

Construction and Practice of First-class Courses in Local Undergraduate Universities: A Case Study of the Latest Developments in Biological Sciences

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Abstract: In the context of rapid development of global higher education, local undergraduate universities face both opportunities and challenges. Driven by national policies, local undergraduate universities have received unprecedented attention in educational reform and innovation, especially in the construction of first-class courses. By analyzing the current teaching situation of the course on the latest developments in biological sciences, this paper points out major issues in course design, such as an excessive emphasis on high-level learning, insufficient industry-academia-research collaboration, inadequate assessment systems, and low student learning motivation. To address these challenges, this paper proposes strategies to enhance course quality based on capstone courses and industry-academia-research collaboration, emphasizing the importance of optimizing course content, strengthening practical components, and improving assessment methods. By introducing capstone courses, local universities can better adapt to national policies such as "Double First-Class" and "Rural Revitalization," promote disciplinary development, and achieve a win-win situation for talent cultivation and local economic development. This research provides important theoretical support and practical guidance for the construction of courses in local application-oriented undergraduate universities.

Keywords: First-Class Curriculum; Curriculum Educational Reform; Curriculum Ideological and Political Education; Capstone course

1. Introduction

In the context of rapid global development in higher education, local undergraduate universities face increasingly severe challenges and opportunities. In recent years, continuous national policy advancements have brought unprecedented attention to local undergraduate universities in terms of educational reform and innovation, particularly in the construction of first-class courses. In January 2022, three ministries and commissions issued the "Several Opinions on Further Promoting the Construction of World-Class Universities and Disciplines," as well as "Double First-Class" construction for universities was initiated, requiring local undergraduate universities to optimize their curriculum and enhance teaching quality to cultivate talents who meet the demands of the new era [1]. Achieving connotative development in higher education is a fundamental policy for the development of China's higher education, with a core focus on improving the quality of talent cultivation. Courses are the core element of talent cultivation, and the quality of courses directly determines the quality of talent cultivation. Therefore, the construction of first-class courses has become the focus of undergraduate teaching in universities, and local universities are facing the dual tests of opportunities and challenges. [2]

2. Orientation of Talent Cultivation for Teaching Objects

For application-oriented undergraduate universities, the core goal of talent cultivation is to meet the demand for high-quality talents from society and employers. With continuous technological advancements, competition among enterprises in China has gradually shifted to the competition for talents and

technology. This shift poses new challenges and requirements for the teaching work of application-oriented undergraduate universities. Only through continuous teaching reform and the construction of first-class specialized courses can we more effectively meet the expectations of employers for talents. Therefore, this reform has become an urgent task for application-oriented undergraduate universities. Under the strategic framework of "Double First-Class" construction, talent cultivation is regarded as a core element and a critical link. Among the many existing methods, the industry-academia-research collaborative education model is recognized as a highly effective educational strategy. This model successfully achieves complementarity and deep integration among education, scientific research, and production in various social domains, promoting smooth docking and efficient integration of various stages of technological innovation. Currently, the country has issued pilot policy documents for the development of application-oriented undergraduate universities, providing clear theoretical guidance and directional support for these universities in the construction of first-class courses. Actively engaging in the construction of first-class courses can not only enhance the competitiveness and social recognition of application-oriented undergraduate universities but also effectively promote student employment, laying a solid foundation for the sustainable development of the universities. The design of first-class university courses centered on students emphasizes the principle of free choice, aiming to fully leverage the value-orienting role of free choice in course design and further strengthen the imparting and transmitting functions of courses [3, 4, 5].

3. Major Issues in the Teaching Process of the Specialized Course on the Latest Developments in Biological Sciences

3.1 Overemphasis on Advanced Content

Learning about the latest developments in biological sciences is not only crucial for students' academic research and career development but also profoundly affects their ability to understand and respond to complex problems in the real world [6]. As a rapidly evolving field, biological sciences continuously produce new research findings and technologies,

such as gene editing technologies (e.g., CRISPR-Cas9), synthetic biology, and single-cell sequencing. These advancements are leading to revolutionary changes in biomedical science, agricultural science, ecological conservation, and other fields. Keeping up with these developments helps students master cutting-edge knowledge and lay a solid foundation for their research and careers. Meanwhile, the interdisciplinary integration of biological sciences with computer science, engineering, chemistry, and other disciplines is increasingly deepening. Understanding the latest developments in biological sciences can enhance students' interdisciplinary communication and collaboration skills and promote innovative thinking. Furthermore, as biological science research progresses, a series of ethical and social issues emerge, such as the ethical controversy surrounding "designer babies" caused by gene editing technologies. By paying attention to the latest developments, students can develop critical thinking skills, learn to assess the social impacts of scientific research, and actively participate in related ethical discussions. In the face of global challenges such as climate change, public health crises (e.g., the COVID-19 pandemic), and food security, biological sciences play an irreplaceable role. Learning about the latest developments in biological sciences enables students to more deeply understand the biological roots of these challenges and engage in exploring solutions [7]. In summary, this course has extremely high practical significance. However, in actual teaching, we have observed that students generally lack enthusiasm for learning, have low final grades, and have a shallow memory of the content they have learned. Through questionnaires and interviews, we have summarized the following three reasons: Firstly, the course content is overly focused on advanced content, making the teaching materials abstract and complex, exceeding students' current abilities and cognitive levels, increasing their learning pressure, and making it difficult for them to effectively master the knowledge. Secondly, teaching resources are excessively concentrated on advanced content, neglecting investments in other necessary teaching links. Lastly, there is a lack of practical links matching hotspots and frontier content, making it difficult for students to apply theoretical knowledge to reality and

unclear about the application scenarios of knowledge.

