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Reform and Practice of Plant Physiology Course Based on Innovative Agricultural and Forestry Talent Cultivation in the Context of New Agricultural Science: A Case Study of Henan Agricultural University

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Abstract: *In the context of "New Agricultural Science" and the "Double First-Class Initiative," the cultivation of agricultural and forestry talents must adapt to new situations and social demands, possessing innovative thinking, solid foundational knowledge, and practical abilities. Through the reform of the theoretical and practical courses in plant physiology, the teaching team actively constructs a teaching and evaluation model centered on the cultivation of innovative abilities. This approach aims to stimulate students' enthusiasm for learning and love for agriculture, cultivate their innovative thinking, and enhance their innovation capabilities, enabling students to understand and appreciate agriculture better and serve agricultural production more effectively.*

Keywords: *Plant Physiology; Innovative Agricultural and Forestry Talents*

1. Introduction

Since the 19th National Congress, the state has implemented the "Rural Revitalization Strategy" plan, comprehensively promoting the construction of "New Agricultural Science," pushing China to transform from a large country in higher agricultural education to a strong country in higher agricultural education, and promoting the construction of "Double First-Class" in higher agricultural universities. "New Agricultural Science" requires the agricultural disciplines in higher education to grasp the modernization development trends of agriculture and rural areas, fully promote the innovation and development of agricultural professional education and teaching, and use modern biotechnology, information technology, and engineering technology to transform traditional agricultural disciplines, improving the quality of cultivating innovative and applied agricultural and forestry talents.

In the context of "New Agricultural Science" and the "Double First-Class Initiative," how to cultivate new agricultural technology talents and enhance the dual innovation attributes of talent cultivation has become an important research direction for universities in training high-quality agricultural talents.

Plant physiology is a compulsory professional course for students majoring in plant production-related fields at our university, covering more than 30 undergraduate and specialist programs in agriculture, forestry, plant protection, life sciences, and more, with an annual enrollment of 2,500 students. This course aids in the completion of students' knowledge systems, fosters their interest in learning and ability to solve practical problems, playing a connecting role in the cultivation of students' professional qualities. As a fundamental course for training high-quality, versatile agricultural technology talents in higher agricultural institutions, the construction of the plant physiology course is closely related to the innovative talent cultivation required by modern agriculture, which demands "solid theoretical knowledge and practical skills in agriculture." Therefore, improving the teaching quality of plant physiology is essential to meet students' professional development needs and better serve agricultural production.

Traditional classroom teaching of plant physiology is teacher-centered, relying on lectures as the primary teaching method, with a monotonous and rigid form that lacks interactivity and flexible teaching

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design. It aims at having students master textbook knowledge, neglecting the "student-centered" teaching philosophy and failing to cultivate students' comprehensive abilities. New Agricultural Science, however, is driven by the integration of the global new technology revolution and industrial transformation, serving national strategic needs such as rural revitalization, ecological civilization, Beautiful China, and Healthy China. It focuses on solving key issues in agricultural and rural modernization and aims to cultivate integrated, excellent new agricultural and forestry talents.

Therefore, in teaching plant physiology, it is necessary to adhere to the standards of the "golden course" of "two essentials and one degree" to promote the organic integration of students' knowledge, abilities, and qualities, cultivate students' comprehensive abilities to solve complex problems and higher-order thinking. Emphasizing a "student-centered" teaching philosophy, the traditional classroom-centered teaching model should be transformed, reconstructing a teaching and evaluation model centered on abilities. This will stimulate students' enthusiasm for learning and love for agriculture, foster their innovative thinking, enhance their innovation capabilities, and make them more dedicated to agriculture. This is a crucial step in improving the teaching quality and effectiveness of plant physiology.

