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AI Facilitates the Construction and Practice of the "Project-Guided and Task-Driven" Teaching Model: Taking "The Working Process of Open-Loop Control Systems" as an Example

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Abstract: Addressing issues such as the disconnect between theory and practice and low student engagement in control system education, this paper uses the course "The Working Process of Open-Loop Control Systems" as a case study to explore the integration of AI technology with the "project-guided and task-driven" teaching model. By constructing a four-dimensional teaching framework of "situation-task-activity-evaluation," AI tools are embedded in project practices such as the construction of a mechanical timed flower watering device and the optimization of a digital timed flower watering device, achieving precision, interactivity, and personalization in the teaching process. Teaching practice demonstrates that this model significantly enhances students' technical awareness, materialization capabilities, and engineering thinking, providing a reference for the teaching reform of technical courses in high school education.

Keywords: AI technology; Project-guided; Task-driven; Open-loop control system; Technical education

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1. Introduction

With the requirements of the "Technology Curriculum Standards for General High Schools" for "strengthening practical inquiry and cultivating innovative awareness," general high school technology courses need to break through the traditional teaching model of "theory instruction + simple practical training" and construct a task-oriented teaching system centered around real-life projects [1]. As a core component of "Technology and Design 2," control systems, with their abstract working principles and complex interrelationships, often lead to difficulties in student understanding and application. Although high school sophomores possess basic knowledge of system design, they lack practical experience and have weak receptivity to technical knowledge, making it difficult for traditional teaching methods to stimulate their learning initiative [2]. The development of AI technology offers a new pathway for teaching model innovation. Its advantages in data processing, scenario simulation, and interactive feedback can effectively address pain points in the "project-guided and task-driven" teaching approach, such as "homogenized task design, fragmented process monitoring, and simplistic outcome evaluation" [3]. This paper takes "The Working Process of Open-Loop Control Systems" as an example to elaborate in detail on how to leverage AI tools to optimize the teaching process and achieve the educational goal of "project-based learning, task decomposition, AI empowerment, and competency realization," providing a practical paradigm for the teaching reform of technology courses in high school education.

2. Practical approaches for AI-enhanced teaching model in "The Working Process of Open-Loop Control Systems"

Based on the four-dimensional teaching framework of "Situation-Task-Activity-Evaluation" and aligned with the teaching objectives of "The Working Process of Open-Loop Control Systems," such as familiarizing students with the components and working processes of open-loop control systems and enabling them to express control principles using block diagrams, AI tools are integrated throughout the entire teaching process. The specific practical approaches are as follows:

2.1. AI-created problem situations to activate prior knowledge

(1) Knowledge review: Utilizing interactive courseware on tablet devices, students are guided to review the "meaning of control, its three essential elements (purpose/object/means), and classifications (manual/automatic)." Through the AI's real-time assessment feature in the question bank, students' grasp of prior knowledge and their accuracy in answering questions are evaluated, laying a foundation for subsequent learning.

(2) Situation creation: Combining real-life scenarios, a question is posed: "How can we achieve timed and demand-based watering for balcony plants with varying water retention capacities when we are away?" This sparks students' thinking. Using AI tools, such as mind mapping software, an associated diagram for the "problem of watering green plants" is generated, illustrating the pain points of "unattended watering" and potential solution directions, such as timed watering and humidity-sensing watering.

(3) Brainstorming: "Activity 1 - Group Discussion on Watering Device Solutions" is conducted, requiring students to submit their ideas, such as mechanical timing, electronic timing, and soil moisture sensing, through the AI collaboration platform on tablet devices. The system automatically consolidates all creative ideas into a nebula diagram and displays them in real-time. Based on the nebula diagram, the teacher guides students to focus on the "timed watering device," clarifying the project theme for this lesson [4]. This segment achieves "visualization of problem situations and efficient aggregation of creative ideas" through AI tools, activating students' prior knowledge while cultivating their technological awareness—identifying technological problems in daily life and proposing solutions.

