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Research on Teaching Reform of Electrical and Electronic Technology (B) Empowered by AI Teaching Assistants

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Abstract: *Against the backdrop of fragmented knowledge points, abstract theoretical content, and uneven prior academic foundations among students taking the course Electrical and Electronic Technology (B), this study constructs an intelligent teaching model integrating AI teaching assistants and the Chaoxing Learning Platform. Taking knowledge graphs as the knowledge navigation framework, AI teaching assistants as the engine for personalized learning support, and the Chaoxing Learning Platform as the hub for full-process teaching management, this research builds a closed-loop intelligent teaching system covering pre-class, in-class, and post-class activities. Supported by AI-enabled personalized pre-class guidance, real-time interactive Q&A, automatic homework grading, and data-driven learning analytics, the proposed model effectively addresses the difficulty of meeting differentiated personalized learning requirements of students. This study provides replicable and scalable practical solutions for advancing intelligent and targeted teaching reform of basic engineering courses.*

Keywords: *AI teaching assistant, Chaoxing learning platform, knowledge graph, electrical and electronic technology, intelligent teaching*

1. Introduction

Driven by the in-depth advancement of the Emerging Engineering Initiative and the digital transformation of higher education, university teaching is undergoing a profound shift from teacher-centered instruction to student-centered learning. As a compulsory foundational course for multiple non-electrical majors at Dalian Jiaotong University, including Vehicle Engineering and Civil Engineering, Electrical and Electronic Technology (B) covers extensive knowledge points with strong theoretical features and high practical requirements. Traditional lecture-dominated teaching cannot accommodate students' diverse learning demands. When faced with abstract circuit principles and complex electromagnetic theories, students are prone to learning anxiety, which leads to unsatisfactory learning outcomes.

Recent advances in large language models (LLMs) have brought transformative opportunities to education. As a typical artificial intelligence application in teaching scenarios, AI teaching assistants exhibit powerful capabilities in natural language processing, knowledge reasoning, and personalized recommendation, offering a viable solution to bottlenecks in conventional teaching[1]. As one of the widely adopted intelligent teaching systems in Chinese universities, the Chaoxing Learning Platform embeds native AI assistant modules, providing solid technical support for pedagogical innovation[2].

This study explores the deep integration of AI teaching assistants and the Chaoxing Learning Platform to develop a customized intelligent teaching system for Electrical and Electronic Technology (B). By constructing a discipline-specific knowledge graph and deploying AI teaching assistants to deliver personalized learning support throughout the whole teaching cycle, this research aims to improve teaching quality, stimulate students' enthusiasm for autonomous learning, and cultivate their ability to solve complex engineering problems. The ultimate goal is to establish a generalizable framework for intelligent teaching reform.

2. Construction of the Integrated Teaching Framework

This research is theoretically underpinned by constructivist learning theory and personalized learning theory. Constructivist learning theory holds that learners construct knowledge actively through

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exploration within specific contexts with scaffolding resources. AI teaching assistants create inquiry-based problem scenarios and serve as effective scaffolds facilitating students'knowledge construction. Personalized learning theory advocates customized learning resources and pathways tailored to individual differences, which can be realized through data analytics and intelligent recommendation functions of AI assistants[3]. Drawing on the above theories, this paper proposes a three-layer integrated framework consisting of knowledge graphs, AI teaching assistants, and the Chaoxing Learning Platform .The integrated teaching framework is shown in Figure 1.