3.2 Insufficient Industry-Academia-Research Collaboration

The teaching content of the course fails to closely align with actual industry demands, resulting in students' knowledge being difficult to directly apply in real work scenarios, thereby triggering the phenomenon of separation between learning and application. The lack of industrial practice opportunities and real-scenario training severely constrains the cultivation of students' practical abilities and innovative spirits. In addition, the mechanism for resource sharing and complementary advantages between schools and enterprises is obstructed, failing to effectively exert the synergistic effect of both parties, thereby hindering the deep integration and joint development of education and industry, and also limiting the effective conversion and application of scientific research results.

3.3 Inadequate Assessment Content and Evaluation System of the Course

The assessment system overly focuses on the evaluation of advanced abilities while neglecting a comprehensive review and assessment of the overall knowledge system. In the specialized course on the latest developments in biological sciences, the assessment and evaluation system is dominated by written exam scores, supplemented by process assessments such as assignments and classroom performance, but overall, the assessment content and format remain relatively monotonous. During the teaching process, teachers' pursuit of advanced content may neglect the importance of basic knowledge and skills, leading to deviations in teaching methods and the evaluation system. Given the breadth of the latest developments in biological sciences, the currently established quantitative assessment indicators for the learning process are not specific and detailed enough, resulting in the neglect of key elements such as students' attitudes and collaboration spirits during the assessment process, which further affects the comprehensive examination of course learning effects.

4. Strategies for Enhancing the Quality of First-Class Courses Based on Capstone

Courses and Industry-Academia-Research Collaboration

4.1 Introducing Capstone Courses to Optimize Course Content

For local universities such as Jining Normal University, how to effectively revitalize talent in the context of the "Double First-Class" initiative and the national "Rural Revitalization" strategy poses another major challenge to talent cultivation models. It is crucial to comprehensively enhance the value of disciplines while better incubating innovation around rural revitalization. Therefore, driven and incentivized by the dual policies of "Double First-Class" and "Rural Revitalization," it is particularly important for the specialized course on the latest developments in biological sciences to seize the opportunity and make the best use of it.

The concept of a capstone course is borrowed from architecture: "course" refers to "a row (of bricks)," while "capstone" refers to "the final stone placed at the top of an arch." Capstone courses are typically offered in the final year of undergraduate study and aim to promote students' comprehensive application of their major. Capstone courses in American universities originated in the late 19th century and were established as regular courses in the late 1980s, becoming a notable feature of American higher education. Therefore, capstone courses serve as both a final examination of undergraduate studies and a preview of professional life; they require not only the comprehensive application of professional knowledge but also the demonstration of soft skills such as teamwork, information gathering, resource integration, and problem-solving. Capstone courses are not only a summary of the course knowledge learned but also an extension, deepening, and integration of the entire professional learning experience [8, 9].

In the teaching process, we adjusted the course content. Out of the 32 class hours, 16 hours were dedicated to students selecting topics of interest, preparing before class, presenting and discussing in class, with the teacher providing a summary. The remaining 16 hours were used to guide students in targeting specific projects, conducting literature searches and organizing their thoughts, writing grant applications and research reports, revising and refining experimental methods/project procedures.

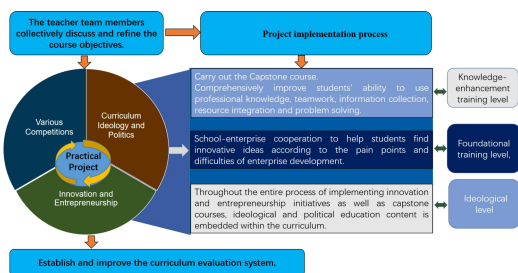


Figure 1. Curriculum Reform Model

4.2 Establishing a Collaborative Innovation Platform and Implementing a "Project-Driven" Teaching Mode

The core issue in the construction of first-class courses is talent cultivation. Among the existing methods, industry-academia-research collaborative education is a highly effective approach and an important model for promoting the development of higher education and the economy and society. [10] In recent years, with the acceleration of technological progress and economic transformation, research on industry-academia-research collaboration has received increasing attention. During the course teaching process, we organize students to form groups based on national, Inner Mongolia Autonomous Region, and school-level competitions such as the Internet+ Innovation and Entrepreneurship Competition, the National College Student Life Science Competition, and the College Student Innovation and Entrepreneurship Training Program, and encourage them to independently design research topics and conduct preliminary experiments or investigations (Figure 1). Teachers guide students in writing project applications and planning. By cooperating with surrounding enterprises and townships in nearby counties and flags, we introduce real industry projects into the curriculum and encourage students to participate in solving practical problems. Students have gradually focused their efforts on improving local agricultural products such as corn and potatoes, disease monitoring, product updates, and alkaline soil improvement. Since the initiation of these projects, students from our college have won two bronze awards in national competitions, two first-prize awards, eight second-prize awards, and fifteen third-prize awards (copper awards) in regional competitions, as well as two second-prize awards and one third-prize award in the Life Science Competition (Innovation and Entrepreneurship Category). Additionally, 21 College Student Innovation and

Entrepreneurship Training Program projects have been successfully approved.

