World Journal of Education and Humanities
ISSN 2687-6760 (Print) ISSN 2687-6779 (Online)
Vol. 8 No. 4, 2026
www.scholink.org/ojs/index.php/wjeh

Original Paper

Research on the Internal Mechanisms and Practical Pathways of Artificial Intelligence Empowering Talent Cultivation in Vocational Education

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Received: September 28, 2026 Accepted: November 09, 2026 Online Published: November 21, 2026

doi:10.22158/wjeh.v8n4p72 URL: http://dx.doi.org/10.22158/wjeh.v8n4p72

Abstract

The deep integration of artificial intelligence and vocational education is currently at a critical stage of transitioning from technological application to system transformation. However, in the process of practical advancement, it still faces multiple challenges such as concepts, resources, teachers, mechanisms, and ethics. Through comparative analysis of multiple cases, this study reveals that the current intelligent transformation of vocational schools presents a diversified path pattern of "hardware element renovation" and "software process empowerment", and extracts common experiences such as data integration, problem-driven approach, and teacher transformation. At the same time, it diagnoses prominent problems such as shallow application of technology, system isolation effects, and lagging institutional supply. Based on this, this study constructs a systematic promotion path from five dimensions: curriculum reconfiguration, teaching innovation, teacher development, evaluation reform, and governance optimization. It emphasizes that the core purpose of artificial intelligence empowering vocational education lies in returning to the educational purpose, regulating the basic logic of technology application with the comprehensive development of people, and providing a theoretical reference and practical framework for promoting the intelligent transformation of vocational education.

Keywords

Artificial Intelligence, Vocational Education, Talent Cultivation, Intelligent Transformation, Educational Governance

1. Introduction

Currently, the development of vocational education in our country is undergoing profound and multi-dimensional changes. At the policy level, the state is systematically promoting the digitalization strategy for education, implementing the plan to improve and enhance vocational education quality, and continuously deepening the reform of the modern vocational education system. These top-level designs provide clear guidance and institutional guarantees for the digital transformation and in-depth development of vocational colleges. At the same time, the wave of industrial intelligent upgrading is accelerating, and the production organization methods and job structures have undergone fundamental changes. The demand for technical and skilled talents has shifted from single operational types to innovative talents with a comprehensive knowledge structure, high-level digital literacy, and efficient human-machine collaboration capabilities. The new requirements for talent specifications urgently need vocational education to make systematic responses.

At the technical level, breakthroughs have been made in cognitive intelligent technologies such as generative artificial intelligence (AIGC) and large models, providing new possibilities for the dynamic generation of educational content, personalized learning path planning, and human-machine collaborative teaching; digital twin technology can accurately map real production scenarios, and intelligent training equipment is constantly being upgraded. The combination of these technologies enables complex skills training with high costs and high risks to be safely and repeatedly conducted in virtual and simulated environments. The collaborative evolution of these technology clusters is driving the vocational education training model to shift from experience-driven to data-driven, and from fixed process presetting to intelligent adaptive, providing key technical support for resolving the problems of unbalanced traditional training resources and scenarios divorced from reality, and creating realistic conditions for responding to the demands of the industry for new types of talent capabilities.

2. Theoretical Foundation

The theoretical framework of this study is constructed on the cross-fusion of multiple theories, aiming to provide a systematic explanatory perspective for the mechanism analysis and practical design of empowering intelligent technology in vocational education. Firstly, the Technology Affordance Theory provides a foundational perspective for understanding how technology shapes teaching actions. This theory emphasizes that technology itself is not the decisive factor; its value lies in providing the possibility and constraints for specific actors in specific contexts to act. In relation to this study, generative artificial intelligence and intelligent training equipment are not directly equivalent to the improvement of teaching effectiveness; instead, they change the scope of teachers' teaching actions and the learning paths of students through providing new affordances such as dynamic knowledge generation, intelligent diagnosis of learning trajectories, and virtual-real interaction operations. This perspective helps to go beyond simple technological determinism and examine the empowering process from the interactive relationship between technological attributes and teaching actions.

