Journal of Frontiers in Multidisciplinary Research

Discussion on the Innovation of Teaching Content of Horticulture Courses in Local Universities in China under the Background of AI

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Article Info

E-ISSN: 3050-9726
P-ISSN: 3050-9718
Impact Factor (RSIF): 7.34
Volume: 07
Issue: 01
Received: 21-02-2026
Accepted: 20-03-2026
Published: 19-04-2026
Page No: 317-320

Abstract
The rapid iteration of artificial intelligence (AI) technology is reshaping the educational ecosystem of modern agricultural science. As the main base for cultivating regional horticultural industry talents, the horticulture major in local colleges and universities has long suffered from a structural imbalance in its course teaching content, characterized by an emphasis on theory over practice, experience over data, and production over management. Against the backdrop of AI, the teaching content of horticulture courses should transform from the traditional agricultural knowledge system to a "smart horticulture" knowledge system. This paper analyzes the current predicament of the teaching content of horticulture courses in local colleges and universities, explores the intrinsic logic of integrating AI technology into horticulture courses, and proposes innovative paths such as constructing an "AI + horticulture" modular course system, developing a virtual-real integrated teaching resource library, and innovating the case-driven presentation of teaching content, aiming to cultivate new agricultural science talents who can adapt to the development of smart agriculture.

DOI: https://doi.org/10.54660/.JFMR.2026.7.1.317-320

Keywords: Artificial intelligence, Local colleges and universities, Horticulture major, Course content, Smart agriculture, Teaching innovation

1. Introduction
With the deep integration of new-generation information technologies such as artificial intelligence, the Internet of Things, and big data with modern agriculture, the horticulture industry is undergoing a profound transformation from "relying on nature" to "knowing nature" and from "experience-driven" to "data-driven". AI application scenarios such as intelligent greenhouse environmental control, image recognition of pests and diseases, precise management of water and fertilizer integration, and fruit harvesting robots have been implemented in large-scale horticultural production. However, as the horticulture major in local universities, which is the supply side for talent cultivation, its course teaching content is significantly lagging behind the technological changes in the industry.

Local universities bear the responsibility of providing applied talents to the regional horticulture industry. Facing the disruptive impact of AI technology on traditional horticulture production methods, how to innovate the course teaching content and enable students to master the composite ability of "traditional horticulture skills + AI-assisted decision-making" has become the core issue that urgently needs to be solved in the current teaching reform of horticulture majors. This article is based on the actual operation of local universities and explores the innovative direction and implementation path of horticulture course teaching content in the context of AI [1].

2. Current predicament: Structural imbalance in the teaching content of horticulture courses in local universities
Currently, the curriculum systems of horticulture programs in most local universities still follow the traditional framework of agricultural science disciplines. There is a significant disconnection between the teaching content and the industrial demands as well as the technological developments.

2.1. The update of the knowledge system lags behind the technological changes in the industry

The horticulture industry has entered a stage of intelligent development. Technologies such as intelligent environmental control, AI identification of pests and diseases, and drone crop protection have become standard practices in the industry [2]. However, the horticulture courses offered by local universities still mainly consist of traditional subjects like "Tree Fruit Cultivation," "Vegetable Cultivation," and "Flower Science." The teaching content focuses on classic knowledge such as variety characteristics, phenological periods, and traditional cultivation techniques. For cross-disciplinary and integrated content such as "Principles of Sensors and Their Applications in Horticulture," "Analysis and Decision-making of Agricultural Big Data," and "Application of AI Visual Technology in Horticulture," there is rarely a systematic inclusion in the curriculum. This "emphasizing tradition while neglecting the frontier" content structure leaves students at a loss when they encounter intelligent production scenarios after graduation.

2.2. The practical teaching content is disconnected from the real production scenarios

The practical teaching of horticulture majors in local colleges has long relied on on-campus internship bases. Due to limited funding and facility conditions, the on-campus greenhouses are mostly traditional single-story greenhouses, lacking intelligent agricultural equipment such as intelligent environmental control, water and fertilizer integration, and data collection. The cultivation experiments completed by students on campus are still mainly based on manual recording of temperature and humidity, manual irrigation and fertilization, and visual observation of pests and diseases. This contrasts sharply with the digital and intelligent production scenarios in the industrial frontlines. This "simulated" practical training is difficult to cultivate students' ability to use AI tools to solve actual production problems.

