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Construction and Practice of "Wisdom + Ideological and Political Education" Course in Veterinary Microbiology

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Abstract: With the deepening of educational digital transformation, university curriculum development is entering a critical phase of transitioning from "digital resources" to "intelligent teaching." Addressing current challenges in smart course construction, such as knowledge fragmentation, "black-box" competency cultivation, and rigid integration of ideological and political education, this paper proposes an integrated approach based on the knowledge graph, competency graph, and ideological and political education graph. Taking the provincial-level exemplary course "Veterinary Microbiology" (a Guangdong First-Class Course) as a case study, the research reconstructs cognitive logic through structured knowledge graphs, clarifies training objectives via competency graphs, and systematically guides values through ideological and political education graphs, forming a new teaching ecosystem characterized by "knowledge as foundation, competence as priority, and values as soul." Teaching practice demonstrates that this model effectively enhances students' professional knowledge mastery, complex engineering problem-solving abilities, and vocational value recognition, providing a replicable paradigm for smart curriculum reform in veterinary medicine under the new agricultural science context.

Keywords: Veterinary microbiology; Smart course; Knowledge graph; Competency graph; Ideological and political graph; Teaching reform

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1. Introduction

Veterinary microbiology serves as a core foundational course in veterinary medicine, functioning not only as a bridge between basic veterinary medicine and preventive veterinary medicine but also as a critical disciplinary support for ensuring animal health and public health safety [1]. In recent years, the Ministry of Education has vigorously promoted the "New Agricultural Science" initiative and the "Double Ten Thousand Plan" for first-class courses, explicitly requiring curriculum development to reflect "advancedness, innovation, and challenge",

while deeply integrating modern information technology with teaching and education [2]. Traditional teaching models often prove inadequate when addressing the vast knowledge system, abstract mechanisms, and rapid updates in microbiology. Meanwhile, comprehensively promoting the construction of curriculum ideology and politics is a strategic measure to implement the fundamental task of fostering virtue through education, and it has become a compulsory course in university curriculum construction [3]. In practice, however, there is often a "two-skin" phenomenon between professional knowledge transmission and value guidance, making it difficult to achieve the subtle educational effect of "moistening things silently." With the development of artificial intelligence technology, smart education technology with knowledge graphs as the core provides new ideas for solving the above problems. This paper relies on the provincial-level curriculum ideology and politics demonstration team of "Veterinary Microbiology" at Foshan University to explore the construction of a smart curriculum system integrating knowledge, ability, and ideology and politics "three graphs", aiming to solve teaching pain points and improve the quality of talent training.

With the rapid development of artificial intelligence technology, the digital transformation of education has moved from the early "digital campus" construction to a new stage of "smart education." The "Education Informatization 2.0 Action Plan" released by the Ministry of Education clearly proposes to build a new "Internet + Education" ecosystem and use big data, artificial intelligence, and other technologies to transform the education model. As a key technology of artificial intelligence, knowledge graphs can structurally describe concepts, entities, and their relationships in the objective world. They have achieved remarkable results in intelligent search, recommendation systems, and other fields. In recent years, they have been gradually introduced into the education field to build subject knowledge maps and realize adaptive learning path recommendations [4–6]. Applying knowledge graph technology to curriculum construction provides a new technical path for solving problems such as knowledge fragmentation and ambiguity in ability cultivation in traditional teaching.

This paper relies on the provincial-level curriculum ideology and politics demonstration team of "Veterinary Microbiology" at Foshan University to explore the construction of a smart curriculum system integrating knowledge, ability, and ideology and politics "three graphs." It aims to reconstruct the logical structure of teaching content through graph technology, manifest the ability training path, systematically implant ideological and political elements, solve teaching pain points, improve the quality of talent training, and provide a theoretical reference and practical paradigm for the smart reform of professional courses in the background of new agricultural science.

2. Analysis of pain points in smart course construction

Although colleges and universities have invested heavily in the construction of online courses and virtual simulation experiments, there are still deep-seated structural contradictions in specific curriculum teaching practice.

2.1. Fragmentation of knowledge organization and cognitive separation

Traditional network course resources are mostly linear videos and discrete test questions, lacking deep semantic association with the subject knowledge system. In veterinary microbiology, the chapters on bacteria, viruses, and fungi contain numerous knowledge points. Students often fall into the misunderstanding of "rote memorization"

and find it difficult to build a complete cognitive map from "microstructure" to "macro-pathogenic mechanism" and then to "clinical diagnosis" [7]. Most existing smart teaching platforms stay at the level of resource piling, lacking a visual presentation of the internal logic of knowledge, resulting in excessive cognitive load on students and hindering knowledge migration ability.

