

AI Empowerment and Industry-Education Integration: Exploration on the Curriculum Reform Path of Network Architecture

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Abstract: Against the backdrop of the digital economy and emerging engineering education construction, Network Architecture, as a core course in the field of information and communication engineering, is confronted with problems such as outdated content lagging behind technological iteration, practical teaching disconnection from industrial demands, insufficient integration of AI technology, and weak industry-education collaboration. Targeting the cultivation of network talents with AI application capabilities and industrial adaptability, this paper constructs a three-in-one reform framework of “AI-empowered teaching innovation-industry-education integrated ecosystem construction-diversified evaluation guarantee.” At the level of AI empowerment, teaching quality is improved through intelligent reconstruction of curriculum content, upgrading of teaching methods, and innovation of the practical system. At the level of industry-education integration, a dual-cycle mechanism of “campus resource integration-off-campus industrial collaboration” is established to cultivate talents jointly through cooperative training bases. At the evaluation level, a value-added evaluation model based on a knowledge graph is introduced to realize the three-dimensional process assessment of “knowledge-skills-literacy.” Empirical research verifies the effectiveness of the reform path, providing a replicable practical paradigm for the AI-based transformation and in-depth industry-education integration of engineering courses.

Keywords: AI empowerment; Industry-education integration; Network architecture; Curriculum reform; Value-added evaluation; Virtual simulation

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1. Research background and significance

Driven by policies including the *14th Five-Year Plan for Digital Economy Development* and the *Three-Year Action Plan for Emerging Engineering Education Construction (2021–2023)*, China’s digital economy has exceeded 50 trillion yuan in scale, generating a surging demand for interdisciplinary talents who understand networks, master AI, and possess practical capabilities^[1–2]. As a core course at the intersection of communication and computer science, *Network Architecture* systematically delivers core contents such as OSI/RM, TCP/IP protocol stack, network topology design, and performance optimization, serving as a key carrier for cultivating students’ capabilities in network planning, operation, and maintenance, and innovation.

However, current network technologies are transforming from traditional static architectures to AI-driven, dynamic intelligent architectures. The popularization of technologies such as Software Defined Networking (SDN), Network Function Virtualization (NFV), 6G satellite communication, and AI-based network fault diagnosis requires the curriculum to break through the traditional paradigm and achieve in-depth coupling with cutting-edge technologies.

The current teaching of *Network Architecture* is plagued by multiple contradictions:

Outdated content lagging behind technological iteration: Traditional teaching focuses on classic systems such as OSI/TCP/IP, with insufficient coverage of cutting-edge content, including SDN/NFV, 6G satellite communication networks, and AI-driven network optimization, leading to a “technological gap” between what students learn and actual enterprise demands.

Teaching methods disconnected from practical scenarios: Dominated by “PPT lectures + NS3 simulation experiments”, the course lacks simulation of real network environments (e.g., multi-domain collaborative communication), making it difficult for students to understand the dynamic interaction logic of complex networks.

Insufficient integration of AI technology: AI tools (e.g., intelligent fault diagnosis) have not been integrated into the whole teaching process, leaving students short of the thinking and ability to “solve network problems with AI.”

Weak industry-education collaboration mechanism: School-enterprise cooperation mostly stays at the level of “enterprise visits” and “case sharing”, lacking in-depth collaboration modes such as real project-driven learning, joint training, and dual-supervisor guidance, so graduates need retraining to qualify for posts after entering enterprises.

Simplified evaluation system: Mainly composed of final written examinations (accounting for more than 70%) + experiment reports (accounting for less than 30%), it ignores the assessment of students’ procedural growth, AI application capabilities, and industrial problem-solving abilities, failing to fully reflect the quality of talent training.

2. Research status at home and abroad

Domestic exploration on the reform of *Network Architecture* has achieved certain progress. In terms of curriculum content, some universities have added modules of “SDN/NFV technology” and “satellite communication networks”, but still offer limited coverage of AI-network integration contents (e.g., AI-driven routing optimization and fault diagnosis). In terms of teaching methods, some universities adopt “project-driven teaching” and guide students to apply theoretical knowledge with tasks such as “campus network planning”, yet practical scenarios are still confined to campuses without connection to real enterprise demands. In terms of industry-education integration, Xidian University has built an “intelligent network laboratory” with Huawei, introducing enterprise equipment for practical training, but cooperation mostly focuses on hardware support, with insufficient collaboration between curriculum content and enterprise technical standards. In terms of the evaluation system, Southeast University has attempted “process assessment” by incorporating experiment reports and classroom discussions into scores, but has not formed a three-dimensional dynamic evaluation mechanism of “knowledge-skills-literacy.”