2.3. The content of the textbook is outdated and lacks digital supplementary resources

The textbooks currently used for the main courses in horticulture are mostly published before 2015, with a long content update cycle. There are few cases that cover the latest applications of AI technology in the field of horticulture [4]. At the same time, the textbook format is still mainly in the form of printed text, lacking digital teaching resources compatible with AI technology, such as virtual simulation experiments, AR/VR three-dimensional models, and online intelligent question banks. This has led to classroom teaching remaining in the traditional mode of "teachers lecturing and students memorizing", making it difficult to stimulate students' interest in learning smart horticulture.

3. Logical Turn: The Value Mechanism of Integrating AI into the Teaching Content of Horticulture Courses

The deep integration of AI technology with horticulture courses is not merely about adding a few new technology courses; rather, it is a reconfiguration of the paradigm for organizing teaching content.

3.1. The transformation from the "experience inheritance" to the "data-driven" knowledge paradigm

Traditional horticulture teaching emphasizes the intergenerational transmission of "old-school" experience, such as "observing the plants and watering them" and "observing the weather and fertilizing" - these are empirical knowledge. The integration of AI technology enables the experiential knowledge in horticulture production to be quantified, modeled, and algorithmized. The teaching content should guide students to understand: how the data collected by temperature and humidity sensors can be transformed into irrigation decisions? How does the convolutional neural network identify the characteristics of leaf diseases? This cognitive leap from "experience" to "data" is the core competence for cultivating horticulture talents in the AI era.

3.2. From "Single Skill" to the Reconfiguration of the "Cross-Field Integration" Capability Structure

Traditional horticulture courses cultivate individuals with a single skill of "being able to grow". In the context of AI, horticulture professionals need to possess a composite ability structure of "basic horticulture knowledge + application ability of AI tools + data analysis thinking" [3]. The content innovation of the courses should break through disciplinary barriers and integrate core concepts from fields such as computer vision, machine learning, and the Internet of Things into the knowledge modules of horticulture professional courses, following the principle of "adequate and practical".

3.3. From "static knowledge" to "dynamic generation" of teaching resources upgrading

AI technology has fundamentally changed the way teaching content is generated. Intelligent teaching assistants based on large language models can dynamically generate personalized case analyses, practice exercises, and knowledge expansion materials based on students' learning progress and interests. Course content is no longer a fixed textbook but a dynamic knowledge base that can be updated in real time according to the evolution of industrial technologies.

4. Innovation Approach: Specific Strategies for Teaching Content of Horticulture Courses in Local Universities

Given the limited resources and diverse student backgrounds of local universities, it is suggested to advance the reform of horticulture course teaching content from the following four aspects.

4.1. Reconstruct the curriculum system: Add modular teaching content of "AI + Horticulture"

Without increasing the total credits, "upgrade the existing content and add new elements" is carried out for the traditional course content [5].

1. Embed AI elements into traditional course content

"Vegetable Cultivation": Add a teaching module on "Production Prediction Model Based on Environmental Factors", explaining how to use temperature, light, water and air data to predict the harvest period and yield.

"Orchard Plant Pathology": Add a teaching module on "Disease Image Recognition Based on Deep Learning", introducing the basic principles of convolutional neural networks and their application in leaf disease diagnosis.

"Horticultural Technology": Treat "Intelligent Greenhouse Environmental Control Algorithm" as an independent chapter, explaining the application logic of PID control, fuzzy control and other algorithms in the environmental control system.

2. Add "AI + Horticulture" specialized courses

It is suggested to offer 1-2 AI application general courses for horticulture majors, such as:

"Introduction to Smart Horticulture": Systematically introduce the application scenarios of IoT, AI and big data in the entire horticulture industry chain.

"Horticultural Data Analysis and Visualization": Teach Excel, Python basics and data visualization tools, and cultivate students' basic ability to process sensor data.

4.2. Develop teaching resources: Build a virtual-real integrated smart horticulture teaching resource library

4.2.1. Virtual simulation experiment resources

Given the limited hardware conditions of local universities, priority should be given to developing virtual simulation experiment projects. For example:

"Virtual Simulation of Intelligent Greenhouse Environmental Control": Students set parameters such as temperature, light, and CO_2 concentration online, and the system simulates the response of crops to these changes, helping to cultivate students' decision-making skills in environmental control [6].

"Virtual Simulation of AI Recognition of Horticultural Pests and Diseases": A large number of diseased leaf images are provided, and students train simple classifiers to understand the working principle of AI recognition.

