Higher Education and Practice Vol. 3 No. 8, 2026

Reconstruction and Practical Exploration of the "Four-Dimensional Linkage" Curriculum System for Electronic Information-related Majors under the Context of AI Empowerment

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Abstract: With the advancement of the national education digitalization strategy and the rapid development of artificial intelligence technology, traditional electronic information- related professional education faces common problems such as significant disciplinary barriers, insufficient AI empowerment depth, and disconnection of industry and education resources. Based on the requirements of new engineering discipline construction and the national strategy for artificial intelligence development, this paper proposes a reform idea of upgrading electronic information-related majors with AI technology empowerment. By constructing a "hardware design - signal processing - communication technology - practical innovation" four- dimensional linkage curriculum group system, deeply integrating AI technologies such as machine learning, virtual simulation, and intelligent evaluation, the model of collaborative education and training between industry and education and the project-based practice system are restructured; at the same time, relying on the digital intelligence resource platform and dynamic interactive evaluation system, the personalized learning path is connected, forming a "teaching - learning - evaluation - improvement" full-chain closed loop. This research provides a replicable and scalable innovative path and practical model for the transformation of the education model of electronic information-related majors.

Keywords: Artificial Intelligence; Electronic Information; Curriculum System Reconstruction; Four-Dimensional Linkage; Industry-Education Collaboration; New Engineering Discipline

1. Introduction and Research Background

Facing the accelerated evolution of a new round of technological revolution and industrial transformation, deepening the construction of new engineering education, strengthening the synergy between science and technology education and humanities education, and improving the discovery and training mechanism for top innovative talents have become the core issues for the reform and development of higher education in the new era [1]. As AI technology ushers in a national trans- formative development in 2025[2], the deep integration of new-generation information technology and education has become an important direction for higher education reform [3]. However, there are still many prominent issues in the current construction of the electronic information curriculum system that are out of touch with the needs of the times. This project takes AI technology empowering the upgrading of electronic information majors as a breakthrough, exploring the deep integration of AI technology into the entire process of curriculum construction and talent training, aiming to promote the cross-integration of artificial intelligence and education teaching, build an intelligentized new curriculum system, and support the digital transformation of higher education and the collaborative development of industry and education.

2. Key Problems Faced by Traditional Electronic Information Majors Teaching

Under the guidance of the "Artificial Intelligence +" action, the traditional electronic information majors teaching mainly faces the following four pain points:

Significant discipline barriers in the curriculum system, and insufficient depth of AI empowerment [4]. In the traditional curriculum system, intelligent technology is fragmented, with hardware, signal, and communication modules operating independently. AI technology is only used as a supplementary decoration, failing to achieve deep integration with core professional knowledge, leading to a disconnection between talent training and industrial intelligence needs.

High student-teacher ratio makes it difficult to teach precisely, and feedback on learning situations is lagging [5]. In large-scale teaching, teachers find it difficult to attend to individual differences, and learning diagnostics often rely on static assessments after the fact, lacking dynamic data tracking and intelligent intervention throughout the process. The "Internet+" model has not yet transitioned to the "Artificial Intelligence+" model.

The path for cultivating innovation capabilities is vague, and the depth of industry-education collaboration is insufficient [6]. Practical teaching mostly remains at the stage of confirmatory experiments, lacking experience in cross-domain system development and real corporate project training. The two-way flow of school-enterprise resources is not smooth, and students' ability to solve complex engineering problems and technology transformation is weak.

Teaching evaluation is static and single, lacking process tracking and value guidance [7]. Traditional evaluation emphasizes results over process, with single evaluation indicators, and there is a disconnection between professional courses and engineering ethics and ideological and political elements, making it difficult to fully and objectively reflect students' engineering thinking and innovation literacy.

3. Overall Reform Framework for AI Empowering Electronic Information Majors

In response to the above issues, this study takes artificial intelligence technology as the core driver, reconstructs the industry-education collaborative education ecology [8], and constructs a whole-chain talent training system of "demand traction- knowledge construction-ability advancement- industry feedback." The overall framework focuses on the "four-dimensional linkage" curriculum group, takes the "AI+ project-based" practice system as the grasp, and uses digital intelligence platforms and dynamic evaluations as support, striving to cultivate six core qualities including engineering thinking, professional ability, innovation awareness, information literacy, teamwork, and national sentiment, realizing a spiral-like ability leap from electronic system cognition to complex engineering innovation.

4. Implementation Path and Practical Exploration of the Reform

4.1 Reshaping the Curriculum System: Building a "Four-Dimensional Linkage" AI Empowerment Modular Curriculum Cluster

Facing the core capability requirements of electronic information talents in the AI era, we break down traditional discipline barriers and construct a "hardware design-signal processing-communication technology-practical innovation" four-dimensional linkage AI empowerment curriculum system, as shown in Figure 1.

