and special lectures. On the other hand, universities can jointly establish teacher enterprise practice mobile stations with enterprises, allowing teachers to participate in various links of enterprises, including scientific research, production, marketing, and management, thereby enhancing their comprehensive capabilities.

4.4. Conducting diversified evaluation and building a process-oriented assessment model

Against the backdrop of the “New Agricultural Sciences” initiative, universities should further promote the innovation and optimization of the teaching evaluation model for Veterinary Microbiology, while advancing reforms in diversified evaluation subjects and process-oriented evaluation.

First, in terms of assessment methods, teachers should divide the evaluation content into four dimensions. Among them, students’ exam scores account for 40%, which assesses their ability to apply knowledge. Experimental assessment accounts for 30%, focusing on evaluating students’ logic in experimental design and data analysis capabilities. Research proposals account for 20%, which assesses students’ ability to write research plans and experimental reports. Daily academic performance accounts for 10%, mainly evaluating students’ learning enthusiasm, teamwork skills, and contribution to group work^[15].

Second, in terms of assessment subjects, modules such as teacher evaluation, students’ self-evaluation, group evaluation, and mutual evaluation among students should be established. In addition, a “defense system” can be introduced for the final assessment, requiring students to present their learning achievements through PPT, with joint review by judges (teachers) and enterprise experts.

5. Conclusion

To sum up, the “New Agricultural Sciences” initiative provides a new direction and development trend for the teaching reform of Veterinary Microbiology. Based on this, universities should carry out optimization in aspects such as the curriculum system, teaching model, integration of industry and education, and evaluation system. This will drive the course towards higher-level, more creative, and practical development, thereby cultivating compound veterinary talents that meet the needs of contemporary agriculture.

Disclosure statement

The author declares no conflict of interest.

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