

Research on Teaching Strategies for Electrical Automation Technology Vocational Education Based on Generative Artificial Intelligence

Jun Yu. Xiaopin Xu

Wenzhou Polytechnic, Wenzhou, Zhejiang, 325035, China

Email: YJYANAForever@163.com

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Abstract

Generative Artificial Intelligence (GAI), as a machine learning system capable of deeply mining data patterns and automatically generating multimodal content, has become a core disruptive technology in digital transformation, reshaping cognitive paradigms and practical pathways in the field of education. In vocational education for the Electrical Automation Technology major, how to effectively leverage GAI to optimize curriculum structures, enhance teaching quality, and strengthen practical skills remains a critical issue facing the discipline's development. From the perspective of the reconstruction of teaching elements driven by technological and environmental changes, this paper proposes teaching strategies for Electrical Automation Technology vocational education based on GAI. These strategies include constructing a core curriculum system closely aligned with the technical requirements of electrical automation positions, optimizing course design through cognitive augmentation technologies, utilizing digital humans for collaborative practical training, and creating a new teaching ecosystem based on multimodal intelligent interaction. Collectively, these strategies give rise to an adaptive learning framework characterized by "data-driven precision — algorithm-based intelligent adaptation — dynamic continuous evolution," promoting the transformation of professional teaching from traditional knowledge-transfer models to autonomous construction models of cross-domain knowledge networks. This provides theoretical support and practical guidance for improving teaching quality and efficiency, meeting market demands, and cultivating applied skilled talents with innovative spirit and practical capabilities.

Keywords

GAI; Vocational Education; Electrical Automation; Teaching Strategies; Adaptive Learning Framework

1. Introduction

Nowadays, China's AI industry reached a milestone in its development, with total

investment exceeding 3.3 trillion yuan, the core AI industry scale approaching 600 billion yuan, and the number of enterprises surpassing 4,500, forming a complete industrial chain covering energy, chips, algorithms, platforms, and applications [1]. Generative Artificial Intelligence (GAI), as a key branch of the AI field, achieves autonomous generation of multi-modal content such as text, images, and code through massive data training. With its powerful capabilities in multi-modal content generation, dynamic learning adaptation, and scenario-based interaction, GAI can efficiently integrate massive data and autonomously output personalized solutions, achieving a leap from knowledge transfer to innovation empowerment and rapidly penetrating into all sectors of society [2, 3].

In the field of education, the penetration of GAI is triggering systematic transformation. At the policy level, the Outline for Building a Leading Country in Education (2024 - 2035) issued in 2024 explicitly calls for "promoting the construction of smart campuses and exploring digital empowerment for large-scale individualized instruction," while emphasizing the need to "facilitate AI-driven educational reform and promote the deep integration of large models with education and teaching" [4]. Amid this wave, vocational education as an educational model deeply embedded in the trajectory of technology embodiment and precisely responsive to industrial adaptability demands finds its inherent adaptive learning mechanisms undergoing an unprecedented, far-reaching, and multidimensionally complex process of systematic deep transformation and comprehensive reconstruction [5]. In 2025, nine government ministries jointly released the Action Plan for Improving Quality and Cultivating Excellence in Vocational Education (2025 - 2027), proposing the construction of "1,000 GAI application demonstration scenarios in vocational education," with a focus on supporting digital teaching transformation in fields such as intelligent manufacturing and industrial automation [6]. In practice, GAI significantly enhances the personalization level of vocational education by intelligently diagnosing learning needs and dynamically adjusting teaching strategies.

For the Electrical Automation Technology major, a cornerstone of modern industry the impact of GAI is particularly profound. As a core pillar of national manufacturing competitiveness, this major demands exceptionally high levels of practical skills and cross-domain knowledge integration. Therefore, how to enhance GAI adaptability to effectively link the education chain with the industrial chain, thereby precisely safeguarding the capability enhancement of skilled talents and the transformation and upgrading of industries, is of great significance [7]. Based on the intrinsic value logic of GAI and adaptive teaching in vocational education for the Electrical Automation Technology major, this study deeply explores the multidimensional forms of GAI-enhanced adaptive teaching in this field, promoting the high-order integration of "instrumental rationality" and "value rationality" in professional education during the digital-intelligent transformation, and supporting the

cultivation of high-quality automation skilled talents as well as the high-quality development of the economy and society.