The hardware design curriculum group forms a "circuit design-chip development-system integration" chain, integrating semiconductor and AIoT technologies, and strengthening the foundation of smart hardware development; the signal processing curriculum group connects time-frequency analysis, image recognition, and deep learning, constructs a "perception-decision" closed loop, and breaks through the core of intelligent algorithms; the communication technology curriculum group delves into 5G/6G and IoT technologies, optimizes data transmission and network collaboration, and empowers scenarios like smart cities; the practical innovation curriculum group relies on smart experiment platforms and school-enterprise collaboration to promote the industrial application of technology.

The four major curriculum groups are vertically connected through AI, horizontally constructing a network of discipline integration, forming a "theory - practice - industry" spiral-strengthened curriculum ecology, focusing on enhancing students' engineering innovation ability to solve "bottleneck" problems.

4.2 Restructuring the Education Model:

Promoting the Construction of a Whole-Chain Talent Training System with AI Empowerment

Based on machine learning algorithms, we analyze industry talent demands, dynamically optimize the architecture of the four-dimensional linkage curriculum group, and construct a four-tier progressive ability training path: basic layer (mathematical thinking and AI algorithms), professional layer (embedded development and intelligent systems), integration layer (multi-source information processing and network collaboration), and innovation layer(industry-level AI topic research), as shown in Figure 2. By building aschool-enterprise smart cloud platform, integrating real corporate project databases and AI development tool-chains, establishing a dual-mentor-driven project workshop, we form a production - education collaboration mechanism that intelligently matches industry demands, shares.

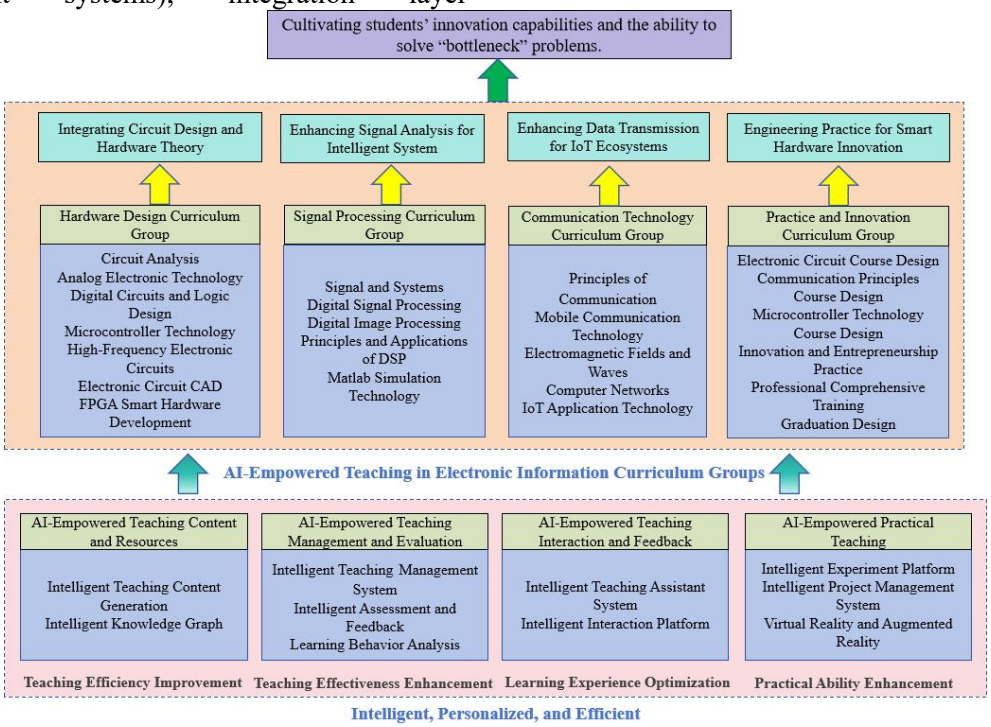


Figure 1. Curriculum Architecture of AI-Empowered Electronic Information Curriculum Groups



Figure 2. AI-Empowered Talent Training System for Electronic Information Majors

Project resources in the cloud, and dynamically feed-backs on learning outcomes, constructing a new model for AI empowerment in electronic information talent training.

