Digital Transformation of Vocational Education: Research on the Construction of AI Teaching Teams for Intelligent Manufacturing Professional Groups

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Abstract: *Under the dual strategic background of the comprehensive digital transformation of vocational education and the rapid iterative upgrading of the intelligent manufacturing industry, artificial intelligence (AI) technology has been deeply integrated into the whole process of vocational education teaching, reconstructing the talent training mode, curriculum system and practical training ecology of intelligent manufacturing professional groups, and putting forward new digital and intelligent transformation requirements for the construction of teaching teams in higher vocational colleges. As the core carrier for cultivating digital and intelligent technical and skilled talents in the manufacturing industry, the intelligent manufacturing professional group determines the adaptation quality between talent training and industrial posts by virtue of the teaching team's capabilities in digital intelligence application, interdisciplinary integration and industry-education collaboration. At present, the construction of AI teaching teams in domestic higher vocational colleges is in the initial exploration stage, with common problems including solidified team structure, insufficient digital intelligence literacy of teachers, superficial industry-education integration, lagging assessment and incentive mechanisms, and weak resource support systems. Adopting the research methods of literature research, comparative analysis and inductive deduction, this paper systematically sorts out relevant research achievements and practical status quo, defines the core connotation and construction logic of AI teaching teams, quantitatively analyzes the differences, advantages and disadvantages between new and old teaching teams as well as mainstream construction modes through two groups of comparative tables, and deeply explores the practical dilemmas in team construction. On this basis, it constructs a systematic construction path from multiple dimensions including structure, literacy, collaboration, evaluation and resources, and prospects the future development trends of the industry. The research aims to improve the theoretical system of digital teacher construction in vocational education, and provide theoretical support and practical reference for the cultivation of high-level AI teaching teams, the digital transformation of teachers and the high-quality training of digital intelligent talents for intelligent manufacturing professional groups in higher vocational colleges.*

Keywords: *vocational education; digital transformation; intelligent manufacturing professional group; AI teaching team; double-qualified teachers; teacher team construction*

1. Research Introduction

With the development of new quality productive forces and the in-depth penetration of the digital economy, the intelligent manufacturing industry has achieved comprehensive upgrading relying on industrial artificial intelligence, digital twin, industrial big data and other technologies. Traditional manufacturing posts are undergoing rapid iteration, resulting in a growing shortage of compound digital and intelligent talents. The state has issued a series of policies such as the Vocational Education Digital Transformation Action Plan (2023–2025), which clearly requires promoting the digital reform of vocational education, strengthening the cultivation of teachers' digital literacy, and advancing the in-depth integration of artificial intelligence with vocational education and teacher team construction. As the core link connecting the advanced manufacturing industry and vocational education, the intelligent manufacturing professional group covers multiple related majors such as industrial robot technology, mechatronic integration technology and numerical control technology, with prominent advantages in cluster talent training. The traditional teaching team's solidified education mode, single professional structure and backward technical capabilities can no longer adapt to the new education modes empowered by AI, including modular curriculum reconstruction, virtual practical training teaching

and integrated education of post, course, competition and certificate. The construction of AI teaching teams has become the core starting point for the digital transformation of vocational education and the connotation improvement of professional groups.

In terms of research value, existing studies mostly focus on single dimensions such as teacher literacy and curriculum reform, while systematic review research on AI teaching team construction of intelligent manufacturing professional groups is relatively scarce. From the perspective of professional groups, this paper integrates research results and practical cases, makes up for the fragmentation shortcomings of existing studies, and enriches the theoretical system of digital teacher construction in vocational education. In practice, it refines construction pain points through multi-dimensional comparative analysis and builds implementable and replicable construction paths, which can effectively optimize the teacher structure of intelligent manufacturing professional groups, improve digital intelligent education capabilities, realize the accurate matching between talent training and industrial posts, and assist the intelligent upgrading of regional manufacturing industries[1].

This research mainly adopts literature research, comparative analysis and inductive deduction methods, and carries out research following the closed-loop logic of "connotation definition – current situation review – comparative analysis – dilemma analysis – path optimization – trend prospect", so as to comprehensively sort out and study the construction of AI teaching teams.

