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Artificial Intelligence Promotes Teaching and Research Practices in Agricultural Science Courses

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Abstract: With the rapid advancement of artificial intelligence (AI) technology, its applications in education are deepening, creating new opportunities for reforming and innovating traditional agricultural courses. This paper examines the significance of AI-enhancing agricultural education, analyzes existing challenges in integrating AI with agricultural curricula, and proposes implementation pathways and optimization strategies through concrete teaching practice cases. The aim is to improve teaching quality in agricultural courses and explore pathways for cultivating high-caliber professionals who meet the demands of smart agriculture development.

Keywords: AI Empowerment; Agriculture; Curriculum; Practice

1. Introduction

Artificial intelligence (AI) promotes agriculture towards an advanced stage of informatization by integrating information technologies such as remote sensing, the Internet of Things, and big data. It realizes diversified production methods such as agricultural information perception and intelligent control, optimizes resource allocation, promotes supply and demand docking, and provides new solutions for sustainable development of agriculture and rural areas and rural revitalization. Implementing the national big data strategy, utilizing AI to transform traditional agriculture, and developing efficient ecological modern agriculture are the directions. At present, China's smart agriculture is still in its infancy, and research on the integration of agriculture and AI is weak. It is urgent to accelerate the reform of agricultural intelligent teaching to drive the development of modern science and industry.

2. The Importance of AI Enabling Agricultural Courses

The integration of AI technology into agricultural courses can not only innovate the teaching mode, but also inject new vitality into the cultivation of agricultural talents, which is embodied in the following three aspects:

2.1 Breaking through the Limitations of Traditional Teaching Methods

Conventional agricultural courses predominantly rely on textbooks, blackboard lectures, and conventional explanations, which struggle to visually present dynamic knowledge such as crop growth cycles and pest-disease development processes. AI technology utilizes virtual simulation and 3D modeling to dynamically demonstrate the entire crop lifecycle from germination to harvest. Students can "observe in real-time" crop growth under various climatic and soil conditions within virtual environments, enabling rapid comprehension of abstract agricultural principles. For instance, in the "Crop Cultivation" classroom, AI-powered virtual simulation systems allow adjustments to parameters like temperature, humidity, and fertilizer application rates while monitoring real-time crop growth. This significantly shortens students' knowledge acquisition process [1].

2.2 Achieving Personalized Education that Meets Students' Differentiated Needs

Traditional "one-size-fits-all" approaches often fail to accommodate individual differences. The AI-powered teaching platform analyzes classroom interactions, assignment completion rates, and test scores to pinpoint knowledge gaps and learning priorities, then delivers tailored resources and customized study plans. For instance, students with weaker agricultural

IT skills receive foundational courses like AI-powered agricultural sensor applications and big data analysis for farming. Those interested in smart agriculture management gain access to advanced topics such as IoT system development and AI-driven crop yield prediction models. This personalized teaching model precisely aligns with students' learning demands [2].

2.3 Meeting the Development Needs of Smart Agriculture

In today's era of rapid smart agriculture development, agricultural production is increasingly moving toward intelligent and precision-oriented approaches, which raises higher requirements for agricultural professionals' practical skills and innovative thinking. AI-enhanced agricultural education can gradually incorporate real-world agricultural case studies, such as AI-powered pest identification and intelligent irrigation decision-making systems. This enables students to participate in actual project development and application during their studies, integrating theoretical knowledge with practical implementation. Through this practice-oriented teaching design, we can enhance the alignment between agricultural talent cultivation and industry needs [3].

3. Major Problems Facing Agricultural Courses Empowered by AI

Although AI has brought many advantages to agricultural courses, it still faces some urgent problems in practical teaching application. The solution to the problem.

3.1 The Development of Agricultural Education Resources Remains Underdeveloped and Lacks Adaptability

Currently, there are limited AI teaching resources specifically designed for agronomy programs. Existing AI tools and platforms predominantly focus on IT and computer science domains, showing poor alignment with agricultural expertise. Many current AI tools fail to adequately address agronomy-specific characteristics in content design, such as seasonal crop growth patterns and regional variations, resulting in inadequate adaptability for agricultural curriculum implementation. Furthermore, the slow pace of AI resource development lags behind advancements in smart agriculture technologies, compromising the timeliness of instructional content [4].