2.2. "Black box" of ability cultivation and lack of evaluation

Based on the Outcome-Based Education (OBE) concept, curriculum goals should focus on the achievement of students' ability to solve complex problems. However, in traditional instructional design, ability goals are often implicit and vague. It is difficult for teachers to accurately grasp the transformation path of students from "mastering knowledge" to "forming ability", and the ability cultivation process is like a "black box" [8]. For example, in the teaching of "Veterinary Microbiology", how to transform the knowledge point of "mastering bacterial culture characteristics" into "the ability of pathogen isolation and identification of clinical samples" lacks a visual step-by-step training path. The lack of visual ability graph support makes personalized learning interventions lack a data basis, and teaching evaluation is often limited to the assessment of memory knowledge, ignoring the assessment of higher-order thinking abilities such as critical thinking and innovative practical ability, leading to the occurrence of "high scores but low abilities."

2.3. Rigidity and discreteness in the integration of curriculum ideology and politics

The biggest challenge currently facing curriculum ideology and politics construction lies in the organic and systematic nature of integration. Some teachers rigidly implant ideological and political elements in teaching, resulting in a separation between professional content and value guidance, and even triggering student resistance. In addition, the excavation of ideological and political elements is often arbitrary, lacking systematic top-level design, resulting in unstable educational effects. In the veterinary microbiology course, there are rich ideological and political resources such as biosafety, professional ethics, and scientific spirit. However, due to the lack of systematic sorting, they are often only occasionally mentioned when teaching a specific pathogen, failing to form a value logic chain that runs through the course. How to visualize implicit education and establish the internal mapping relationship between ideological and political elements and professional knowledge points to achieve the educational effect of "salt dissolving in water" is a difficult problem that needs to be solved urgently [9].

3. Theoretical framework and construction logic of "three graphs" integration

In order to solve the above pain points, this study proposes a smart course construction model of "three graphs" integration. This model takes the knowledge graph as the underlying architecture, the ability graph as the goal orientation, and the ideological and political graph as the value core to realize the deep coupling of teaching elements.

3.1. Knowledge graph: Reconstructing a structured cognitive system

A knowledge graph is a technology that models concepts and their relationships in the objective world through a graph structure data model. In curriculum construction, the study used a combination of natural language processing technology and expert manual verification to build a knowledge graph in the field of veterinary microbiology [10]. First, define entity types such as "bacterial morphology and structure", "pathogenic

mechanism", and "immunological diagnosis"; second, extract semantic relationships such as "cause", "belong to", "inhibit", and "diagnose." For example, "Staphylococcus aureus" is connected to "purulent infection" through the "cause" relationship, and "Gram staining" is connected to "bacterial identification" through the "used for" relationship. This network structure effectively breaks the barriers of textbook chapters and helps students establish systematic scientific thinking.

3.2. Ability graph: Visualizing the step-by-step training path

The ability graph is a concrete mapping of the graduation requirement indicator points. According to Bloom's Taxonomy of Educational Objectives, the study divided the ability goals of veterinary microbiology into three dimensions: "basic operation ability", "clinical diagnosis ability", and "scientific research innovation ability" [8]. Through the ability graph, abstract training goals are refined into observable and measurable behavioral indicators. For example, the knowledge point of "bacterial isolation and culture" is mapped to "aseptic operation ability" (Level 1) and "pathogen isolation and identification ability" (Level 2). The system can automatically diagnose the student's achievement in the ability graph based on the student's answer situation at the knowledge graph node, thereby realizing precise navigation from "knowledge transmission" to "ability generation."

3.3. Ideological and political graph: Systematic value gene chain

The ideological and political graph is the core innovation of this study. Relying on the resources of the provincial-level curriculum ideology and politics demonstration team, the study excavated and constructed an ideological and political element graph with unique veterinary characteristics. This graph contains four main nodes: "scientific spirit", "professional ethics", "family and country feelings", and "biosafety" [11–12]. The study established associations between these value nodes and specific knowledge points in the knowledge graph. For example, when teaching "Bacillus anthracis", the system automatically associates the "biosafety" and "national defense" nodes, introducing biosafety laws and regulations and the national security concept; when teaching "antibiotic resistance", it associates the "professional ethics" and "social responsibility" nodes, discussing the harm of antibiotic abuse and the professional ethics of veterinarians. The construction of the ideological and political graph makes value guidance no longer a random "embellishment", but a "gene chain" running through the course, realizing the systematization, structuration, and visualization of ideological and political education.