2. Main Content of the Reform and Practice of Plant Physiology Course

2.1 Integration of Ideological and Political Education

The course team has boldly and actively explored and attempted to integrate ideological and political education into course teaching. In the course construction, they deeply explore the connections between professional course knowledge, practical production and life, and ideological and political elements, and appropriately introduce these into teaching segments. Major current events can also be used as perspectives, such as the COVID-19 pandemic in 2020, to timely educate students on compliance with regulations, patriotism, and more.[1]

2.2 Optimizing Teaching Content to Enhance the Advanced and Innovative Nature of the Course

The course adopts the nationally planned textbook "Modern Plant Physiology" (4th Edition) edited by Professor Li Hesheng from Huazhong Agricultural University, adhering to the principle of "teaching basic theories with an application-oriented approach, focusing on necessity and sufficiency, emphasizing clear concept explanation and application enhancement." Based on the basic knowledge of plant physiology, the course appropriately introduces new knowledge, new technologies, and research hotspots in the field of plant physiology to guide students in thinking and exploration, conveying the spirit of science to students.

2.3 Continuously Promoting the Reform and Innovation of Traditional Classroom Teaching Models

Constructing and further improving the provincial online open course teaching platform for "Modern Plant Physiology," carrying out blended teaching both online and offline.

Course construction aligns with the background of informatization development, utilizing the advantages, methods, and means of educational technology to reform traditional teaching content and concepts. Centering on student development, the course leverages online teaching resources and various teaching methods, innovates assessment methods, focuses on the learning process, stimulates students' self-learning awareness and professional interest, and cultivates students' comprehensive abilities and advanced thinking to solve complex problems.[2]

The teaching resources of the provincial online course for "Modern Plant Physiology" are divided into five sections: theory, experiments, exercises, discussion and communication, and knowledge expansion:

Theory Section: Recorded 49 theory teaching videos, totaling 505 minutes, with lecture notes totaling 158,200 words, and 48 sets of supporting PPTs (587 non-video resources in total). The teaching videos are fresh in appearance, clear in explanation, and concise in content.

Experiment Section: Completed the recording of 18 standard experiment videos to enhance experimental operations, including 14 validation experiments and 4 comprehensive experiments. The course team is actively preparing for network virtual simulation experiments to further improve practical teaching segments.

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Exercise Section: Set up 48 in-class questions; added 11 sets of chapter test questions, totaling 165 questions, 11 sets of unit assignments, and 1 set of final exam questions, totaling 50 questions, to supervise students' comprehensive mastery of theoretical knowledge points.

Discussion Section: The communication section includes a classroom discussion area and a post-class Q&A area, where all teachers in the course group are available 24/7 to interact with students in real-time and at zero distance. During the COVID-19 pandemic, the discussion area was very active, with single post replies reaching over 680, and up to nearly 200 post-class topic discussions in a semester.[3]

Knowledge Expansion Section:

Experiment Expansion: Recorded 4 comprehensive experiments to cultivate students' comprehensive application abilities.

Knowledge Expansion: Launched the "Advances in Plant Physiology Research" course to explain the origin, application, and prospects of major research techniques in plant physiology, further broadening students' horizons and enhancing their professional confidence.

News Expansion: Launched the "Light of Plant Physiology" WeChat public account to expand classroom content, track the frontiers of the discipline, and update the latest research results and technologies in plant physiology in real-time.[4]

Rich and high-quality teaching resources on the online teaching platform expand the teaching time and space of the course and change the traditional classroom teaching model. The combination of online course learning and offline classroom teaching achieves the transformation of traditional teaching to a blended teaching model, significantly improving students' theoretical knowledge, practical abilities, and comprehensive qualities, achieving the goal of cultivating professional and compound talents.

Strengthening the Deep Integration of Modern Information Technology and Educational Teaching, Enhancing Teacher-Student Interaction

Centered on students, a comprehensive, multi-perspective teaching model is constructed. Through platforms such as MOOCs, MOOC mini-programs, WeChat groups, QQ groups, DingTalk groups, and WeChat public accounts, teaching activities such as class sign-in, live class broadcasts, classroom discussions, random questions, post-class Q&A, classroom content expansion, and frontier dynamics tracking are carried out to strengthen teacher-student and student-student interactions. This guides students to discover and solve real-world problems, igniting their passion for exploring course content.