2.2. AI-supported project practice to overcome key teaching challenges

2.2.1. Task 1: Building a Mechanical Timed Flower Watering Device—Understanding the Composition and Working Process of a Control System

(1) Self-directed learning: Students watch an AI-generated video titled "Materials and Functions of a Mechanical Timed Flower Watering Device" on their tablets. The content covers the properties and installation methods of timers, water pumps, and outlet pipes. The system can provide personalized knowledge point prompts based on students' viewing progress and the number of pauses, such as "the

principle of timer time adjustment."

(2) Hands-on practice: Conduct "Activity 2 - Building a Flower Watering Device According to the Diagram." Students use the provided materials, including a mechanical timer, water pump, potted plants, etc., to complete the construction based on the design diagram in the study guide. During the process, students can use the AI Q&A function on their tablets to inquire in real-time about issues such as "water pump wiring methods" and "connection methods between the timer and the water pump." The system provides answers in the form of graphics, videos, etc.

(3) Results presentation and analysis: Using real-time screen projection tools, students project the constructed flower watering device and descriptions of the working process, such as "setting the time → timer activates the water pump → water pump draws water → waters the potted plant," onto a large screen. The teacher guides students to analyze the relationship between "input (set watering time), control system (timer + water pump + potted plant), and output (soil moisture)," abstracts the concept of an open-loop control system, and draws a block diagram (**Figure 1**):

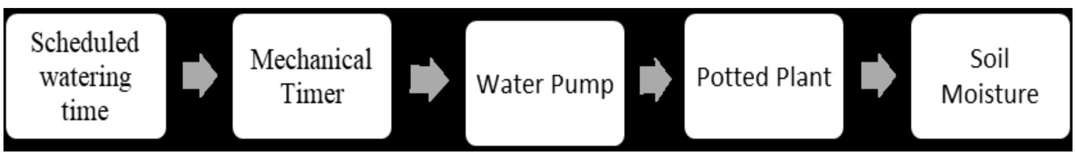

Figure 1. Block diagram

This segment utilizes AI tools to achieve "personalized learning resources and visualized practical processes," helping students overcome the key teaching challenge of "understanding the composition of a control system" and cultivating their materialization ability—transforming design plans into actual devices [5].

2.2.2. Task 2: Making a Digital Timed Flower Watering Device—Optimizing Control Schemes and Strengthening Block Diagram Drawing

(1) Problem-driven approach: Raise the issue that "the mechanical timed flower watering device cannot set multiple timed intervals and has low accuracy" (Question 3), guiding students to think about improvement plans. Utilize an AI comparison tool to display parameter differences between "mechanical timers" and "digital timers," such as timing accuracy and periodic setting functions, helping students clarify the optimization direction.

(2) Group collaboration: Carry out "Activity 3 - Making a Digital Timed Flower Watering Device," where students, working in groups of three, select materials such as a digital timer, water pump, and sensors for construction. Students are required to fill out the "Control Process Description" in the task sheet on the tablet and attempt to draw a block diagram. The system can automatically detect the logical correctness of the block diagram, such as whether the signal transmission direction is unidirectional, and provide modification suggestions.

(3) Feature summarization: Compare the block diagrams of the two flower watering devices and pose the question (Question 4): "Do the input and output variables affect each other?" Teachers use AI simulation experiments, such as "changing the output variable, soil moisture, and observing whether the input variable, set time, changes," to verify the characteristic of "unidirectional signal transmission in an open-loop control system" and clarify the functions of the "controller (timer), actuator (water

pump), and controlled object (potted plant)": Controller: Receives input signals (set time), analyzes them, and then issues commands to the actuator; Actuator: Receives commands, outputs control variables (water flow rate), and directly controls the controlled object; Controlled object: The device that needs to be controlled in the control system (potted plant) [6].

This segment achieves "data-driven plan optimization and intelligent block diagram drawing" through AI tools, helping students overcome the teaching challenge of "differentiating the characteristics of open-loop control systems" and fostering their engineering thinking-optimizing control plans from a technical parameter perspective.

2.3. AI-expanded case analysis to enhance knowledge application ability

(1) Case analysis: Conduct "Activity 4 - Practical Applications of Open-Loop Control Systems," using the "bus door switch control" as an example and utilizing AI animations to demonstrate the process of "pressing the switch → controlling the circuit → solenoid valve → door → door switch." Students are required to select other real-life examples, such as automatic doors and traffic lights, from the case library on the tablet, draw block diagrams, and submit them. The system can automatically match and display "excellent cases" for students to refer to and learn from.