2. Analysis of the Current Status of the Electrical Automation Technology Major

2.1. Comparison of the Current Development Status of the Electrical Automation Technology Major Domestically and Internationally

Globally, the development of the Electrical Automation Technology major exhibits differentiated and diversified characteristics. Vocational education programs in this field both domestically and internationally closely follow the trends of industrial transformation and technological upgrading, presenting a differentiated yet complementary development landscape. Domestically, the major is deeply aligned with national strategies, driven by the "Dual Carbon Goals," "New Power System Construction," and "Made in China 2025," focusing on core areas such as power system automation, new energy development, industrial robotics applications, and the industrial Internet. Through the "industry-education integration" model, a trinity training system of "theory + practical training + internship" has been constructed, exemplified by the localized practice of Germany's "dual system" and the co-construction of training bases by vocational colleges with the State Grid Corporation of China, enabling rapid response to industry demand for skilled talents. However, challenges remain, including accelerating technology iteration, rising cross-disciplinary competency requirements, and uneven distribution of regional educational resources. Internationally, models such as Germany's "dual system," the U.S. "STEM education," and Australia's TAFE system are typical, emphasizing cross-disciplinary integration and innovative thinking. Curricula cover cutting-edge technologies such as artificial intelligence, the Internet of Things, and digital twins, with deep collaboration with multinational corporations including Siemens, General Electric, and ABB, providing international internship and employment pathways. Meanwhile, flexible certification systems such as "micro-credentials" and "skill modularization" accommodate lifelong learning needs. Nevertheless, high study-abroad costs, cultural adaptation pressures, and fierce international competition constrain some students' choices. Overall, the domestic major focuses more on industrial demand-oriented large-scale talent cultivation, while international models emphasize innovation-driven personalized vocational pathways. The two form a differentiated and complementary relationship in terms of technological direction, job markets, and training models, jointly promoting the supply and upgrading of skilled talents in the global electrical automation field.

2.2. Main Problems and Challenges Facing the Current Teaching Model of the Electrical Automation Major

Currently, the teaching model of the Electrical Automation major faces numerous

problems and challenges. With its broad knowledge coverage and strong practical orientation, coupled with limited class hours, both teaching and learning encounter significant difficulties, making the reform of this teaching model particularly urgent. Although some institutions have explored a series of practical teaching models based on their own circumstances, conducting research from the perspectives of teaching philosophy and forms, content selection, project design, implementation, and evaluation, and have achieved some innovative results, the overall practical teaching system still suffers from pressing real-world problems that require resolution. These include the failure to achieve seamless alignment between teaching content and the knowledge and skill competency requirements of actual job positions, low modularity in teaching project design, and an imperfect teaching evaluation system. These problems seriously constrain the cultivation of students' technical and practical competencies.

3. The Necessity of Teaching Transformation in the Electrical Automation Technology Major in the Context of AI

At a time when artificial intelligence technology is deeply integrating into and reshaping the ecosystems of various industries, higher vocational education, as the primary arena for cultivating applied talents, is facing unprecedented transformational pressures and opportunities. As a core branch of traditional engineering, the Electrical Automation Technology major is seeing increasingly prominent problems, including the disconnection between teaching content and industrial demands, the misalignment between practical training models and intelligent application scenarios, and the imbalance between competency structures and job requirements. These issues urgently necessitate the systemic reconstruction of the teaching system through artificial intelligence technology.

Therefore, promoting the teaching transformation of the Electrical Automation Technology major is not only an inevitable choice for adapting to industrial intelligent upgrading but also a key pathway for resolving the "industry-education disconnection" challenge in higher vocational education and enhancing the alignment between talent cultivation and regional economic development. The core of this transformation lies in reconstructing the entire chain of "teaching, learning, practicing, and evaluating" through artificial intelligence technology, thereby achieving a fundamental shift from knowledge transfer to competency cultivation, from equipment operation to system operation and maintenance, and from single-skill proficiency to compound innovation.

4. Instructional Strategy Design for Electrical Automation Driven by GAI

This paper proposes a study on vocational education teaching strategies for the Electrical Automation Technology major based on Generative Artificial Intelligence

(GAI). The strategies encompass the construction of a core curriculum system aligned with electrical automation job technologies under GAI guidance, course design based on cognitive augmentation technology, collaborative practical training based on digital humans, and teaching ecosystem practice strategies based on multi-modal intelligent interaction.