The Activity Theory provides a structured analytical framework for analyzing the teaching activity system after the intervention of intelligent technology. This theory regards human activities as an organic system composed of six elements: the subject, the object, the tool, the community, the rules, and the division of labor. The core driving force of the system's operation is the achievement of the goal oriented by the object. In traditional training teaching, the teacher (the subject) uses the training equipment (the tool) to guide students to master operational skills (the object), and the fixed organization of the class, training regulations, and roles constitute the existing community, rules, and division of labor. When AIGC large models are embedded as new intelligent tools or the digital twin environment reshapes the training space, the qualitative change in the tool element will be transmitted to the entire activity system, triggering the adaptive reconfiguration of teacher-student role division, interaction rules, and even the organizational form of the community. The analytical framework of the Activity Theory helps to systematically identify such structural changes and their internal contradictions.

The situational learning theory and the embodied cognition theory provide cognitive scientific support for explaining why intelligent training is effective from the perspective of learning mechanisms. The situational learning theory holds that the learning of knowledge and skills cannot be separated from the real context in which they are generated and applied. Learning is essentially a legitimate marginal participation process within a practical community. The embodied cognition theory further emphasizes that cognition is not limited to symbolic operations within the brain, but is rooted in the sensory-motor experiences of the body and its real-time interaction with the environment. By combining these two theories to examine the intelligent training domain, it can be found that the high-fidelity virtual context constructed by digital twin technology can simulate the complex context and social-cultural elements of the real workplace, empowering learners to gradually construct professional identity in a realistic practice context; while the visual, tactile feedback and human-machine interaction provided by intelligent training equipment strengthen the cognitive role of the body in skill acquisition, allowing tacit operational knowledge to be effectively internalized through embodied interaction, compensating for the limitations of traditional classroom decontextualized teaching.

The theory of vocational education curriculum provides standardized guidance from the perspective of curriculum design and content organization for this research. The theory of systematic work process courses emphasizes breaking the constraints of the disciplinary system and organizing curriculum content based on typical work processes and their action domains to achieve the overall cultivation of vocational action abilities. The learning domain course model transforms typical work tasks into learning domains, structuring the course content to be in line with the logical operation of vocational actions. When AIGC can automatically generate typical task descriptions and learning project materials based on the latest industry dynamics, and when the digital twin platform can provide visualized typical work scenarios for each learning domain, technological empowerment not only stops at the improvement of teaching methods, but also penetrates into the core section of curriculum content

development and update. The theories provide educational norms for defining the boundaries and directions of technology application, ensuring that technological innovation always serves the achievement of curriculum goals.

The theory of educational ecology provides a holistic thinking paradigm for examining the reconfiguration of the vocational education system after technological empowerment from the macro-system level. This theory regards education as a dynamic ecosystem composed of multiple entities, resources, environment, and their interrelationships, focusing on the structural balance, energy flow, and co-evolution of the system. When the technology populations such as AIGC, digital twins, and intelligent training equipment enter in large-scale quantities, the resource patterns, information flow methods, symbiotic relationships among entities, and the boundaries of the vocational education ecosystem are fundamentally reshaped. Introducing an ecological perspective can go beyond the optimization thinking of a single element and analyze how intelligent technologies and teaching subjects, curriculum content, training environments, and even industry demands form new dynamic balance and co-evolution mechanisms at the system level, thereby providing theoretical basis for making institutional arrangements and path designs at the system level. These five theories jointly form the theoretical foundation of this research, from technological availability, activity system structure, learning cognitive mechanism, curriculum design norms to system ecological reconfiguration, forming a progressive analytical logic from micro to macro.

3. The Internal Mechanism of How Artificial Intelligence Empowers Vocational Education Talent Cultivation

3.1 The Element Reconfiguration Mechanism

Element reconfiguration is the fundamental mechanism through which intelligent technology enables the operation of the vocational education system. Its core essence lies in promoting a structural transformation of the training elements from the traditional form to the intelligent form. At the course element level, traditional vocational education courses have long followed the internal logic of disciplinary knowledge for content arrangement, which often leads to a disconnection between teaching content and the real working process. The intervention of intelligent technology enables the reordering of course content according to "typical work processes", while integrating the intelligent technology itself as an organic component of the course content, forming a new type of course form that is "work processes + intelligent technology" intertwined in two lines. At the training practice element level, the high-fidelity virtual training environment constructed by digital twins and virtual simulation technologies can effectively supplement and partially replace traditional physical training, allowing high-risk operations and high-cost equipment disassembly and assembly training to be repeatedly conducted in a safe and controllable virtual space. At the resource element level, generative artificial intelligence can automatically generate multi-modal learning resources covering micro-video, virtual workstation operation demonstrations, and intelligent question banks based on teaching objectives and