2.4 Reform of the Experimental Teaching System

Adjust and integrate the original experimental content, and change the plant physiology experiments to a teaching model mainly composed of design-based and research-based experiments.[5]

Use experimental teaching videos from the online course to conduct flipped classrooms, encouraging students to independently design and complete experimental processes. This fully stimulates students' interest, enhances their practical skills, and strengthens their team spirit.

Students are required to record the experimental process in the form of photos or videos and create short PPTs or video materials. The final experimental report is submitted in the form of an academic paper, training students to grasp overall knowledge and improving their scientific thinking abilities, laying a solid foundation for the completion of graduation theses and the cultivation of scientific literacy in the postgraduate stage.

2.5 Innovating Course Assessment Methods, Building a Process Evaluation Mechanism, and Focusing on the Learning Process

The process and final scores of the "Plant Physiology" course are adjusted to each account for 50%. Process scores include regular scores and mid-term scores, accounting for 30% and 20% of the total score, respectively. Regular scores are composed of student attendance, online course learning scores, classroom performance, and post-class assignments. Classroom performance assessment includes answering questions, participating in classroom discussions, taking detailed notes, and challenging learning content or raising valuable questions. Post-class assignments involve writing short papers or conducting group topic discussions after each chapter. Mid-term scores can be closed-book exam scores or course papers.

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2.6 Building a Well-Structured, High-Quality, High-Level Informatized Teaching Team

The plant physiology course group currently has 12 full-time teachers, including 2 professors, 5 associate professors, and 5 lecturers. There are 4 teachers over 45 years old and 8 teachers under 45. Ten have doctoral degrees, one has a master's degree, and one has a bachelor's degree. The entire teaching team has a reasonable structure in terms of education level, age, and academic background, with a relatively high educational level. In response to national requirements for informatized teaching reform, a training community of "key leadership, disciplinary linkage, team mutual assistance, and overall improvement" has been established. This community promotes the deep learning of related teaching equipment and informatization software applications around course standards and professional teaching standards, conducting activities such as teaching case studies and classroom recording analysis. By utilizing online resources and combining offline discussions, teachers' abilities in learning analysis, teaching design, learning method guidance, and academic evaluation through information technology are enhanced. Various lecture contests and teaching skill competitions are leveraged to promote teaching through competition, learning through competition, and reform through competition, collectively improving informatized teaching abilities and effectively enhancing classroom teaching quality.

3. Results of Course Reform and Practice

Since the approval and implementation of the teaching reform project "Reform and Practice of Plant Physiology Course Based on Innovative Agricultural and Forestry Talent Cultivation in the Context of New Agricultural Science," significant achievements have been made in course teaching reform, innovative talent cultivation, and faculty development:[6]

3.1 Establishing a New Blended Teaching Model to Improve Course Teaching Quality

The construction of the online course "Modern Plant Physiology" has greatly stimulated students' enthusiasm for learning and provided a platform and opportunity for the course team to further develop a new blended teaching model combining online and offline methods. This has improved course teaching quality and innovated talent cultivation models. Students can independently preview, review, submit assignments, and participate in tests on the online platform. They can also maintain seamless communication with teachers through the discussion area. Teachers can organically combine online courses with offline classroom teaching, realizing flipped classrooms and project-based teaching, thus enhancing students' classroom participation and cultivating innovative thinking. Teachers can also obtain timely feedback to adjust their teaching methods.