2. Core Connotation, Construction Logic and Research Status Quo

2.1 Core Concepts and Construction Characteristics

The digital transformation of vocational education is a systematic reform that relies on digital technology to carry out all-round and in-depth reconstruction of vocational education concepts, teacher construction, curriculum and practical training, as well as evaluation and governance systems. Its core is to build a data-driven and industry-education integrated modern vocational education ecology. The AI teaching team of intelligent manufacturing professional groups is a new compound education team adapted to industrial upgrading and vocational education transformation. Based on the intelligent manufacturing professional group, it consists of professional leaders, digital intelligence specialized teachers, backbone teachers and enterprise AI engineers, and possesses comprehensive capabilities including interdisciplinary integration, digital intelligent teaching, industrial technical service and accurate talent training, serving as the core support for the digital upgrading of professional groups.

Compared with traditional teacher teams, AI teaching teams have four core characteristics. First, interdisciplinary structural integration breaks the barriers of single majors and realizes the complementarity of teachers from multiple disciplines and schools and enterprises. Second, capability digital intelligence empowerment enables teachers to possess both traditional teaching capabilities and new capabilities such as AI curriculum development, intelligent learning situation diagnosis and virtual practical training design. Third, accurate and dynamic education realizes the dynamic iteration of teaching content and personalized training of students relying on big data. Fourth, in-depth industry-education integration connects enterprise real projects and technical standards to achieve the synchronous iteration of teachers' capabilities and industrial technologies[2].

2.2 Team Construction Logic under Digital Transformation

Digital transformation and AI teaching team construction form a two-way empowering coupling logic. On the one hand, the industrial technology iteration, popularization of intelligent teaching and integrated education of post, course, competition and certificate force traditional teachers to break capability bottlenecks and achieve all-round transformation of digital literacy, teaching modes and collaboration mechanisms. On the other hand, high-level AI teaching teams are the core support for the implementation of vocational education digitalization. Only teachers with digital intelligent innovation capabilities can complete the digital transformation of curricula, the construction of intelligent practical training systems and the establishment of dynamic evaluation systems, promoting the transformation of vocational education from information application to in-depth digital empowerment, and forming a benign ecology of "technology empowering teachers, teachers supporting education, and education adapting to industry"[3].

2.3 Review of Domestic and Foreign Research and Practice

Foreign manufacturing powers have taken the lead in promoting the integrated construction of AI and vocational

teachers, forming a standardized and industrialized cultivation system. Germany has upgraded its dual vocational education system relying on Industry 4.0, integrated industrial intelligent technical standards into teacher assessment and cultivation, and implemented a dual school-enterprise practical training and cultivation mode. The United States has built a national digital teacher cultivation platform to dynamically optimize teacher training content based on industrial big data. Japan and South Korea focus on the field of precision manufacturing, promote schools and enterprises to jointly build AI teacher cultivation centers, and realize the in-depth integration of industrial projects and teacher training. Foreign construction modes feature mature systems and solid implementation, but they adapt to local industrial and vocational education systems and cannot be directly copied.

Domestic research and practice mainly focus on four dimensions: teachers' digital intelligence literacy cultivation, team structure optimization, AI teaching reform and evaluation mechanism improvement. Double-high vocational colleges have taken the lead in pilot projects, building interdisciplinary AI teaching teams and co-constructing school-enterprise intelligent practical training platforms, initially forming diversified construction modes. However, the overall construction faces problems such as unbalanced regional development, insufficient construction depth, inconsistent standards and immature paradigms. Although existing studies cover a wide range of dimensions, they have deficiencies in systematization, comparative research and systematic problem sorting, which provides innovative space for this research.

3. Multi-dimensional Comparative Analysis of AI Teaching Team Construction

To accurately highlight the construction advantages and iterative value of AI teaching teams and clarify the applicable scenarios of different construction modes, this paper constructs two groups of comparative tables to conduct quantitative comparison from the differences between new and old teaching teams and mainstream construction modes, providing empirical support for dilemma analysis and path optimization.