3.2 Teachers' Limited Proficiency in Applying AI Technology

As the primary implementers of AI-enhanced agricultural courses, educators' technical capabilities directly determine the success of AI integration. Many agricultural faculty members lack specialized AI training, resulting in inadequate mastery of AI tools and difficulty in organically combining AI technology with course content. Furthermore, their insufficient expertise in AI resource development and innovative teaching design prevents them from creating scientifically sound AI-based instructional plans that address learners' needs and course characteristics [5].

3.3 Students Exhibit Varying Levels of Acceptance and Adaptability

Due to differing foundational knowledge in information technology, their receptiveness and adaptability to AI-enhanced agricultural courses differ significantly. Those with stronger IT backgrounds readily embrace AI-assisted teaching methods, actively participating in virtual simulations and intelligent project practices. Conversely, many students with weaker IT skills fear AI technology and struggle to use AI tools, resulting in low learning motivation and suboptimal outcomes. Additionally, some students lack a deep understanding of AI applications in agriculture, failing to recognize how AI can enhance professional skills and cultivate vocational competencies, which diminishes their intrinsic learning drive.

4. Implementation Path of AI-Enabled Agricultural Courses

Based on the above issues and practical teaching practice, we can construct the implementation path of AI-enabled agricultural courses from three dimensions: teaching resource construction, teacher ability improvement, and student guidance.

4.1 Enhance the Construction of AI Agricultural Teaching Resources and Improve the Adaptability of Resources

4.1.1 Collaborative development of specialized resources

Universities can partner with agricultural technology innovators and AI enterprises to create AI-adapted teaching resources tailored to core agricultural curriculum content. For

example, in the core course "Plant Protection Science", collaborative development of AI-powered pest image recognition databases and virtual simulation systems could be implemented. These databases would encompass pest images from various regions and crops, while the simulation system would demonstrate pest occurrence processes and control methods. For the specialized course "Agricultural Meteorology", an AI-driven platform integrating meteorological data with crop growth models could be developed, providing students with interactive learning tools to understand the relationship between weather patterns and crop development. Through industry-academia collaboration in smart agriculture programs, these resource development models offer valuable references for curriculum innovation in industry-education integration [6].

4.1.2 Establishing resource sharing and updating mechanisms

Develop regional or national AI-powered agricultural education resource platforms to encourage universities, enterprises, and research institutions to upload high-quality teaching materials, thereby achieving resource sharing. Simultaneously, implement a dynamic resource update mechanism. Based on advancements in smart agriculture technologies and evolving agricultural curriculum needs, experts will regularly review and update resources. Relevant personnel will promptly develop corresponding teaching cases and experimental projects, which will be updated on the platform to ensure timeliness and accuracy [7].

4.2 Enhance Teachers' AI Application Capabilities and Strengthen Teaching Research through Multiple Measures

4.2.1 Implementing AI-driven targeted training

Universities and AI training institutions will jointly develop tiered AI training programs for agricultural education faculty. The foundational training covers AI concepts, core principles, and practical use of AI-powered teaching software and platforms. Advanced training focuses on AI curriculum development, innovative teaching strategies, and effectiveness evaluation of AI-assisted instruction. Faculty are encouraged to participate in AI pedagogy seminars and case study workshops to gain hands-on experience in AI application [8].

4.2.2 Strengthening interdisciplinary teaching team development

By integrating resources from agricultural science faculty, IT specialists, and AI engineers, we establish interdisciplinary research teams. These teams collaborate on AI-enhanced agricultural education, resource development, and pedagogical innovation. For example, agricultural science instructors identify teaching requirements and key knowledge points, while IT experts and AI engineers provide technical support to jointly design AI-enhanced teaching plans and develop educational resources. Through cross-disciplinary collaboration, we leverage expertise from diverse fields to elevate AI-powered agricultural education [9].