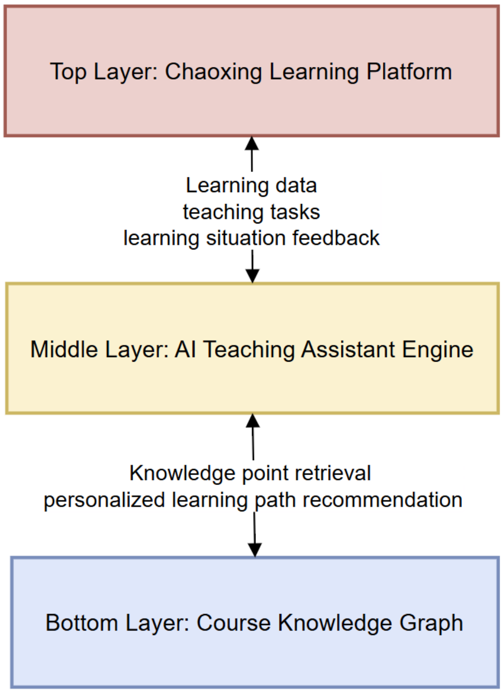

Figure 1: Three-tier integrated teaching framework

2.1. Course Knowledge Graph (Bottom Layer)

A knowledge graph serves as a structured navigation map of disciplinary knowledge. The authors deconstruct textbooks, teaching syllabi, and exercise banks of Electrical and Electronic Technology (B) to extract core knowledge nodes such as Kirchhoff's laws, Thevenin's theorem, and three-phase circuits. Logical relationships between nodes—including prerequisite, inclusive, and applicative connections—are mapped to form a visualized course knowledge graph. This graph helps students overcome fragmented understanding of knowledge and provides a structured knowledge base for reasoning operations performed by AI teaching assistants[4].

During graph development, knowledge granularity is defined based on micro-lesson units. Each unit contains one or several interrelated sub-knowledge points together with matched learning resources. Such a design balances the holistic presentation of knowledge and precise differentiated instruction.

2.2. AI Teaching Assistant Engine (Middle Layer)

Built on large language models such as DeepSeek, the AI teaching assistant functions as a round-the-clock personalized learning engine with context awareness and interactive capabilities[5]. Beyond answering conceptual questions such as the definition of the superposition theorem, the assistant can interpret circuit principles and guide exploratory engineering design. Prompt engineering is adopted to embed the course knowledge graph and standardized teaching discourse into the assistant, ensuring that responses to student queries are rigorous, accurate, and heuristic.

2.3. Chaoxing Learning Platform (Top Layer)

The Chaoxing Learning Platform acts as the integrated operating carrier for all teaching elements. It stores multimedia resources (micro-videos, lecture slides, knowledge graphs), supports teaching activities such as attendance management, online quizzes, and group discussions, and collects full-

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dimensional learning data[6]. The AI teaching assistant is embedded as an internal plugin on the platform, enabling students to access intelligent tutoring via a unified entry. All human–AI interaction records and student learning trajectories are automatically captured to support targeted teaching interventions based on teachers' learning analytics.

3. Practical Implementation of the Closed-Loop

AI teaching assistants are deployed across pre-class, in-class, and post-class sessions to form a self-optimizing closed-loop intelligent teaching workflow. The closed-loop teaching workflow is shown in Figure 2.