(2) Innovative thinking: Pose open-ended questions (Question 5)—"Which aspect of the block diagram above the blackboard would you like to modify to achieve the desired control?"—to guide students in contemplating the optimization directions for control systems, such as "adding a soil moisture sensor to the digital timed flower watering device." Utilize AI creative generation tools to transform students' ideas into simple design sketches, stimulating their innovative thinking [7].

(3) Foreshadowing: Raise the question, "Do the working processes of the soil moisture-based flower watering device and the timed flower watering device differ?" (Question 6). Employ AI comparison tools to illustrate the differences between "timed control" and "moisture control," such as whether there is a loop where "the output quantity feeds back into the input quantity," thereby laying the groundwork for subsequent learning on "closed-loop control systems."

This segment enriches case resources and visualizes innovative ideas through AI tools, aiding students in transferring their knowledge of open-loop control systems to real-life scenarios and enhancing their abilities in knowledge application and innovative design.

2.4. AI-empowered diverse evaluation and knowledge organization

(1) Diverse evaluation: Utilize an AI evaluation system to assess students across three dimensions: "knowledge mastery (accuracy of block diagram drawing), practical ability (completeness of flower watering device construction), and innovative thinking (rationality of optimization plans)." The system automatically aggregates students' tablet learning data, including task completion progress, frequency of queries, practical achievements, videos of the flower watering device in operation, and peer evaluation results, to generate personalized learning reports [8].

(2) Knowledge organization: Students use AI mind mapping tools on their tablets to independently organize the core knowledge of this lesson, encompassing the meaning of control systems, characteristics of open-loop control systems, and methods for drawing block diagrams. The system can automatically supplement the logical relationships between knowledge points, such as "block diagrams are tools for expressing the working principles of control systems," helping students construct a comprehensive

knowledge framework.

(3) Emotional enhancement: Teachers, in conjunction with the "student creative flower watering device plans" displayed by AI, emphasize the concept that "technology originates from and serves life" [9]. They guide students to recognize that technological innovation is not beyond reach but can be achieved through meticulous observation and practice, further enhancing students' technological awareness.

2.5. AI-enhanced extended learning tasks for seamless integration with subsequent courses

Assign students the task of "drawing a block diagram illustrating the working process of a soil moisture-based flower watering device," which they must complete using drawing tools on tablet devices. The system provides learning resources on the "working principles of humidity sensors" and prompts students to "consider whether there exists a feedback loop," thereby laying the groundwork for the next lesson on "closed-loop control systems" [10]. Teachers utilize AI-assisted assignment grading to monitor students' progress in real time. Common issues (such as "incorrect drawing of feedback loops") are addressed collectively in the following class.

3. Teaching practice outcomes and reflections

3.1. Outcomes

(1) Significant increase in student learning initiative: Interactive scenarios created through AI tools, such as creative nebula diagram displays and real-time screen sharing, have boosted classroom participation from 60% in traditional teaching to 90%. The number of proposed flower watering device designs has increased by 1.5 times, reflecting a "student-centered" teaching approach.

(2) Enhanced knowledge acquisition and application abilities: Post-class assessments reveal that students' understanding of the "components of an open-loop control system" has risen from 75% to 92%. The proportion of students capable of independently drawing block diagrams has increased from 60% to 85%, and they can now cite more than five examples of open-loop control systems in daily life, indicating a marked improvement in knowledge transfer capabilities.

(3) Effective cultivation of core competencies: In AI-supported project practices, students' materialization abilities (the success rate of constructing flower watering devices increased from 70% to 88%), engineering thinking (the proportion of students considering technical parameters in their optimization plans rose from 50% to 80%), and innovative design capabilities (30% of groups proposed composite solutions combining "rainwater collection + timed watering") have all shown notable improvements, achieving the teaching goal of "putting competencies into practice."

3.2. Reflection

(1) The selection of AI tools should align with teaching objectives: In practice, it was found that some AI tools (such as complex virtual simulation software) were difficult to operate, resulting in increased learning time for students. In subsequent teaching, it is necessary to select simple and practical AI tools based on students' cognitive levels to avoid "technology for the sake of technology."