learners' characteristics. The production mode of resources shifts from manual presetting to intelligent dynamic generation. The collaborative reconfiguration of these elements, from the generation logic of course content, the spatial expansion of training forms, and the supply mode of teaching resources, provides a systematic solution to the "three high" training predicament faced by vocational education - high equipment investment, high operational risks, and high material loss. It lays the material and content foundation for empowering technology to empower talent cultivation.

3.2 The Process Empowering Mechanism

The process empowerment mechanism focuses on the precise and personalized operation of the training process, which is a key mechanism for empowering intelligent technology in vocational education. The traditional vocational education training process is limited by the organizational form of class teaching, making it difficult to achieve precise perception of the individual state of learners and differentiated responses. The embedding of intelligent technology makes it possible to break through this predicament. Firstly, in the aspect of learning emotion perception, by leveraging multimodal learning analysis technology, the system can collect real-time multi-source data such as the behavior trajectory, action sequence, interaction frequency, and physiological signals of learners during practical operation, and construct a multi-dimensional learner profile to achieve precise diagnosis of cognitive state, skill level, and learning engagement. Secondly, in the aspect of adaptive learning, based on the diagnosis results of the learner profile, the intelligent recommendation system can dynamically match and adapt learning content from the resource library and generate differentiated learning paths, allowing each learner to conduct targeted training according to their own pace and weak points. Finally, in the aspect of AI tutor, the AI tutor system can undertake the immediate guidance function of some skill training, using action recognition algorithms to conduct real-time detection and scoring of operation norms, and immediately provide corrective feedback when operational deviations occur, compensating for the limitation that a single teacher cannot take care of all students. The collaborative operation of these three mechanisms enables personalized training to break through the limitations of small-scale experiments and initially possesses the realistic conditions for large-scale implementation, promoting vocational education to transform from standardized "batch training" to "large-scale individualized training" that takes into account both scale and individuality.

3.3 The Relationship Reshaping Mechanism

The mechanism of relationship reconfiguration focuses on the collaborative reconfiguration of the interaction relationship structure between the subjects, constituting the guarantee mechanism for intelligent technology to empower vocational education. Firstly, the teacher-student relationship undergoes a fundamental reconfiguration. With the support of intelligent technology, teachers can partially be liberated from repetitive knowledge teaching and operational demonstrations, and shift their energy to the contextual design of learning tasks, the guidance and adjustment of the learning process, and the infiltration and cultivation of vocational values. Their role positioning shifts from a single knowledge instructor to a composite role of learning designer and value guide. Secondly, the

collaborative relationship between the school and enterprises gains technical support. AI-driven industrial talent demand prediction and job capability mapping analysis can dynamically capture the evolving trends of industrial skills requirements, providing data-driven decision-making basis for the adjustment of professional settings and the update of course content of colleges and universities, empowering the connection between industry and education to shift from experience-based judgment to intelligent matching, and from lagging response to forward-looking warning. Furthermore, the human-machine collaborative relationship becomes a new structural dimension in the teaching relationship. On one hand, the human-machine collaboration ability itself is included in the training target system, becoming a key capability that technical-skilled talents must possess for intelligent work scenarios; on the other hand, the composition of the subjects in teaching activities expands from the binary structure of "teacher-student" to the triadic structure of "teacher-student-machine", and the intelligent system participates in teaching interaction as a quasi-subject. The collaborative reconfiguration of these three relationships jointly promotes the formation of a "teacher-student-machine-enterprise" multi-dimensional collaborative education ecosystem, providing institutional guarantees and relational support for the continuous release of the effect of intelligent technology empowerment.