4.2.2. Construction of Digital Case Library

Collect and organize typical cases of smart horticulture at home and abroad, forming a teaching case library that can be updated dynamically. The cases should cover:

Application of intelligent water and fertilizer integration systems in tomato production

Application of multi-spectral images from drones in orchard pest and disease monitoring

Visual recognition and path planning of harvesting robots in strawberry picking

Each case includes background introduction, technical principles, application effects, and issues for discussion, facilitating classroom discussion-based teaching.

4.3. Innovative teaching methods: Introducing an AI-assisted case-driven teaching model

4.3.1. AI-assisted generation of teaching cases

Teachers can utilize generative AI tools (such as ChatGPT, Kimi, etc.) to quickly generate teaching cases and discussion questions for specific knowledge points. For example, when explaining "The Impact of Facility Environment on Flowering", input the prompt: "Generate an agricultural experimental case about the effect of light duration on flowering position in tomato facility cultivation, including experimental design, data results, and thinking questions." The AI can provide usable teaching materials within minutes, significantly reducing the teacher's preparation burden.

4.3.2. Flipped classroom and project-based learning

Integrate the use of AI tools into classroom activities. Assign "project-based learning" tasks, such as:

"Using public meteorological data and crop models, predict the optimal sowing period for a certain horticultural crop in this region".

"Using mobile phones to take photos of diseased leaves in the campus, attempt to diagnose using AI image recognition tools (such as PlantNet, Flower Companion), evaluate the accuracy of the diagnosis and analyze the reasons for misjudgment".

Through real tasks, students can "learn by doing", intuitively experiencing the application value and limitations of AI tools in the field of horticulture.

4.3. Reform the evaluation system: Add an assessment dimension for AI application capabilities

Traditional closed-book exams are difficult to measure students' ability to apply AI tools. It is suggested to innovate the assessment methods as follows:

Process-based evaluation: Require students to complete an "AI Tool Application Log", documenting which AI tools were used in the course learning, what problems were solved, and what difficulties were encountered.

Project-based assessment: Complete the "Smart Horticulture Solution Design" as a group, proposing a solution idea integrating AI technology for a specific production problem (such as early warning of tomato gray mold in greenhouses), and writing a solution report.

Practical assessment: Set up a specific horticultural production scenario on a virtual simulation platform, assessing students' ability to complete production management tasks using the AI-assisted decision-making functions provided by the system.

5. Implementation Guarantee: Key Conditions for Local Universities to Promote Curriculum Innovation

5.1. Improvement of the digital literacy of the teaching staff

The bottleneck of curriculum content innovation lies in the teaching staff. Local universities should enhance the AI literacy of horticulture teachers through the approach of "bringing in talents and sending out students". On one hand, they should invite teachers from computer science and agricultural informatization fields or enterprise technicians to conduct interdisciplinary joint teaching activities; on the other hand, they should select key teachers to participate in the teacher training programs related to smart agriculture [7].

5.2. Collaborative construction of on-campus and off-campus practical platforms

Local universities can establish stable school-enterprise partnerships with smart agricultural parks and modern horticultural enterprises in the region. The actual production scenarios of the enterprises can be used as the "second classroom" for students, with them being arranged to visit intelligent greenhouses and participate in data collection and analysis projects, thus forming a closed loop between teaching content and industrial practice.

5.3. Organizational Guarantee for Interdisciplinary Teaching and Research Teams

It is suggested to establish a "Interdisciplinary Teaching and Research Department of Smart Horticulture", consisting of teachers from the horticulture major and those from computer science, automation and other fields. Regularly organize collective lesson preparation, jointly develop teaching cases, and jointly guide student projects. This will break down the disciplinary barriers and form an organizational synergy for curriculum content innovation.

6. Conclusion

AI technology is profoundly transforming the production methods of the horticulture industry, and it will also inevitably force a systematic reform of the teaching content of horticulture courses in universities. For local universities with limited resources, this is both a challenge and an opportunity. Instead of passively waiting for conditions to mature, it is better to take the initiative to carry out "small-step fast-run" type progressive innovations: starting from a chapter of a course, from a virtual simulation experiment project, or from a school-enterprise cooperation case, gradually build a new teaching content system that combines "traditional horticulture wisdom with AI technology empowerment". Only in this way can the horticulture talents cultivated by local universities stand firm in the tide of smart agriculture and truly serve the high-quality development of the regional horticulture industry.

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How to Cite This Article

Gunawan DI, Sili EB, Wisudawan IGA. Discussion on the innovation of teaching content of horticulture courses in local universities in China under the background of AI. J Front Multidiscip Res. 2026;7(1):317–320. doi:10.54660/.JFMR.2026.7.1.317-320.

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