4. Teaching reform implementation path

4.1. Resource reconstruction: Creating a graph-driven smart resource library

Resources are the cornerstone of curriculum construction. The study broke the traditional textbook chapter system and reconstructed the curriculum resource library based on the "three graphs" architecture. First, build granular micro-lesson resources. The course content is dismantled into micro-lesson videos that correspond one-to-one with the knowledge graph nodes, with a duration controlled at 5–10 minutes, facilitating fragmented learning and precise push. Each micro-lesson is associated with corresponding ability requirements and ideological and political labels, realizing the trinity of "value shaping, ability cultivation, and knowledge transmission." Second, develop case libraries and utilize virtual simulation projects. Real scientific research cases, such as African Swine Fever prevention and control, and zoonotic disease monitoring, are introduced, and the case analysis process is mapped to the ability graph to cultivate students' practical ability. For example, the virtual simulation experiment project of "Laboratory Diagnosis of Important Livestock and Poultry Diseases" is

used to simulate the whole process from sample collection to pathogen identification, solving the pain point that high-risk and high-cost experiments are difficult to carry out [13]. Third, embed implicit ideological and political resources. Excavate educational materials in the history of discipline development, such as the contributions of Chinese scientists in eliminating rinderpest and fighting avian influenza, and make them into short videos or graphic materials to be integrated into teaching videos and extended reading, realizing the "gene-like" implantation of value guidance.

4.2. Model innovation: Implementing whole-process blended teaching

Relying on the smart teaching platform, a teaching process of "pre-class intelligent guidance, in-class deep discussion, and post-class expansion and sublimation" was designed. Before class, the system pushes preview tasks to students based on the knowledge graph and generates personalized learning paths; after students complete the self-test, the system automatically generates a learning situation radar chart to assist teachers in lesson preparation. In class, teachers organize case discussions and Problem-Based Learning (PBL) projects based on the weak links fed back by the ability graph. For example, in the "bacterial drug resistance" topic, teachers guide students to use the knowledge graph to retrieve drug resistance mechanisms, and combine the "social responsibility" node in the ideological and political graph to discuss the harm of antibiotic abuse, realizing the resonance of knowledge transmission and value guidance [9]. After class, the system pushes differentiated expansion tasks based on student portraits. For students with "scientific research innovation" potential shown in the ability graph, frontier literature and scientific research training projects are pushed; for students with weak foundations, remedial exercises are pushed.

4.3. Evaluation reform: Establishing a multi-dimensional value-added evaluation system

Breaking the traditional evaluation mode of "one exam determining life", a multi-dimensional evaluation system based on graph data was established. Process evaluation accounts for 50%, including online learning duration, graph node lighting rate, discussion interaction frequency, etc. The system records students' behavioral data in the three dimensions of knowledge, ability, and ideology and politics in real time, generating a dynamic "learner portrait." Summative evaluation accounts for 50%, focusing on examining comprehensive application ability. The design of test questions shifts from a single knowledge point assessment to a situational, comprehensive case assessment, requiring students to use the knowledge they have learned to solve complex clinical problems and reflect professional ethical thinking in their answers. After two rounds of teaching practice, this model has achieved preliminary results. Student teaching evaluation results show that satisfaction with course logic clarity and learning goal clarity has increased by more than 25%. Comparative analysis found that the pilot class students were significantly better than the traditional teaching class in indicators such as comprehensive experimental scheme design scores and clinical case analysis report quality, and their ability to solve complex engineering problems was effectively exercised. At the same time, the "moistening things silently" effect of curriculum ideology and politics integration has initially appeared. Students actively combine professional knowledge with topics such as "guaranteeing animal-derived food safety" and "serving rural revitalization" in course assignments and discussions, and their professional mission and sense of responsibility have been significantly enhanced.

However, some challenges were also found in the practice process: first, the workload in the early stage of graph construction is huge, requiring deep collaboration between subject experts and technical personnel;

second, there are individual differences in students' adaptation to intelligent learning tools, and guidance and support need to be strengthened; third, the deep integration of the ideological and political graph still requires teachers to play a core role in instructional design, and technology cannot replace the wisdom of education. In the future, educators will further improve the automated construction tools of graphs, strengthen the digital literacy training of teachers and students, and explore the application of graphs in cross-curriculum and cross-major connections to promote the in-depth development of smart course construction.

6. Conclusion

Smart course construction is the core handle of the digital transformation of higher education. This paper takes "Veterinary Microbiology" as an example to explore the curriculum construction model of the integration of knowledge, ability, and ideology and politics, "three graphs." Practice has proved that the application of graph technology can effectively solve teaching pain points such as knowledge fragmentation, ability black box, and rigid ideology and politics, realizing the organic unity of professional knowledge transmission, comprehensive ability cultivation, and core value guidance. In the future, with the further development of artificial intelligence technologies such as large models, smart courses will evolve in a more personalized, adaptive, and immersive direction, continuously promoting the leap in the quality of higher education.

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