4.3 Innovating Practical Teaching: Creating an AI-Driven "Project-Based" Ability Training System

Facing the transformation needs of engineering practice, we construct a four-dimensional linkage "AI+ project-based" practice system that runs through the entire "experiment-internship-training -competition" chain, as shown in Figure 3. At the Experimental teaching level, we build a modular AI virtual simulation platform, relying on the knowledge map to realize intelligent guidance of experimental processes and dynamic adaptation of personalized tasks, breaking through the limitations of traditional experiments in time and space; at the internship practice stage, schools and enterprises jointly build an embedded AI project resource library, realizing precise identification of industry demands through a job ability demand system, and constructing a production-education collaboration mechanism that intelligently matches industry demands, shares project resources in the cloud, and dynamically feed-backs on learning outcomes; in comprehensive training, we use enterprise-level AI reverse engineering and digital twin technologies as carriers[9], constructing a cross-domain system development full-process virtual-real linkage platform, strengthening the ability to solve engineering problems; in terms of competition innovation, we rely on the intelligent training platform to achieve multi-dimensional competition preparation diagnostics, cultivate composite abilities through hardware-software collaborative innovation competitions, and establish AI accelerators to promote the transformation of outstanding achievements. The system deeply integrates AI technology to reshape the practical teaching paradigm, forming a closed loop of ability progression training.

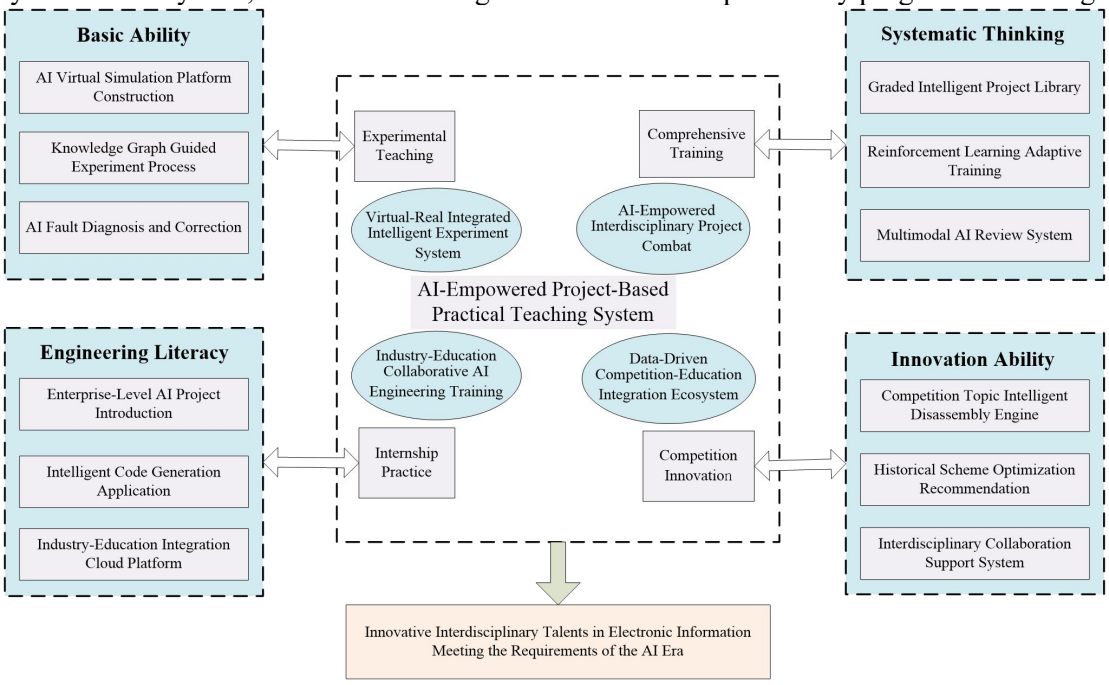


Figure 3. AI+ Project-Based Practical Teaching System

4.4 Restructuring the Platform Architecture: Penetrating the Personalized Learning Path Empowered by AI

Based on the overall framework of "restructuring the teaching resource platform architecture, penetrating the personalized learning path empowered by AI," we construct a new digital teaching support system: systematically promoting the development of new forms of integrated media teaching materials and digital course construction, creating a cross-curriculum full-life-cycle online open course cluster, through experiment, internship, training, and competition practice platforms, forming a ubiquitous digital resource matrix that supports personalized independent learning. Relying on the AI intelligent tutoring system, we achieve seamless collaboration between virtual and actual teachers, analyzing students' needs and learning behavior characteristics to build a multi-dimensional data representation system, using a dynamic labeling system to collect and visualize learning behavior

trajectory data in real-time, and iteratively optimizing the knowledge mastery prediction model. Simultaneously integrating online intelligent evaluation and mid-term covert learning situation surveys, we establish a knowledge gap diagnosis mechanism based on machine learning algorithms, constructing a dynamic evaluation and closed-loop optimization system for teaching effects, ultimately forming a data-driven, precision intervention, continuous improvement of the wisdom teaching new paradigm.