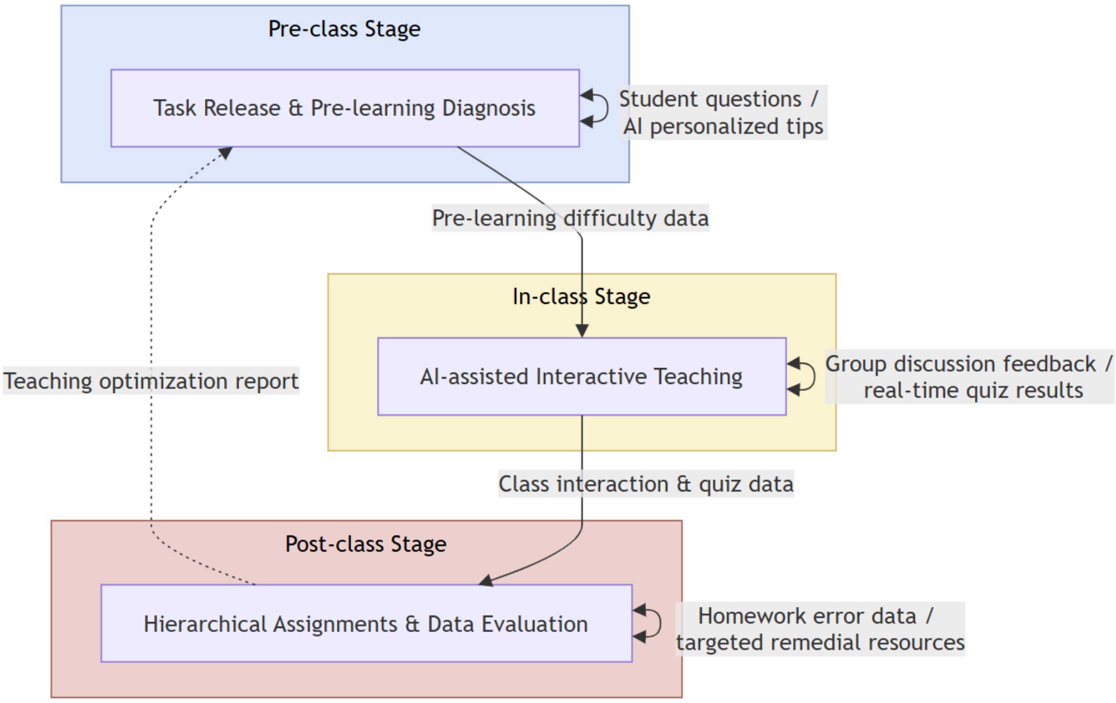

Figure 2: Closed-loop full-cycle teaching workflow

3.1. Pre-class Stage: AI-Driven Personalized Preview and Learning Diagnosis

Traditional preview activities mainly rely on passive textbook reading, which suffers from vague learning objectives and ineffective feedback. Within the proposed framework, pre-class activities focus on AI-enabled individualized preview and proactive learning diagnosis.

(1) Structured preview arrangement by instructors

Teachers publish chapter-based preview tasks on the Chaoxing Platform, covering three components:

a) Learning objectives and segmented subgraphs of knowledge, helping students grasp core concepts and the overall logical structure of each chapter in advance;

b) Multimedia micro-resources, including condensed lecture clips and dynamic animation demonstrations (e.g., visualized electromagnetic induction);

c) An embedded AI assistant within discussion forums. Pre-trained with chapter handouts and the knowledge graph, the assistant provides targeted real-time Q&A support.

(2) Exploratory knowledge navigation for students

Students use the knowledge graph as a cognitive roadmap for active exploration. For example, before learning sinusoidal AC circuit analysis, students identify the phasor method as the core node connected to complex number operations and impedance branches. When confused about the physical meaning of phasor representation using complex numbers, students can raise questions to the AI assistant. The assistant offers multi-perspective explanations covering mathematical definitions, physical connotations,

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and derivations based on Euler's formula to deliver customized tutoring.

(3) Data feedback for determining in-class teaching priorities

The platform automatically collects multi-dimensional pre-class data, including students' browsing duration on each knowledge node, frequently asked questions submitted to the AI assistant, and error distributions in pre-class quizzes, and generates early warning reports for instructors. For instance, if more than 40% of students consult the assistant regarding inductive and capacitive reactance and the error rate of pre-tests reaches 35%, teachers will prioritize the differentiation of impedance characteristics as a core in-class teaching focus, realizing data-informed lesson planning.

3.2. In-class Stage: Inquiry-Based Collaborative Learning Supported by Pre-class Diagnosis

In-class teaching shifts from one-way knowledge transmission to collaborative problem-solving targeting common misconceptions identified in pre-class diagnostics. Teachers begin lessons by presenting visualized pre-class learning data to clarify key learning difficulties, followed by multi-modal inquiry activities:

(1) Group discussions moderated by the AI assistant

Students are divided into groups to discuss the functional differences of neutral wires between three-phase three-wire and three-phase four-wire systems under unbalanced loads. The AI assistant serves as an impartial moderator, offering real-time comments and supplementary knowledge to guarantee the rigor and scientific validity of group discussions.