Through three semesters of exploration and practice in the blended teaching model, not only has students' enthusiasm for learning been reignited, but it has also effectively addressed issues arising from Henan Agricultural University's multi-campus operation, such as difficulties in meeting with teachers, submitting assignments, and grading assignments. The online course has become a powerful supplement to the plant physiology course. Based on the online open course platform, centered on student development, and supplemented by various teaching methods and tools, the course has truly transitioned from traditional classroom teaching to a blended teaching model. This has strengthened teacher-student and student-student interactions, guiding students to discover and solve real-world problems, igniting their passion for exploring course content, and significantly improving their self-learning ability, classroom participation, and professional quality.

The interactive Q&A and classroom discussion areas of the online course are lively, with the highest number of replies in a single session reaching 1,000. Students' interest in pursuing further studies has increased, and many have participated in national college student innovation and entrepreneurship training projects and won awards. Students' theoretical knowledge, practical abilities, and comprehensive qualities have greatly improved, effectively achieving the goal of cultivating professional and versatile talents.

The construction and practice of the provincial online course "Modern Plant Physiology" were recognized as a provincial first-class online course and a university-level first-class online course in 2021. It was also recommended by the Henan Provincial Department of Education to compete for the second batch of national first-class online courses. Additionally, the plant physiology course was recognized as one of the first model courses for ideological and political education in Henan Province.

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3.2 Strengthening Textbook Development

Textbooks are the foundation of teaching. The course team has always emphasized textbook development, integrating textbook content with cutting-edge advances in the discipline, and has edited and co-edited a series of new digital theory and experimental textbooks suitable for agricultural and forestry colleges. This has increased the difficulty and challenge of the course. Among them, the textbook construction research project led by Teacher Hu Xiuli, funded by the China Agricultural Science and Education Foundation, aims to integrate cutting-edge knowledge of plant physiology with basic theories while considering the professional characteristics of agricultural and forestry colleges. The new "Plant Physiology" textbook is currently being written and proofread, with official publication planned for June 2024.

On the other hand, to strengthen practical teaching reform, we collaborated with Higher Education Press and universities such as Yunnan Agricultural University, Henan University of Science and Technology, Shangqiu Normal University, and others. The "Plant Physiology Experiment Guide" textbook, edited by Xue Ruili and Zi Shuhui, with contributions from Wang Yuexia, Ji Yue, Li Haixia, and others, has completed the manuscript and is currently being typeset and proofread, with official publication expected in July 2024.

In addition, the national "14th Five-Year Plan" textbook "Modern Plant Physiology," based on the provincial online open course, was approved for construction in September 2021 by the National Forestry and Grassland Administration.

3.3 Significant Improvement in Faculty's Informatization Teaching Level and Teaching Innovation Ability

Besides holding regular internal teaching seminars and lesson observations, the course team has raised funds from various sources to encourage teachers to actively participate in on-campus and off-campus teacher training and planned further studies. This has continuously improved the overall teaching quality and level of the course team. During the project construction period, team teachers attended 8 off-campus teaching exchange meetings and over 10 research conferences.

Teaching competitions are excellent platforms for enhancing the teaching abilities of young teachers. Team teachers have participated in multiple teaching skill competitions and lecture contests, achieving outstanding results. The teaching team includes one university-level teaching master (Teacher Hu Xiuli) and three university-level excellent teachers. Team teachers have hosted 12 provincial and university-level teaching quality projects, including the National Forestry and Grassland Administration's "14th Five-Year Plan" textbook projects, Henan Province Excellent Online Open Courses, Henan Province First-Class Online Courses, Henan Agricultural University's Excellent Virtual Teaching and Research Office for Plant Physiology, Henan Agricultural University's Online Open Courses for Adult Higher Education, and Henan Agricultural University's Higher Education Teaching Reform and Practice Projects. They have also won 10 awards, including the National Forestry and Grassland Administration's Ecological Civilization Informatization Teaching Achievement Award, the First Prize for Excellent Online Courses in Henan Province, the First Prize for Education Informatization Achievements in Henan Province, the Second Prize for Teaching Achievements at Henan Agricultural University, and the Second Prize for Undergraduate Teaching Quality at Henan Agricultural University.