4.5 Innovating Interactive Evaluation: Creating a Dynamic Interactive Evaluation System Based on AI Empowerment

Taking artificial intelligence technology as the core driver, we build an innovative model of teaching interaction and evaluation, focusing on four dimensions: teaching interaction, evaluation system, early warning mechanism, and closed-loop improvement. We construct a blended teaching scenario that integrates virtual and real elements, leveraging the industry-education intelligent platform to incorporate real corporate project cases, forming a dynamic interaction loop of "simulation deduction-practical verification-production and research feedback," thus extending the intelligent reach of teaching interaction scenarios. We establish an AI dynamic evaluation index system that integrates multiple subjects, including teachers, students, and enterprises [10], innovating an evaluation module that merges professional courses with engineering ethics and ideological and political education. Utilizing multimodal data monitoring, we build a dynamic early warning system that intelligently adjusts teaching strategies based on learning feedback. We also create learning analysis reports that cover cognitive trajectories and practical abilities, simultaneously forming a feedback loop for teacher capability enhancement, realizing real-time feedback and intelligent optimization of the entire "teaching-learning- evaluation-improvement" chain, and ultimately developing a transferable intelligent solution for training new engineering talents in electronic information, providing an innovative paradigm for solving the challenges in engineering education evaluation reform.

5. Reform Effects and Practical Achievements

Since the implementation of the "AI+ Electronics and Information" four-dimensional linkage curriculum system and the industry-education collaborative education model, the reform effects have gradually emerged, achieving a synchronous leap in students' core capabilities, professional construction quality, and teaching and research levels. Specifically, the following three aspects are evident:

Continuous improvement in academic atmosphere and significant increase in talent training quality: Leveraging AI's personalized guiding path and dynamic feedback mechanism, we have precisely addressed the issue of delayed learning situation feedback, greatly stimulating students' intrinsic motivation and professional identity. Surveys show that students have shifted from passive reception to active exploration, actively participating in project practice in innovation laboratories. Both the willingness and quality of further education have improved, as evidenced by the steady increase in the acceptance rate of postgraduate entrance exams for our electronic information engineering students (25%, 28.7%, and 30.3% over the past three years), with their aspirations strongly focused on this major and AI-related interdisciplinary fields, confirming the solid effectiveness of the "thick foundation, strong intersection" curriculum system. Additionally, the initial employment rate of graduates from this major has remained above 95% for the past three years, highlighting the precise alignment between the "emphasizing practice, promoting integration" education model and the demands of the intelligent electronic information industry.

Breakthrough in engineering practice capabilities and continuous outstanding achievements in innovation incubation: Benefiting from the "AI+project-based" practice system and the virtual-real joint training platform of "reverse engineering + digital twin," students have transcended the barriers of a single discipline, significantly enhancing their ability to solve complex engineering problems and technology transfer. In the past three years, the team has guided students to win 5 national and over 30 provincial awards in top competitions such as the National College Electronics Design Competition and the National College Embedded Chip and System Design Competition. The emergence of high-level competition results demonstrates the effectiveness of the "experiment - training -

competition - incubation" full-chain innovation practice closed loop.

Significant improvement in teaching and research, and fruitful results in teacher team building: In the process of reconstructing the curriculum system and teaching resources, the "teaching and learning benefiting each other" effect has become evident, forging a "dual-qualified" team proficient in the integration of AI technology and education. The curriculum team has initiated 6 provincial teaching reform projects (including 2 key projects) over the past three years, providing solid theoretical support for model promotion. Additionally, the team has won over 10 awards in school-level and provincial teaching competitions, fully reflecting the advanced level in digital teaching design and dynamic interactive evaluation. The feedback from teaching and research achievements has further promoted the continuous iterative optimization of the "teaching-learning-evaluation-improvement" closed loop.

6. Conclusion

This project thoroughly implements the important guiding spirit of "focusing on the application of artificial intelligence to assist educational reform," taking the reconstruction of the AI-empowered curriculum system for electronic information majors as the core, systematically promoting the deep integration of traditional course content and cutting-edge intelligent technology. Through the construction of the "four-dimensional linkage" curriculum group, the reconstruction of the entire industry-education collaborative chain, and the innovation of intelligent practice and evaluation systems, we have effectively addressed the challenges of disciplinary barriers, delayed learning feedback, and the disconnection between industry and education, forming a deep integration of the education chain and the industrial chain, and providing a transferable intelligent solution for the cultivation of interdisciplinary talents in electronic information under the new engineering background.

Acknowledgments

This paper is supported by the Key Project of Teaching Reform Research in Regular Undergraduate Colleges and Universities in Hunan Province, China(202502000505); Teaching Reform Research Project in Regular Undergraduate Colleges and Universities in Hunan Province, China (202502000528); Key Project of Teaching Reform Research in Virtual Teaching and Research Rooms of Electronic Science Curriculum Group in China (EV2025-006); Teaching Reform Research Project in Virtual Teaching and Research Rooms of Electronic Science Curriculum Group in China (EV2025-018).

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