3.1 Comparison between Traditional Teaching Teams and New AI Empowered Teaching Teams

Traditional teaching teams are built based on single majors and adapted to the traditional manufacturing talent training mode, showing prominent drawbacks in the digital transformation. Based on the cluster and digital intelligent education needs of professional groups, new AI empowered teaching teams have achieved all-round upgrading. The core differences between the two are shown in the table below[4].

Table 1 Comparison between Traditional Teaching Teams and AI Empowered New Teaching Teams

Comparison Dimension	Traditional Intelligent Manufacturing Teaching Team	AI Empowered New Teaching Team
Team Establishment Logic	Established based on single majors with strict professional barriers and fixed division of labor; focused on classroom theoretical teaching and basic practical training	Established based on intelligent manufacturing professional groups with interdisciplinary and cross-field layout; breaking professional barriers and focusing on digital intelligent education and industrial technical services
Team Structural Characteristics	Dominant full-time on-campus teachers with a low proportion and shallow participation of enterprise part-time teachers; no specialized digital intelligence teachers, resulting in single and fixed structure	Diversified collaborative structure with full-time and part-time integration; covering professional leaders, digital intelligence specialized teachers, backbone teachers and enterprise AI engineers with complementary and dynamically optimized structure
Core Capability Requirements	Focused on traditional professional teaching, basic equipment practical training and conventional teaching management; no mandatory requirements for digital technology application	Possessing both traditional teaching capabilities and capabilities in AI tool application, digital curriculum development, virtual practical training design, industrial technology research and development, and accurate learning situation diagnosis
Teaching and Education Mode	Standardized and homogeneous teaching dominated by offline classroom indoctrination and basic practical training; teaching content lags behind industrial technology iteration	Personalized, scenario-based and accurate teaching; dynamic iteration of teaching content relying on AI and integrated virtual and real practical training to adapt to intelligent post requirements
Industry-education Collaboration Level	Superficial cooperation limited to student internship and employment connection; no in-depth cooperation in curriculum co-construction, teacher co-cultivation and technology joint research	

Assessment and Evaluation System	Centered on class hours, academic scores and attendance; dominated by subjective evaluation with single dimensions and insufficient scientificity	Big data-based full-process dynamic quantitative evaluation covering multiple dimensions such as teaching innovation, digital application, technical services and school-enterprise collaboration
Development Adaptability	Adapted to talent training for traditional manufacturing industries, unable to meet the training needs of digital and intelligent compound talents in intelligent manufacturing	Accurately adapted to the dual needs of intelligent manufacturing industry iteration and vocational education digital transformation with higher education adaptability and quality

3.2 Comparison of Mainstream Domestic AI Teaching Team Construction Modes

In view of the differences in school-running foundation and industrial resources of domestic colleges and universities, three mainstream construction modes have been formed in China, namely literacy training-oriented mode, industry-education collaboration-oriented mode and ecological innovation-oriented mode. The three modes differ significantly in advantages, shortcomings and applicable scenarios, as detailed below.

Table 2 Comparison of Mainstream Domestic AI Teaching Team Construction Modes

Construction Mode	Core Construction Content	Core Advantages	Existing Shortcomings	Applicable College Types
Literacy Training-oriented Mode	Focus on improving teachers' basic digital literacy; carry out basic training on AI teaching tools, digital courseware production and smart classroom construction	Low construction difficulty, short cycle and quick results with strong universality; able to quickly make up for basic digital capability shortcomings	Superficial construction focusing only on basic skills; lack of in-depth construction such as curriculum reconstruction and technology research and development with insufficient systematization	Ordinary higher vocational colleges with weak school-running foundation and late digital transformation start
Industry-education Collaboration-oriented Mode	Deepen school-enterprise cooperation, introduce enterprise AI technical backbones, and carry out teacher mutual employment, project joint research and practical training base co-construction	Accurately docking industrial technical standards, making up for teachers' lack of industrial experience, and improving the adaptation degree between teaching and posts	Highly dependent on enterprise resources with weak independent innovation capability, imperfect cultivation system and insufficient construction sustainability	Public higher vocational colleges with abundant regional industrial resources and sound school-enterprise cooperation foundation
Ecological Innovation-oriented Mode	Build a full-chain system of "training-practice-research-evaluation" to carry out all-round construction including curriculum reform, technology research and development and education innovation	Perfect and systematic construction system with multiple capabilities in teaching, scientific research, talent training and social services and optimal education effects	High investment, long cycle and high difficulty with strict requirements on college funds, teachers and industrial resources	Double-high construction colleges and regional benchmark higher vocational colleges