4.3 Strengthening Ideological and Political Education in Courses

First-class courses should not only aim to transmit knowledge but also cultivate students' principles of serving society, fostering innovative thinking, and embodying the craftsmanship spirit. "We should integrate moral education into ideological and moral education, cultural knowledge education, and social practice education in all aspects and throughout basic education, vocational education, and higher education. The discipline system, teaching system, textbook system, and management system should be designed around this goal. Teachers should teach around this goal, and students should learn around this goal [11, 12]. Therefore, we explore ideological and political elements and continuously integrate ideological and political education into professional course teaching, infusing value guidance throughout professional courses, practical training courses, and educational activities to stimulate students' patriotic enthusiasm, foster a correct view of professional course learning, and establish correct outlooks on life and values. We utilize typical individuals and events from the history of discipline development that demonstrate responsibility and achievement, incorporating them organically into the teaching process of professional courses through classroom lectures, multimedia presentations, and other forms. By comparing the past with the present, we stimulate students' strong sense of national pride, historical mission, and aspirations for progress, educating them to embrace their era's mission, excel in professional knowledge, and enhance their comprehensive qualities.

First-class courses are not only intended to transmit knowledge but must also adhere to the basic principles of cultivating students to serve society, fostering innovative thinking, and embodying the craftsmanship spirit. The discipline system, teaching system, textbook system, and management system should be designed around this goal. Teachers should teach around this goal, and students should learn around this goal." [11, 12] Therefore, we explore ideological and political elements and continuously integrate ideological and political education into professional course teaching,

infusing value guidance throughout professional courses, practical training courses, and educational activities to stimulate students' patriotic enthusiasm, foster a correct view of professional course learning, and establish correct outlooks on life and values. We deeply explore typical individuals and deeds from the history of discipline development that demonstrate courage and responsibility, skillfully incorporating them into the teaching system of professional courses through various teaching methods such as classroom lectures and multimedia presentations (Figure 1).

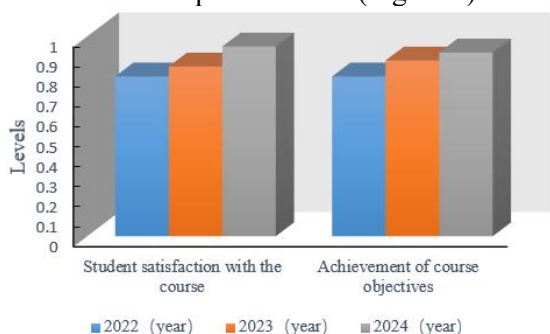


Figure 2. Satisfaction and Achievement Levels of the Special Topic Course on the Latest Developments in Biosciences from 2022 to 2024

4.4 Quantifying Course Assessment Content and Enhance Student Satisfaction with the Course.

Establish and improve a multi-level and multi-dimensional evaluation system. Learning effectiveness evaluation includes teacher evaluation, student self-evaluation, and peer evaluation. Before the evaluation, students and teachers jointly develop the final evaluation criteria. The final course grade consists of regular grades (60%) and final grades (40%). Among the regular grades, theoretical course grades (20%) include answering questions (5%), reading notes (5%), and essays (10%); practical course grades (40%) are based on a combination of practical process records and practical results, including process materials (20%), result materials (10%), and evaluation materials (10%). Final grades include cooperative learning essay writing (15%) and experimental design and implementation (25%).

By reforming the teaching methods, there has been an increase in student satisfaction with the course. As can be seen from Figure 2, from 2022 to 2024, student satisfaction with the course increased from 0.85 in 2022 to 0.9 in

2024, and the degree of achievement of course objectives increased from 0.85 in 2022 to 0.92 in 2024.

5. Conclusion

The construction of a first-class specialized course on the latest developments in biological sciences contributes to the advancement of the discipline. The development of first-class courses in local universities needs to rely on regional advantages and their own characteristics to achieve differentiated competition with other institutions and realize differentiated and distinctive development. Secondly, the establishment of capstone courses aims to overcome the drawbacks of discipline-oriented and fragmented knowledge in courses, enhance students' knowledge application abilities, shorten the adaptation period between graduation and employment, and thereby promote the individualized growth of university students and the enhancement of their innovation and entrepreneurship capabilities. This addresses the challenges of a lack of talent and technology in local economic development, as well as a lack of direction and support in the development of local universities, achieving a mutual benefit between local economic development and university development. It holds exploratory significance for the course construction and development of local application-oriented undergraduate universities.

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