(2) AI-assisted parameter adjustment for virtual simulation

For abstract concepts such as series RLC resonance, instructors utilize the Matlab/Simulink simulation platform. Upon student requests, the AI assistant generates executable simulation code and dynamically adjusts parameters (e.g., resistance R), visualizing variations in resonance curves and transforming abstract mathematical theories into intuitive phenomena.

(3) Instant quizzes generated by AI for real-time proficiency assessment

After explaining key difficulties, teachers adopt the platform's AI question generator to produce targeted objective tests. The system instantly calculates the overall accuracy rate to judge whether supplementary explanations are required.

3.3. Post-class Stage: Hierarchical Assignments and Data-Driven Iterative Teaching Optimization

Post-class arrangements emphasize knowledge transfer and continuous teaching iteration supported by comprehensive learning data analytics.

(1) Tiered learning tasks with differentiated AI tutoring

Basic consolidation tier: Students complete standardized homework graded automatically by the AI assistant. The assistant provides feedback on calculation procedures and formatting for subjective circuit analysis questions.

Advanced exploratory tier: Open-ended engineering design tasks are assigned (e.g., designing a corridor delay lighting circuit and discussing component parameter selection of 555 timers with support from the AI assistant). Students submit preliminary design schemes, and the AI assistant offers multi-dimensional optimization suggestions covering circuit principles, component selection, and cost control, extending theoretical learning to engineering simulation practice.

(2) Data analytics facilitating iterative teaching improvement

The platform aggregates post-class data, including homework error patterns, depth of human–AI interactions, and hot topics in forum discussions, for teachers to identify neglected teaching blind spots. For example, if many students consult the AI assistant about timing relay calibration for star–delta reduced-voltage startup—a topic rarely covered in textbooks—instructors can carry out three optimization measures in the next teaching cycle:

a) Add micro-lecture modules concerning timing parameter calibration for star–delta startup;

b) Expand the asynchronous motor startup branch in the knowledge graph by adding sub-nodes for timing calibration and corresponding supporting resources;

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c) Adjust the response logic of the AI assistant to provide detailed explanations proactively for relevant inquiries.

A self-improving closed loop is therefore formed: data collection → learning situation analysis → targeted teaching intervention → iterative system upgrading.

4. Conclusion

This study constructs an intelligent teaching model for Electrical and Electronic Technology (B) through the deep integration of AI teaching assistants and the Chaoxing Learning Platform. Supported by knowledge graph navigation, personalized AI tutoring, and full-cycle data analytics, the proposed framework transforms teaching from passive knowledge transmission to competency-oriented cultivation. It provides referable and scalable reform experience for other basic engineering courses. Future research will further explore multi-scenario applications of AI in teaching to cultivate high-quality engineering talents adaptable to the intelligent era.

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References

[1] Fu Jianmei, Ren Guofeng, Xun Yanqin and Yang Yakun. (2025) Teaching strategies of digital signal processing empowered by artificial intelligence. Journal of Electrical and Electronic Education, 47 (4), 115-119.
[2] Zhai Pu. (2025) Research on teaching methods of programming courses in the digital-intelligence era based on the Chaoxing Learning Platform. Information & Computer, 18, 233-235.
[3] Guo Jun and Pan Xinzheng. (2025) Application and reflection of knowledge graph based on the Chaoxing Learning Platform. Technology Wind, 21, 120-121+143.
[4] Wang Wei, Wang Qing and Wu Junjie. (2025) Construction and practice of digitized courses - taking the analog electronic circuit course as an example. Innovation and Entrepreneurship Theory Research and Practice, 8 (7), 162-164.
[5] Yan An, Jin Yazhong, Zhang Didi, Zhang Haiyang, Shi Lei, Yao Xuan, Li Chunxia and Wu Xia. (2026) Construction and practice of online-offline blended teaching model for plant physiology course. Anhui Agricultural Science Bulletin, 32 (7), 121-123.
[6] Ma Jialin. (2026) Thoughts and exploration on teaching reform of vocational ideological and political courses empowered by generative artificial intelligence - a practice based on Mao Zedong Thought course on the Chaoxing Intelligent Platform. Industrial & Science Tribune, 25 (9), 230-232.