In the general research field of AI empowerment and industry-education integration, scholars have explored valuable experiences: Li Zhoukang (2025) used AI tools (e.g., DeepSeek intelligent retrieval) to

assist teaching in *Forage Crop Cultivation*, verifying the role of AI in improving practical capabilities^[3]. Li Qiurong (2025) constructed a content system of “basics + topics + frontiers” in the *Building Construction* course and introduced VR technology to realize the visualization of building structures, providing a reference for content reconstruction and virtual simulation of network courses^[4]. Fu Gaoqin (2025) proposed a ternary collaborative framework of “technology-education-ecology”, whose concept of “multimodal perception + dual-cycle ecology” provides theoretical support for AI integration and industry-education collaboration of network courses^[5]. Hu Zhenni (2025) applied a knowledge graph to value-added evaluation in vocational education, solving the problem of “emphasizing results over process” in traditional evaluation, which can be transplanted to dynamic assessment of network courses^[6].

The reform of network-related courses in foreign universities focuses on technical application and industrial connection. MIT introduces an “AI-driven network experiment platform” in the *Computer Networks* course, enabling students to optimize routing strategies through reinforcement learning algorithms and observe real-time changes in network performance. Stanford University cooperates with Cisco to develop an “SDN practical course”, integrating real enterprise network topologies and fault cases into teaching; students are required to complete tasks such as “enterprise-level SDN controller configuration” and “traffic anomaly detection.” In addition, the EU “Digital Skills and Jobs Coalition” promotes universities to build “5G/6G talent training centers” with enterprises such as Ericsson and Nokia, realizing synchronous updating of curriculum content and industrial standards^[7].

3. Research content and methods

Centering on the three cores of “AI-empowered teaching quality improvement, industry-education integrated ecosystem construction, and diversified evaluation guarantee”, the specific research contents are as follows:

AI-empowered curriculum teaching innovation: Reconstruct the curriculum content system of “basic theory + AI integration module + cutting-edge technology”, develop a hybrid teaching mode of “problem-driven + virtual simulation + AI assistance”, and build an “AI intelligent experiment platform” (including modules such as network fault diagnosis, traffic prediction, and satellite communication scheduling).

Construction of industry-education integrated collaborative ecosystem: Establish a dual-cycle mechanism of “campus resource integration—off-campus industrial collaboration”, including school-enterprise co-construction of curriculum resource libraries, joint training bases, introduction of real projects, and dual-supervisor guidance.

Knowledge graph-based value-added evaluation system: Construct a three-dimensional knowledge graph of “knowledge-skills-literacy”, design an assessment strategy combining process evaluation (classroom interaction, experiment reports, project progress) and academic evaluation (final thesis/enterprise project defense), and realize dynamic tracking of students’ growth trajectories.

The research systematically sorts out domestic and foreign literature on *Network Architecture* curriculum reform, AI education application, and industry-education integration to extract referable theoretical frameworks and practical experiences. Taking Grade 2023 students majoring in information and communication engineering as research objects, the reform is implemented in phases (September 2023 – January 2024), and the reform plan is continuously optimized through classroom observation, student interviews, and teacher reflection. An experimental class and a control class are set up to verify the reform effectiveness through score comparison, practical ability assessment, and enterprise satisfaction survey.

Typical cases are selected to analyze the specific application effects of AI and industry-education integration in the curriculum [8–10].

4. Construction of the curriculum reform path

In response to the above problems, with the core of “quality improvement through AI empowerment and efficiency enhancement through industry-education integration”, a five-in-one reform path of “teaching content reconstruction—teaching method upgrading—practical system innovation—industry-education collaboration deepening—evaluation system guarantee” is constructed. Adhering to the principle of “solid foundation, AI integration, and alignment with frontiers”, the curriculum content is reconstructed into three modules: basic theory, AI integration, and cutting-edge technology (Table 1). Logical connections are established through a knowledge graph to realize in-depth coupling of “theory-AI-industry.”

Table 1. Curriculum content

Module	Proportion	Core Content	Integration Points	Industrial Connection Points (Enterprise Cases)
Basic Theory	40%	OSI/RM and TCP/IP; Routing algorithms; Basics of satellite communication networks	Visualization of protocol logic based on knowledge graph; AI-assisted comparison of routing algorithm efficiency	Huawei “TCP Protocol Optimization” case; China Satcom “Satellite Basic Communication” case
AI Integration	40%	AI-driven network optimization; AI network fault diagnosis; Beidou satellite AI collaborative scheduling simulation	LSTM-based network traffic prediction experiment; CNN-based network fault recognition; AI scheduling for satellite communication	ZTE “AI Network Fault Diagnosis System”; BDSStar “Satellite AI Scheduling” case
Cutting-edge Technology	40%	SDN/NFV technology; 6G converged network; Emergency communication	AI-assisted SDN slice configuration; AI resource allocation for 6G networks; AI routing reselection for emergency communication	ZTE “SDN Network Slice”; Huawei “6G Satellite Convergence” case

Taking core knowledge points of network architecture as nodes, a three-level practice chain of “AI + virtual + real” and an AI experiment assistance system are built. Students’ operations are monitored in real time during experiments; for example, if an SDN controller configuration error is detected, the cause (e.g., “OpenFlow protocol not enabled on the port”) is automatically prompted, and a configuration tutorial is pushed. After the experiment, AI automatically analyzes experimental data (e.g., traffic prediction accuracy) and generates an analysis report. When students configure OSPF protocols with eNSP, AI detects configuration errors in real time (e.g., “mismatched area number”, “unestablished neighbor relationship”) and provides troubleshooting steps. After the experiment, AI compares the configuration schemes of different students and analyzes the optimal path. When students simulate TCP traffic with NS3, AI automatically collects data (e.g., throughput, delay), generates visual charts (e.g., line charts, bar charts), and analyzes traffic variation rules.