3.4 The Evaluation Innovation Mechanism

The evaluation innovation mechanism focuses on the transformation of the talent evaluation paradigm towards value-added and dynamic development, and plays a guiding role among the four mechanisms. The traditional vocational education evaluation often has structural limitations such as overemphasizing end-of-term assessments, focusing on declarative knowledge memorization in the evaluation content, and having a single teacher as the evaluation subject. Intelligent technology provides a new methodological path and tool support to solve these evaluation problems. Firstly, process-based evaluation can be deeply implemented. Based on behavioral data, the entire learning profile can be refined from periodic examinations to the micro-process of each operation training, integrating evaluation with the learning process rather than being an independent step outside of learning. Secondly, capability value-added evaluation becomes operational. By continuously recording and analyzing the trajectory of learners' skill formation, the growth path from novice to proficient can be depicted, and on this basis, the quantitative measurement of the increment of capability can be achieved, shifting the focus of evaluation from the horizontal group ranking to the vertical individual growth. Thirdly, the evaluation subjects tend to be diversified and collaborative. Enterprise experts can participate in the authenticity evaluation of students' practical training outcomes through remote systems, industry standards can be embedded as automatic scoring rules, and AI systems provide objective analysis based on data. A complementary and mutual verification collaborative evaluation mechanism is formed among teachers, enterprises, the industry, and the AI system. The evaluation innovation mechanism, by establishing a new orientation of "emphasizing process and results,

capability and knowledge, value-added and compliance", plays a regulatory and guiding role in the practical directions of element reconfiguration, process empowerment, and relationship reformation.

3.5 The Intrinsic Correlation of the Four Mechanisms

The four mechanisms are not independent operating units but form an organic system with distinct levels, logical progression, and functional coupling. In terms of their internal connections, element reconfiguration holds a fundamental position, providing a material carrier and content support for process empowerment, relationship reformation, and evaluation innovation. Without the intelligent reorganization of courses, practical training, and resources, the subsequent precise training, collaborative relationships, and value-added evaluations would lose their supporting objects. Process empowerment holds a key position, being the concentrated manifestation of the technological empowerment effect at the teaching operation level, converting the potential provided by element reconfiguration into actual teaching actions and learning outcomes. Relationship reformation plays a guaranteeing function, providing institutional arrangements and collaborative support among subjects for the continuous operation of the former two, avoiding technical innovation from falling into difficulties due to the absence of subject roles or relationship imbalance. Evaluation innovation plays a guiding role, feeding back and calibrating the direction of element reconfiguration, the strategies of process empowerment, and the pattern of relationship reformation with value-added and dynamic evaluation standards. The four elements form a progressive and closed-loop feedback relationship of "foundation - key - guarantee - guidance", constituting an integrated system with internal consistency, and jointly interpreting the deep mechanism of intelligent technology empowering vocational education talent cultivation. The internal structure of the four mechanisms is shown in Figure 1.

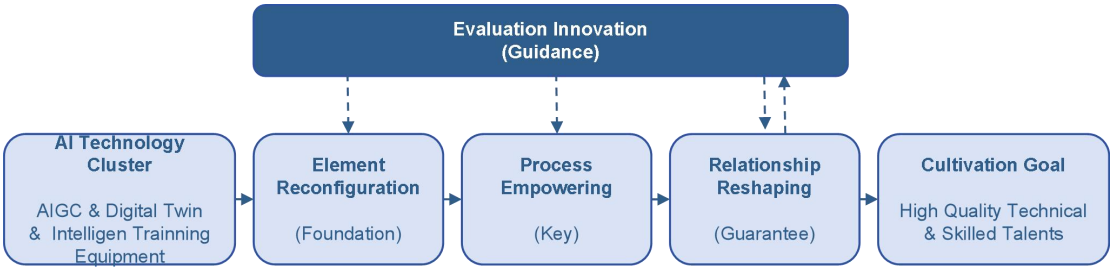


Figure 1. The Internal Mechanism Framework of AI-Empowered Talent Cultivation in Vocational Education