4.1. Construct a core curriculum system aligned with electrical automation job technologies

Against the backdrop of the rapid advancement of electrical automation technology and the growing diversification of industry demands, generative artificial intelligence has become a powerful tool for constructing a scientific and rational core curriculum system. Leveraging its robust data mining and analysis capabilities, it conducts comprehensive and in-depth research on numerous enterprises within the electrical automation industry. It collects massive amounts of information on the technical requirements, skill demands, and knowledge reserves of electrical automation-related positions from enterprises of different scales and business domains, and carries out detailed analysis ^[8,9].

4.2. Course design based on cognitive augmentation technology

The cognitive diagnostic function of generative artificial intelligence has brought personalized and precise transformation to the course design for the electrical automation major. It is capable of conducting comprehensive and accurate assessments of each student's learning ability, knowledge foundation, and learning style, much like drawing a unique learning profile for every student. Based on this profile, it tailors personalized learning paths for each student and recommends suitable learning resources, tasks, and progress schedules ^[10]. For students with strong learning abilities and solid foundational knowledge, it provides more challenging extended learning content and project tasks to encourage in-depth exploration and innovative practice, such as participating in complex electrical automation system design projects. For students with weaker learning abilities and less solid foundational knowledge, it provides more basic tutoring materials and targeted exercises to help them gradually master knowledge and skills, such as conducting basic circuit connection experiment exercises.

4.3. Collaborative practical training based on digital humans

The development of digital human training instructors is a major innovative application of generative artificial intelligence in collaborative practical training for electrical automation. By leveraging generative artificial intelligence and 3D modeling technology, highly realistic digital human training instructors are created ^[11]. These digital human training instructors not only possess lifelike appearances but are also equipped with rich electrical automation professional knowledge and

practical experience. They are capable of simulating the teaching behaviors and communication styles of real instructors, engaging in natural and smooth interactions with students. During the training process, the digital human training instructor can provide real-time guidance and feedback based on the training content and students' operational performance, answer students' questions, and correct their erroneous operations. For example, when students are performing wiring operations on electrical equipment, the digital human training instructor will promptly identify any wiring errors and explain in detail the correct wiring methods and precautions, much like a dedicated professional instructor constantly accompanying the students.

In conjunction with the digital human training instructors, a virtual electrical automation training environment is constructed. This virtual environment simulates real-world work scenarios such as factory workshops and automated production lines, incorporating various electrical automation equipment and instruments. Students can conduct training operations including equipment operation, commissioning, and maintenance within the virtual environment without concerns about equipment damage or safety issues. The digital human training instructor provides real-time guidance and supervision alongside, ensuring that students correctly acquire the training skills. For instance, in a virtual automated production line training environment, students can perform operations such as starting and stopping the production line and adjusting operating parameters. The digital human training instructor will provide timely prompts and guidance based on students' operational performance, enabling students to become familiar with the operating procedures and standards of the automated production line.

4.3. Teaching Ecosystem Practice Strategy Based on Multi-modal Intelligent Interaction

Integrating teaching resources of multiple modalities, including text, images, audio, video, and animations, to construct a rich and diverse teaching resource library serves as the foundation for fostering a favorable teaching ecosystem. By leveraging the text generation, image generation, and video production capabilities of generative artificial intelligence, high-quality teaching courseware, instructional videos, virtual simulation experiments, and other teaching resources are created. For instance, three-dimensional animated demonstrations of electrical automation equipment are produced to vividly illustrate the working principles and internal structures of the equipment, enabling students to grasp them at a glance; practical operation videos are recorded to allow students to intuitively learn equipment operation methods and techniques, as if the teacher were demonstrating right beside them.

A teaching platform based on multi-modal intelligent interaction is established to facilitate real-time interaction and communication between teachers and students,

as well as among students. The teaching platform supports multiple interaction modes, such as voice interaction, gesture interaction, and text interaction, allowing students to engage with the teaching platform in a natural manner to access learning resources and feedback information. For example, when students encounter problems during their learning process, they can ask questions via voice, and the teaching platform can quickly understand the query and provide answers; students can also operate and commission equipment in the virtual training environment through gesture controls, enhancing the interactivity of the learning experience.

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