Drawing on FU Gaoqin’s (2025) ternary collaborative framework of “technology-education-ecology”, a dual-cycle ecosystem of “campus resource integration—off-campus industrial collaboration” is constructed (Table 2) [1].

Table 2. Dual-cycle ecosystem of “campus resource integration-off-campus industrial collaboration”

Type	Core Goal	Implementation Path
Internal Cycle	Intelligent Integration of Campus Resources	<ol style="list-style-type: none"> 1. Integrate equipment, AI platforms, and curriculum to establish a “Network Teaching Resource Center”; 2. Form a team of “campus teachers + enterprise supervisors” to jointly develop experimental projects; 3. Establish a project incubation mechanism to support outstanding projects in connecting with enterprise demands.
External Cycle	In-depth Connection of Industrial Demands	<ol style="list-style-type: none"> 1. Build “intelligent network joint laboratories” with communication enterprises, introducing enterprise equipment and technical standards; 2. Enterprises provide real projects and data as practical materials for students; 3. Enterprises participate in curriculum evaluation and formulate post competency standards.

Centered on the network architecture knowledge graph, evaluation indicators are divided into three dimensions: “knowledge”, “skills”, and “literacy.” Based on the node scores and weights of the knowledge graph, the students’ “graph weighted score” is calculated:

$$G = \frac{\sum_{i=1}^n k_i p_i}{\sum_{i=1}^n k_i} \quad (1)$$

where G is the graph weighted score, k_i is the weight of the i -th node (set according to industrial importance), p_i is the score of the i -th node (e.g., 85 points for the “TCP Protocol” node), and n is the total number of nodes.

To verify the effectiveness of the reform path, Class 1 (experimental class, 45 students) and Class 2 (control class, 43 students) of Grade 2023 majoring in information and communication engineering are selected. There is no significant difference in admission scores and scores of previous courses (e.g., *Computer Communication*) between the two classes ($P>0.05$), making them comparable. The experimental class adopts the reform plan proposed in this paper (AI-empowered teaching, industry-education integration, knowledge graph evaluation), while the control class follows the traditional teaching mode (mainly theoretical lectures, NS3 simulation experiments, summative evaluation). The two classes have identical curriculum content, class hours, instructors, and textbooks, differing only in teaching methods, practical links, and evaluation systems. The written examination covers basic theories and cutting-edge knowledge; the average score of the experimental class is 85.2, and that of the control class is 76.8, showing a significant difference ($P<0.05$). The proportion of high scores (above 90) in the experimental class is 28.9%, while that in the control class is only 11.6%. No student in the experimental class scores below 60, while 5 students (11.6%) in the control class do.

Both classes complete three experimental projects: “routing optimization”, “satellite communication scheduling”, and “AI fault diagnosis.” The experimental class is significantly better than the control class in “AI tool utilization rate”, “project innovation”, and “scheme practicability” (**Table 3**).

Table 3. Experimental comparison

Practical Indicators	Experimental Class	Control Class	Significance of Difference
AI tool utilization rate (e.g., fault diagnosis)	75.6%	20.9%	$P<0.01$
Enterprise acceptance rate of project schemes	86.7%	39.5%	$P<0.01$
Average number of project innovations	2.30	0.80	$P<0.05$

5. Conclusion and prospect

The “AI empowerment + industry-education integration” reform framework for *Network Architecture* constructed in this paper has been verified effective through empirical research. Intelligent reconstruction of curriculum content effectively solves the problems of “outdated content and insufficient AI integration”; the module design of “basics + AI + frontiers” enables students to master core theories and adapt to industrial technological iteration. AI-empowered teaching methods and practical systems significantly improve students’ practical abilities and learning interests; AI-assisted experiment tools help students understand abstract knowledge and solve real industrial problems. The dual-cycle mechanism of industry-education integration deepens school-enterprise collaborative talent training, realizing a closed loop of “teaching-practice-employment” and improving students’ post-adaptability. The knowledge graph value-added evaluation system breaks through the limitations of traditional evaluation, realizing comprehensive assessment and dynamic feedback of “knowledge-skills-literacy” and providing a basis for teaching optimization.

Disclosure statement

The authors declare no conflict of interest.

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