4. An Examination of the Current Situation of Artificial Intelligence Empowering Vocational Education Talent Cultivation

4.1 The Case Study Analysis

The construction and practical application of the virtual simulation training base in a vocational college, which focuses on the long-term practical challenges faced by the training teaching of equipment manufacturing-related majors, such as high equipment value, high operational risks, and slow update

and iteration, has systematically constructed a virtual simulation training platform integrating digital twin models, immersive virtual operation environments, and real-time data collection systems. This platform is guided by typical work tasks, digitally reproducing high-risk operations, precise assembly, fault diagnosis, and emergency handling on the real production line with high fidelity, forming a step-by-step training teaching system that combines virtual and real worlds and compensates for the real world with the virtual. In teaching applications, the platform simultaneously records the complete behavioral trajectory of students' operations, generating training analysis reports for each learner covering multiple dimensions of indicators such as operational standardization, smoothness of movements, and problem-solving efficiency. Teachers implement stratified guidance and targeted corrections based on these reports. The value of this case lies in that it comprehensively presents the practical implementation path of the element reconfiguration mechanism in training teaching, demonstrates the breakthrough effect of virtual simulation technology on the "high cost, high risk, and high loss" training predicament, and also exposes the phased limitations of virtual training in aspects such as the lack of tactile feedback and insufficient cultivation of real operation feel, providing reference experiences and risk warnings for inter-school promotion.

The personalized teaching reform practice is driven by an AI learning analysis platform in a vocational college. The school introduced a multimodal learning analysis system, integrating various sources of data such as educational administration management, online learning, classroom interaction, and skills training, to construct a dynamic learning profile and academic status early warning mechanism covering all students in the school. The platform continuously analyzes students' learning behavior sequences and automatically identifies each student's knowledge weak points, skill deficiencies, and learning style preferences, and accordingly generates personalized learning resource recommendations and differentiated training task pushes, initially achieving "one person, one strategy" adaptive learning support. At the same time, the teacher-end learning situation dashboard presents the real-time learning status of the entire class and individual students in a visualized manner, empowering teachers to shift from empirical judgment to data-driven precise teaching decisions. The implications of this case lie in that it empirically demonstrates that the exploration of "large-scale individualized cultivation" in the process empowerment mechanism is feasible - under the condition that the basic framework of class teaching system does not undergo fundamental changes, through the effective integration of intelligent learning analysis technology and adaptive recommendation mechanisms, differentiated cultivation strategies can be implemented in a large-scale student population. However, this case also reveals practical challenges such as the incomplete data collection dimensions (especially the process data of practical skills is still scarce) and the constraint of teachers' data literacy on the effectiveness of the platform, and the presentation of these issues provides practical basis for subsequent improvement directions and policy recommendations.

The two cases exhibit significant differences in their empowerment paths: The virtual simulation training base focuses on the reconfiguration of key elements, with the integration of virtual and real

environments and the digitization of course content as its core, which belongs to the intelligent transformation at the "hard element" level; the AI learning analysis platform emphasizes process empowerment, with precise perception of learning status and differentiated responses to training strategies as its core, which belongs to the intelligent intervention at the "soft process" level. This indicates that the current intelligent transformation of vocational colleges presents a diversified pattern of "infrastructure taking the lead" and "teaching application taking the lead". In terms of successful experiences, both cases demonstrate three commonalities: Firstly, both case schools take data integration as the premise, and data is the key production factor for intelligent empowerment of education; Secondly, both case schools follow the "problem-driven" logic, directly addressing the "three highs" pain points and individualized training dilemmas of training, rather than being driven by technology for technology's sake; Finally, both case schools rely on the adaptation of teachers' roles as the support, and the release of technical efficiency depends on the simultaneous improvement of teachers' data interpretation and intervention design capabilities. The two case schools have three shortcomings: Firstly, the application of technology is shallow, the level of virtual training intelligence is limited, and there are blind spots in the depiction of the learning process in learning analysis; Secondly, the isolated effect of systems is prominent, the training data and academic data are difficult to integrate, which restricts the decision-making for comprehensive education; Thirdly, the supply of institutional regulations is lagging, the recognition of class hours, the exchange of credits, and the assessment effectiveness of AI evaluation all lack institutional definitions. These findings provide an empirical basis for subsequent policy recommendations.