(2) Individual differences among students should be considered: Although AI tools provide personalized learning resources, 10% of students still encountered difficulties in drawing block diagrams. In subsequent teaching, the "personalized tutoring" function of the AI system can be utilized to provide

targeted exercises for these students, such as exercises on decomposing and drawing block diagrams, to further enhance the precision of teaching.

(3) It is necessary to strengthen the connection with occupational scenarios: Although the "flower watering device" project selected in this teaching session is close to daily life, it still falls short of the "integration of industry and education" requirements in vocational and technical education. In the future, industrial open-loop control system cases (such as production line conveyor belt control) can be introduced, utilizing AI tools to simulate industrial scenarios and enhance students' vocational adaptability.

4. Conclusion

The integration of AI technology with the "project-led, task-driven" teaching model provides a new teaching paradigm for the high school course "The Working Process of Open-Loop Control Systems." By embedding AI suitable for high school students throughout the entire process of "situational introduction, task implementation, transfer application, and evaluation summary," the goals of "precision in teaching processes, personalization in student learning, and concretization in competency development" have been achieved. This effectively addresses the issues of "disconnection between theory and practice, and low student engagement" in traditional teaching. In the future, with the continuous development of AI technology, further exploration can be made into the applications of "AI + virtual simulation" and "AI + intelligent evaluation" in control system teaching, such as constructing a "virtual laboratory for industrial open-loop control systems" to allow students to conduct practical operations in immersive scenarios. Additionally, AI big data analysis can be utilized to analyze students' learning behaviors, achieving a closed loop of "precision teaching-personalized tutoring-continuous improvement" and providing stronger support for educational reform.

Disclosure statement

The author declares no conflict of interest.

References

[1] He W, Qi Q, Wu J, et al., 2025, Exploration of a Four-Dimensional Integrated Teaching Model for Ideological and Political Education in New Engineering Courses Empowered by AI. Journal of Hunan Institute of Science and Technology (Natural Science Edition), 1–4.

[2] Wang Z, 2025, Research and Practice on Innovation of Classroom Teaching Models in Universities Empowered by AI Teaching Assistants. Information Systems Engineering, (08): 158–161.

[3] Li Y, Yu Y, Gong Q, et al., 2025, Design of a Growth-Oriented Problem-Based Teaching Model for the Course "EMU Structure and Principles" Empowered by Chaoxing AI Teaching Assistants. Science & Education Culture, (13): 116–119.

[4] Gao Q, Xiang X, Li S, et al., 2025, Exploration of Teaching the Course "Thermal Control System Experimentation and Maintenance" Empowered by AI. Journal of Chongqing Electric Power College, 30(03): 50–55.

[5] Wang P, Cheng H, 2025, An Analysis of Personalized Teaching in Secondary Vocational PLC Courses Empowered by Artificial Intelligence Technology: Taking the Traffic Light Control System at Intersections as an Example. Guangxi Education, (17): 12–15 + 19.

[6] Zhong M, Zhang X, Feng Y, 2023, Research on the Application of the "Project-Led, Task-Driven" Teaching Model

in Secondary Vocational School Classrooms: Taking the Course “Sensor Application Technology” as an Example. Guangdong Vocational and Technical Education and Research, (01): 32–35.

[7] Li F, Guo Y, Cao J, et al., 2022, Information Security Assurance Technology for Space-Ground Integrated Information Networks. People’s Posts and Telecommunications Press, 10: 320.

[8] Wu Z, Yu S, Chen Y, et al., 2022, Innovation and Practice of a Modular Teaching Model Based on “Project-Led, Task-Driven” Approaches. Fujian Building Materials, (08): 108–112 + 34.

[9] Cao F, Su M, Zang H, et al., 2020, Exploration of a Three-Stage Teaching Model Based on “Project-Led, Task-Driven” Approaches: Taking the Course “Principles and Applications of Single-Chip Microcomputers” as an Example. International Public Relations, (11): 135–136.

[10] Zheng W, Li J, 2018, Practice of the “PLC” Course Based on the “Project-Led, Task-Driven” Teaching Model: Taking “PLC Control of Automatic Garage Doors” as an Example. Education Modernization, 5(50): 242–243.

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