Moreover, team teachers have actively carried out reforms and practices in course teaching models and methods, publishing over 10 related teaching papers.

3.4 Cultivating Students' Innovation and Entrepreneurship Abilities

While conducting course teaching, the course team subtly cultivates students' innovation and entrepreneurship abilities, actively leading students to participate in university-level and provincial-level student innovation and entrepreneurship projects, open laboratory projects, and national-level student innovation and entrepreneurship projects, winning awards. For example, Teacher Hu Xiuli's team won the provincial second prize in the 2021 National College Student Life Science Competition, Teacher Yang Hao's team won the provincial third prize in the 2021 National College Student Life Science Competition, and Teacher Wang Yuexia's team won the special prize in the 2022 "Challenge Cup" Henan Provincial College Student Entrepreneurship Plan Competition.

Through the above aspects of teaching reform and innovation practice, a plant physiology online

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teaching platform conforming to modern educational concepts has been constructed at our university. This has promoted the transformation of traditional classroom teaching models into a new blended teaching model combining online and offline methods. As a result, students' theoretical knowledge, practical abilities, and comprehensive qualities have significantly improved, effectively achieving the goal of cultivating professional and versatile talents.

Additionally, the effectiveness of the "blended teaching method" and "Seminar" classroom teaching models developed by the project team members in the plant physiology course has been fully verified. These models have also been applied to course teaching in other universities, such as Yunnan Agricultural University, Henan University of Chinese Medicine, Zhengzhou University of Light Industry, Shangqiu Normal University, and Henan Agricultural Vocational College, achieving good results.

4. Conclusion

The cultivation of innovative agricultural and forestry talents within the "New Agriculture" framework is a key aspect of educational and teaching reform in higher agricultural and forestry institutions. Various universities are currently exploring and practicing this initiative, as there is no relatively mature fixed training model nationwide. Therefore, we should actively update our teaching philosophies and pursue educational reforms in response to the new requirements for cultivating innovative agricultural and forestry talents. "Plant Physiology" is one of the core courses for plant production majors in higher agricultural and forestry institutions. By leveraging the opportunity provided by the establishment of national first-class courses and first-class undergraduate programs, and considering the characteristics of this course along with the agricultural and forestry economic features of our province, we aim to integrate teaching, learning, and practice. This integration is geared towards the construction of the rural revitalization strategy and the concept of green development. Through the reform of the "Plant Physiology" course, we strive to cultivate a group of "New Agriculture" talents with strong practical skills, strong innovative capabilities, and broad international perspectives, thereby providing stronger talent support for the development of rural revitalization.

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References

[1] Tang Renjian. Accelerating the Construction of an Agricultural Power [N]. People's Daily, 2022-12-15(13).

[2] Fan Dong, Pan Junbo, Wang Xiaoyun. Key Issues and Countermeasures in Improving the Quality of Talent Cultivation in Plant Production-related Majors [J]. China Agricultural Education, 2013(04): 79-83.

[3] Zhang Yan, Wang Menghan, Zhang Mo, et al. Research on Talent Demand Changes and Cultivation Trends Driven by the Construction of "New Agricultural Science" [J]. Modern Education Management, 2020(11): 8-13.

[4] An Meichen. Research on the Integration of Ideological and Political Education into the Cultivation of New Talents Who Know and Love Agriculture in Agricultural Universities [J]. Research on Ideological and Political Education, 2022, 38(02): 136-141.

[5] Yin Ying. Research on the Dilemma and Improvement Strategies of Ideological and Political Teachers' Informatization Teaching Ability in the New Era [J]. Journal of Jilin Radio and TV University, 2022(05): 114-116.

[6] Yuan Qing, Huang Jindou, Li Ping, et al. Research on Blended Teaching of Basic Materials Science Course Based on MOOC Platform [J]. Innovation and Entrepreneurship Theory Research and Practice, 2024, 7(03): 159-161.