4.2 The Realistic Difficulties

At the conceptual level, in the practical advancement of artificial intelligence empowering vocational education, some institutions have developed a cognitive bias of equating technology application with educational reform. They overly pursue the introduction and display of intelligent devices, while neglecting the fundamental purpose of technology serving the all-round development of people. This tendency has led to an excessive tilt of resource allocation towards hardware construction, and the teaching design being dominated by technical logic rather than educational logic. The humanistic care, professional spirit cultivation, and value shaping in skills training have been weakened to varying degrees under the veil of technological brilliance. In terms of resources, the current intelligent learning resources for vocational education generally present a situation of insufficient quantity and uneven quality, especially the high-quality virtual simulation training resources and intelligent course resources that meet the needs of specific industry positions and conform to the laws of skill formation are still relatively scarce. At the same time, the differences in regional economic development levels and the differentiation of educational informatization bases have led to a serious imbalance in the allocation of high-quality intelligent resources between the eastern and western regions, as well as between model schools and ordinary schools. The digital gap has further intensified under the overlay of intelligent technology. At the teacher level, most vocational school teachers have not systematically received

training on the application of intelligent technology in teaching goals setting, learning task design, and teaching process regulation during their pre-service training and on-the-job training. They generally have insufficient knowledge of the functions of intelligent tools, weak data interpretation abilities, and a lack of human-machine collaborative teaching strategies, and their ability to integrate intelligent technology into the setting of teaching objectives, the design of learning tasks, and the regulation of the teaching process remains limited. The application of technology mostly stays at a shallow level of assistance and has not deeply reached the essence of teaching structure transformation and model innovation. From the mechanism level, in the aspect of industry-academia collaboration, although AI technology provides technical possibilities for industry demand prediction and job ability analysis, the institutional barriers in data sharing, standard co-construction, and resource interconnection between schools and enterprises are still solid. The technical potential cannot be transformed into substantive collaborative effectiveness. In terms of data governance, the data standards among the educational administration system, training platform, online learning system, and internship management system are inconsistent, and the interfaces are not connected, forming disconnected data islands that restrict the precise educational decision-making based on panoramic data. In the evaluation system, the process-based evaluation and ability growth evaluation supported by intelligent technology have not received the same institutional recognition as traditional examination evaluation, and the deepening of evaluation reform is constrained by the strong influence of institutional inertia. In the ethical aspect, the continuous collection and analysis of learners' behavioral data enhance the accuracy of education while also triggering ethical concerns such as blurred data collection boundaries, weakened informed consent procedures, and security issues regarding data storage and use. The problem of algorithm bias is also not to be ignored. The gender, regional, and class biases hidden in the training data may be solidified or even amplified through intelligent recommendation and evaluation systems, posing a potential threat to educational equity. Moreover, excessive reliance on intelligent system feedback and decision-making may lead to the dual weakening of the subjectivity of teachers and students - students losing the willingness to make independent judgments and conduct autonomous exploration, and teachers giving up the responsibility for professional intuition and educational reflection. The risk of technology transforming from an auxiliary means to a dominant force is worthy of high vigilance.

5. The Practical Path of Leveraging Artificial Intelligence to Enhance Vocational Education Talent Cultivation

5.1 The Course Path: Reconstructing the Intelligent Curriculum System

The curriculum system is the core carrier for talent cultivation, and its intelligent reconfiguration is a key link in empowering artificial intelligence to empower vocational education. Firstly, a modular curriculum structure of "professional group + AI" should be constructed. Taking the professional group as the basic unit, integrate the AI general knowledge module, industry AI application module and professional core course module organically, forming a curriculum framework that maintains the

professional core while having the flexibility for intelligent expansion. This enables students to master core skills while developing a composite ability structure oriented towards the intelligent era. Secondly, efforts should be made to develop intelligent integrated courses and digital textbooks based on the work process orientation. Using typical work tasks as a clue, integrate the practical application of AI tools in the work scenarios into the course content design. Develop interactive, adaptive and updatable digital textbook forms to ensure that the course content keeps dynamic synchronization with the technological iteration of the industry. Moreover, digital literacy and human-computer collaboration ability should be officially incorporated into the training specifications and graduation requirements of each profession, transforming them from implicit expectations into explicit standards. This enables students to systematically form data thinking, intelligent tool application ability and human-computer collaborative operation ability beyond professional skills, laying a foundation for lifelong career development.