4. Practical Dilemmas and Causes of AI Teaching Team Construction

4.1 Solidified Team Structure and Insufficient Interdisciplinary Integration Capability

Most colleges still adopt the traditional single-major team construction mode with unbroken professional barriers. On the one hand, the teacher professional structure is unbalanced. The team is dominated by traditional mechanical and electrical teachers, with a huge shortage of specialized teachers in industrial AI, digital twin, big data and other digital intelligence fields and a lack of interdisciplinary compound talents. On the other hand, the full-time and part-time teacher structure is unreasonable. Enterprise AI engineers and front-line technical backbones have a low participation rate and shallow integration in teaching teams, only participating in short-term practical training guidance rather than in-depth core work such as curriculum construction and technology research and development. Meanwhile, the team echelon construction is imperfect. Young teachers have weak digital intelligence capabilities, backbone teachers lack innovation motivation, and professional leaders have insufficient digital leading capabilities, resulting in low overall innovation vitality and inability to support the digital reform of professional groups[5].

4.2 Weak Teachers' Digital Intelligence Literacy and Capability Iteration Lagging behind Industrial Development

The lag of teachers' digital intelligence capabilities is the core bottleneck restricting team construction. Senior teachers have solidified teaching thinking and only apply industrial intelligent technologies, virtual simulation platforms and AI teaching tools at the basic level, unable to carry out in-depth work such as digital curriculum reconstruction and personalized intelligent teaching. In addition, the existing teacher training system is fragmented. The training content is mostly general digital tool teaching, lacking industrial-level technical training adapted to the intelligent manufacturing industry, which is disconnected from professional teaching and industrial posts with poor training effectiveness. Furthermore, the lack of a regular enterprise practice mechanism for teachers makes it impossible to keep up with industrial technology iteration in a timely manner. The teaching content and practical training projects are disconnected from real enterprise production scenarios, and the updating speed of teachers' capabilities is far behind the pace of industrial development.

4.3 Superficial Industry-education Integration and Lack of School-enterprise Two-way Empowerment Mechanism

In-depth industry-education integration is the core support for AI teaching team construction, but current school-enterprise cooperation is generally formalistic. Most cooperation is limited to basic links such as student internship and equipment donation, lacking in-depth cooperation mechanisms for teacher co-cultivation, curriculum co-construction, technology joint research and achievement sharing. High-quality enterprise intelligent production and technical resources cannot feed teacher cultivation, and colleges' teaching and research advantages can hardly serve enterprise technological upgrading, forming no two-way empowerment pattern. At the same time, the implementation of incentive policies for enterprises' participation in vocational education construction is insufficient with low return on investment, resulting in low initiative of enterprises to participate in teacher team construction. In addition, the absence of a regular school-enterprise docking mechanism leads to prominent information and resource barriers, further weakening the industrial adaptation capability of the team[6].

4.4 Lagging Assessment System and Imperfect Incentive and Restraint Mechanism

The traditional teacher assessment system is seriously disconnected from the digital and innovative construction needs of AI teaching teams. In terms of evaluation dimensions, it overemphasizes conventional indicators such as class hours and academic scores, ignoring core indicators such as digital teaching innovation, digital curriculum transformation, industrial technical services and digital intelligent talent training, resulting in a one-sided evaluation system. In terms of evaluation methods, it is dominated by artificial subjective evaluation and result-oriented evaluation, lacking full-process dynamic quantitative evaluation based on teaching big data, which cannot accurately reflect the real education effect of the team. In terms of incentive and restraint, the incentive for digital teaching innovation and industrial technical services is insufficient, leading to weak teachers' transformation motivation. Meanwhile, the absence of corresponding supervision and rectification mechanisms makes the digital construction of the team formalistic and unsustainable.