4.3 Strengthen Student Guidance and Support to Improve Learning Outcomes

4.3.1 Conduct AI technology training

Prior to implementing AI-enhanced agricultural courses, students receive foundational training in information technology and AI basics to address knowledge gaps among those with weaker foundations. The program covers computer fundamentals, core AI concepts, and practical use of AI teaching tools, combining theoretical instruction with hands-on practice. This approach enhances students' IT application skills and improves their adaptability to AI-driven teaching models [10].

4.3.2 Enhancing student engagement through diverse teaching models

The course employs case-based instruction, project-based learning, and collaborative group work, while integrating AI technology into educational activities. For instance, in the "Introduction to Smart Agriculture" course, a project titled "Design of AI-Driven Small-Scale Intelligent Irrigation Systems" was implemented. Students were organized into teams to utilize AI technology for collecting soil moisture and crop water requirements data, developing irrigation decision-making models, and completing system design and debugging. This project-based approach not only stimulates students' interest and initiative but also enhances their teamwork skills and practical innovation capabilities. Additionally, invited experts from agricultural technology enterprises delivered lectures showcasing real-world applications of AI in modern agricultural production. These sessions helped students understand the critical role of AI empowerment in employment, further boosting

their enthusiasm for learning [11].

5. Strategies for Optimizing Agricultural Courses with AI

To further enhance the teaching and research effectiveness of AI-enabled agricultural courses and achieve sustainable development, the following aspects need to be optimized.

5.1 To Ensure Teaching Quality, We Establish a Comprehensive Evaluation System

This system integrates multi-dimensional AI-enhanced assessments for agricultural science courses, focusing not only on students' knowledge mastery but also their practical application skills, innovation capabilities, and AI technology proficiency. The evaluation framework combines formative and summative assessments: formative evaluations analyze student participation in AI virtual experiments, project performance, and classroom interactions, while summative evaluations assess overall performance through AI-powered test scores, course design reports, and completed projects. Additionally, we implement student feedback and peer reviews to collect insights on AI teaching models and instructional suggestions from faculty colleagues. These inputs enable timely adjustments to teaching plans, continuous quality improvement, and the refinement of the multi-dimensional evaluation system [12].

5.2 To Enhance Policy Support and Financial Investment

Government departments and universities should strengthen policy support and funding for AI-enhanced agricultural education. Develop policies to encourage universities to implement AI-integrated curriculum reform projects, with recognition and rewards for outstanding teaching research achievements. Establish special funds to support AI teaching resource development, faculty training, and educational platform construction, providing financial backing for AI-powered agricultural education initiatives. For instance, universities can use these funds to purchase advanced AI teaching equipment, create AI-powered virtual agricultural laboratories, and continuously support technology-enhanced instruction. This also enables the provision of better practical training environments for students.

5.3 To Deepen the Integration of AI Technology with Agricultural Education

Universities and research institutions are encouraged to explore AI-enhanced teaching models that align with agricultural curriculum characteristics and student learning needs. For instance, developing personalized teaching recommendation algorithms using big data and machine learning to improve resource delivery precision, and creating immersive VR/AR-enhanced virtual experiments to elevate learning experiences. Through continuous innovation, some researches can provide theoretical foundations and technical support for AI-driven agricultural education development [8].

6. Conclusion

The application of AI technology in agricultural education presents transformative opportunities, particularly in overcoming pedagogical constraints, delivering personalized classroom instruction, and aligning with industry talent demands. However, challenges persist in AI-enhanced agricultural curricula, including inadequate resource compatibility, limited teacher proficiency in AI applications, and significant disparities in student competencies. To address these issues, we must strengthen specialized teaching resources, enhance educators' AI capabilities, optimize student guidance systems, refine evaluation frameworks, implement supportive policies, and advance sustained research. By achieving these objectives, we can elevate the quality of agricultural education, cultivate high-caliber professionals for smart agriculture development, and better serve China's agricultural modernization goals.

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