5.2 The Teaching Path: Innovating the Intelligent Teaching Model

The intelligent transformation of teaching models serves as a practical hub that connects intelligent technologies with educational goals. It needs to be advanced from multiple dimensions. First, a "virtual-real integration" blended practical training teaching approach should be implemented. Virtual simulation should be fully utilized to break through time and space limitations, reduce training costs, and ensure operational safety. At the same time, the irreplaceable nature of real training in terms of tactile perception, material recognition, and situational adaptability should be retained. A stepped teaching sequence of virtual training cognition and real skill practice should be formed. Second, a data-driven precise teaching and personalized tutoring model should be constructed. Through the continuous collection and analysis of learning behavior data, teachers can precisely identify the knowledge weak points and skill obstacles of the entire class and individual students, thereby achieving hierarchical setting of teaching goals, differentiated push of teaching resources, and targeted design of tutoring plans, and maximizing the approach to the educational ideal of individualized teaching within the framework of large-scale teaching. Third, a three-party collaborative teaching model of "AI tutor + enterprise master + professional teacher" should be explored. The AI tutor should undertake basic knowledge Q&A and standardized skill training, the enterprise master should provide experience transmission and process demonstration in real production scenarios, and the professional teacher should be responsible for teaching design coordination and in-depth guidance. The three parties should each display their strengths and cooperate with each other to reshape the labor division pattern of teaching.

5.3 The Faculty Path: Enhancing Teachers' Intelligent Competence

Teachers are the core drivers of the intelligent teaching transformation, and their qualities and capabilities directly determine the effectiveness of technology in educational scenarios. Firstly, a standard for teachers' intelligent literacy and a hierarchical training system should be established. A literacy framework should be constructed from dimensions such as intelligent technology cognition and understanding, application and operation of intelligent tools, intelligent integrated teaching design and

implementation, data interpretation and educational decision-making. Based on the development stage of teachers and differences in subjects, a progressive training plan should be designed to achieve a step-by-step advancement from general enlightenment to professional improvement. Secondly, efforts should be made to cultivate "dual-teacher + digital" teaching innovation teams, breaking the traditional model of individual teachers operating independently, and forming a cross-border collaborative team composed of professional leaders, key teachers, enterprise technical experts and educational technicians. In aspects such as intelligent course development, teaching mode innovation and teaching research, they should form synergy to drive the overall improvement of individual teachers' abilities. At the same time, the evaluation and incentive mechanism for teachers' intelligent teaching capabilities should be improved. The teaching application ability of intelligent technology should be included in the teacher's assessment and evaluation system. Effective incentives should be provided in aspects such as teaching achievement awards, professional title evaluation, and performance distribution to stimulate teachers' internal motivation to actively enhance their intelligent literacy and actively participate in teaching innovation.

5.4 The Evaluation Path: Establishing the Intelligent Evaluation System

The evaluation system has a powerful guiding function, and its intelligent reconfiguration is an important guarantee for the empowerment of talent cultivation by artificial intelligence. Firstly, a learning evaluation platform based on big data should be constructed, connecting multiple data interfaces such as teaching platforms, training systems, and internship management systems. Data collection and comprehensive analysis of students' knowledge acquisition, skill training, project practice, and professional qualities should be carried out throughout the process in a continuous manner, using data to enrich the evaluation basis and compensating for the shortcomings of summative evaluation through process evaluation. Secondly, the intelligent connection of "1+X" certificates and ability value-added evaluation should be implemented. By using intelligent analysis technology, a mechanism for mutual recognition of learning outcomes and ability profiling between academic certificates and vocational skill level certificates should be established. At the same time, through the longitudinal tracking of process data, the quantitative analysis of each student's ability growth amplitude should be realized, guiding students to shift their focus from paying attention to one-time examination results to paying attention to their continuous progress, and making the evaluation truly serve the growth of students. Thirdly, a diversified evaluation mechanism involving school and enterprise collaboration should be established. Industry enterprise standards and job ability requirements should be systematically embedded in the evaluation index system. Enterprise mentors should be involved in the evaluation of students' practical performance, empowering the teaching evaluation standards to effectively connect with the employment standards of the industry, and enhancing the social recognition of the evaluation results and the industrial compatibility of the talent output.