4.5 Weak Resource Support and Unformed Sustainable Construction Ecology

Most colleges have not built an all-round guarantee system adapted to AI teaching team construction. In terms of hardware, the configuration of industrial AI training equipment, digital twin platforms and virtual simulation teaching systems is imperfect, and the construction of intelligent teaching scenarios lags behind. In terms of resources, digital resources such as AI modular curricula, loose-leaf textbooks and virtual practical training projects adapted to intelligent manufacturing professional groups are scarce, making it difficult and costly for teachers to independently develop resources. In terms of funds, colleges lack special investment for digital teacher construction, unable to support regular teacher training, school-enterprise cooperation, resource development and technology research and development. The multiple shortcomings in software, hardware and funds lead to slow progress and poor effect of team construction, failing to form a sustainable development ecology.

5. Systematic Construction Path of AI Teaching Teams under Digital Transformation

5.1 Optimize Interdisciplinary Teacher Structure and Build Echelon Collaborative Teams

Breaking traditional professional barriers, this paper builds a new team structure of "interdisciplinary integration, full-time and part-time combination, and echelon development" based on the cluster education needs of professional groups. Integrate on-campus teachers from multiple majors such as electromechanics, numerical control, industrial big

data and artificial intelligence, and set up special groups for curriculum development, intelligent teaching, practical training innovation and technical services to realize collaborative and efficient work. Adopt the talent introduction mode of "fixed posts + special appointed posts + mobile posts", accurately introduce enterprise AI engineers and intelligent equipment technical backbones as part-time teachers, and clarify their responsibilities in curriculum construction, practical training guidance and technology research and development to integrate them into team construction in depth. Meanwhile, build an echelon system of "leader guidance, backbone teacher core, young teacher reserve and enterprise expert support", improve the training mechanism for young teachers, and activate the team's innovation vitality[7].

5.2 Build Hierarchical Cultivation System to Comprehensively Improve Digital Intelligence Literacy

A hierarchical and precisely adapted digital intelligence cultivation system is constructed according to the capability differences of team members. For professional leaders and backbone teachers, high-level training focusing on cutting-edge industrial AI technologies, digital curriculum reconstruction and school-enterprise joint technology research is carried out to improve team leadership and innovation capabilities. For young teachers, basic skill training in AI teaching tools, virtual practical training design and smart classroom construction is emphasized to consolidate their digital teaching foundation. For enterprise part-time teachers, special training in vocational education teaching theories and curriculum design is launched to standardize their teaching capabilities. Establish a regular enterprise temporary training mechanism to promote teachers' in-depth participation in enterprise intelligent production projects and realize the synchronous iteration of industrial technology and teaching capabilities. Relying on on-campus teaching and research competitions, case discussions and project research, promote teaching improvement through research and capability upgrading through competitions.

5.3 Deepen Industry-education Integration and Improve School-enterprise Collaborative Mechanism

Construct a long-term school-enterprise collaborative mechanism with two-way empowerment and in-depth integration. Jointly establish an AI teacher construction steering committee with industry associations and leading enterprises to dynamically connect industrial technical standards and post needs and optimize team construction objectives and cultivation content. Implement the dual employment system of schools and enterprises, promote teachers' temporary training in enterprises and enterprise engineers' teaching in colleges, and jointly build AI teaching innovation studios, virtual practical training bases and technology research and development centers to realize the sharing of teachers, resources, projects and achievements. Improve the enterprise incentive and guarantee policy, implement preferential policies such as tax reduction and exemption and special subsidies, clarify the rights, obligations and benefit distribution mechanism of both schools and enterprises, stimulate enterprises' initiative to participate in teacher cultivation and teaching reform, and transform superficial project cooperation into in-depth strategic integration[8].