5.5 The Governance Path: Optimizing the Intelligent Governance Ecosystem

A favorable governance environment is the institutional foundation and environmental protection for the sustainable development of vocational education empowered by artificial intelligence. Firstly, it is necessary to improve the data governance and privacy protection system, clearly define the scope boundaries, usage permissions and circulation rules of educational data, establish a data classification management system and a security protection system for the entire life cycle, effectively safeguard the data rights and privacy security of teachers and students, and seek a dynamic balance between data utilization and privacy protection. Secondly, it is necessary to build an intelligent resource co-construction and sharing mechanism for industry-academia integration, break through the resource barriers between schools and enterprises, between colleges and universities, and among regions, establish a collaborative development and resource sharing platform with multi-party participation, shared benefits, and cost sharing, promote the cross-regional flow and inclusive application of high-quality virtual simulation training resources, digital course resources and enterprise case libraries, and narrow the digital gap. At the same time, it is necessary to improve the ethical norms and risk prevention system for the application of artificial intelligence, address potential risks such as algorithm bias, technological dependence, and alienation of human-machine relationships, formulate ethical guidelines covering the entire process of design development, deployment application and effect evaluation, establish algorithm review, human intervention and appeal relief mechanisms, transform the "people-oriented" value principle into operational and accountable institutional arrangements, and ensure that artificial intelligence always operates in the track of education in an orderly manner.The five-dimensional practical path system is shown in Figure 2.

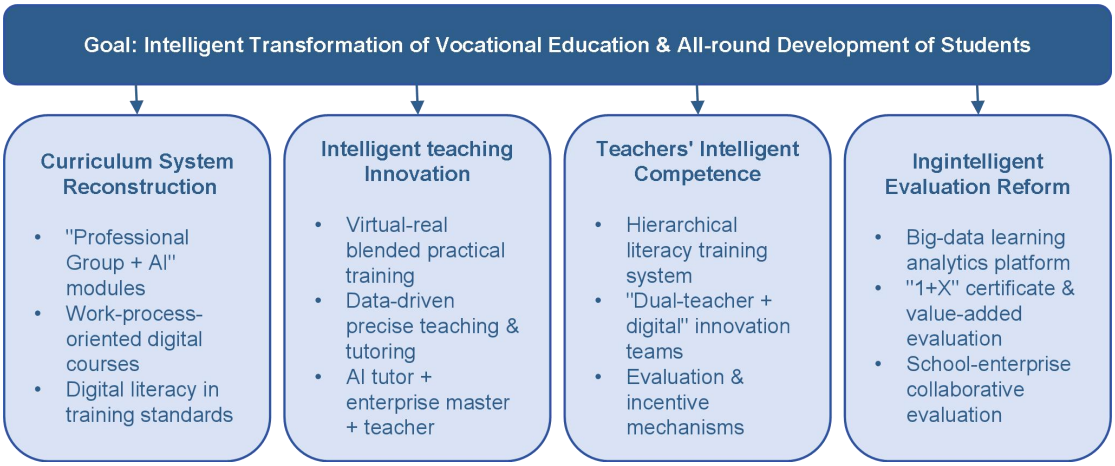


Figure 2. The Five-dimensional Practical Path System of AI-Empowered Talent Cultivation in Vocational Education

6. Conclusion

The deeper challenge lies in the deviation of the value axis. The technology-oriented mindset leads to "emphasizing hardware over concepts, efficiency over education". The technical logic overrides the educational logic, weakening the fundamental purpose of all-round human development. The primary task of the intelligent transformation lies in returning to the original educational focus and establishing the basic stance of "people-oriented, technology-utilized". The current transformation presents a phased characteristic of "combining soft and hard aspects" and a structural shortcoming of "lack of coordination". Infrastructure renovation and teaching process intervention are carried out simultaneously and mutually support each other. However, data silos, resource gaps, and institutional obstacles constitute key bottlenecks. It is urgently necessary to move from a single scenario to a systematic ecological construction. The systematic design of the promotion path is a necessary condition for moving from local exploration to overall breakthrough. The five paths of curriculum reconstruction, teaching innovation, teacher improvement, evaluation transformation, and governance optimization are interlinked. Only by comprehensively promoting can a sustainable reform synergy be formed. The ultimate proposition lies in the continuous adjustment of the relationship between humans and technology. Issues such as data privacy, algorithm bias, technology dependence, and teacher subjectivity are essentially exploring how to maintain the independence of education and the status of human subjects when technology is involved in education. It is necessary to maintain a necessary tension between technological innovation and humanistic care to make artificial intelligence a constructive force promoting the high-quality development of vocational education, rather than an alien presence outside the essence of education.

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