5.4 Reconstruct Intelligent Evaluation System and Improve Closed-loop Incentive and Restraint Mechanism

Build a full-dimensional and dynamic team assessment and evaluation system relying on big data technology. Construct a five-in-one evaluation index system covering "teaching innovation, digital empowerment, practical education, technical services and collaborative education", add core indicators such as digital curriculum development, AI teaching application effect, students' digital intelligence capability improvement and enterprise technical services, and make up for the shortcomings of traditional evaluation. Optimize evaluation methods, collect full-process teaching data through smart teaching platforms, and combine process evaluation with result evaluation, quantitative data evaluation with qualitative evaluation to improve evaluation accuracy and scientificity. Link evaluation results directly with professional title evaluation, performance appraisal and merit evaluation, provide special incentives for teachers with outstanding digital innovation achievements, and carry out special supervision and rectification for teachers with backward transformation and inadequate performance, forming a closed-loop management mechanism of "evaluation – incentive – rectification – iteration"[9].

5.5 Strengthen All-round Resource Guarantee and Build Sustainable Construction Ecology

Improve the guarantee system from four dimensions: funds, hardware, resources and teaching research. Set up special funds for teacher digital transformation, focusing on equipment upgrading, teacher training, resource development and school-enterprise cooperation. Iteratively upgrade hardware platforms such as virtual simulation, digital twin and industrial AI training to build a virtual-real integrated intelligent teaching scenario. Jointly build a digital resource library of AI modular curricula, loose-leaf textbooks and virtual practical training cases with leading enterprises to realize the dynamic updating of teaching resources. Build an on-campus AI teaching and research innovation platform to carry out regular teaching reform research, achievement incubation and teacher exchange activities, promote the coordinated

improvement of the team's teaching, scientific research and innovation capabilities, and form a sustainable team construction ecology[10].

6. Conclusion and Prospect

6.1 Research Conclusion

Under the background of vocational education digital transformation, the construction of AI teaching teams is the core starting point for the quality improvement of intelligent manufacturing professional groups and solving the mismatch between talent supply and demand. Through systematic review of existing research and practical achievements, this paper clarifies the core connotation, construction characteristics and two-way empowerment logic of AI teaching teams, and defines the differences, advantages and disadvantages between new and old teacher teams and various construction modes through two comparative tables. The research finds that the construction of AI teaching teams in domestic higher vocational colleges generally faces five core dilemmas: solidified structure, weak digital intelligence literacy, superficial industry-education integration, lagging evaluation mechanism and insufficient resource support. In view of this, this paper constructs a set of systematic and implementable construction paths adapted to intelligent manufacturing professional groups from five dimensions: teacher structure optimization, hierarchical literacy cultivation, school-enterprise collaboration deepening, intelligent evaluation reconstruction and resource ecology improvement, which can effectively solve the pain points and difficulties in current team construction and provide practical guidance for the digital transformation of teachers in higher vocational colleges.

6.2 Development Prospect

With the continuous deepening of vocational education digital reform and the rapid iteration of intelligent manufacturing industry, the future construction of AI teaching teams will present four major development trends. First, systematic construction system. Team construction will evolve from single capability upgrading to all-round integrated construction of structure, capability, mechanism and ecology, forming a standardized and replicable construction paradigm. Second, accurate capability cultivation. Relying on AI post portrait and student learning situation portrait technology, realize the accurate and personalized adaptation of teacher cultivation and talent training. Third, in-depth industry-education integration. Schools and enterprises will achieve in-depth integration of technological symbiosis, talent co-education and achievement win-win, realizing the synchronous iteration of teacher capabilities and industrial technologies. Fourth, diversified education roles. Teaching teams will transform from traditional knowledge imparters to intelligent education designers, industrial technical service providers and teaching innovation researchers, fully empowering the high-quality training of digital intelligent talents in intelligent manufacturing, and providing solid support for the high-quality development of vocational education and the transformation and upgrading of advanced manufacturing industry[11].

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