Article

Research on the Path of Digital Transformation of Higher Vocational Education Empowered by Artificial Intelligence

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Abstract: The advancement of artificial intelligence, particularly the rapid evolution of large-scale models and generative AI (GenAI), has ushered in a new phase for the digital transformation of higher vocational education. This paper examines the imperative for this digital shift, assesses the current state of AI technology and its educational implications, and investigates pathways for AI-facilitated digital reform in vocational institutions. Aiming to enhance student learning outcomes and employability, the study puts forward a "four-dimensional integration" framework. This framework comprises the development of intelligent teaching systems, the enhancement of instructors' digital competencies, the advancement of smart education management, and the fostering of digital integration between industry and education. Leveraging AI enables higher vocational education to significantly improve its quality and efficiency, thereby producing high-quality technical talent equipped for the digital economy.

Keywords: artificial intelligence; higher vocational education; digital transformation

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1. Introduction

In recent years, the national strategy has placed significant emphasis on the digital evolution of higher vocational education, with a series of policy directives issued to accelerate educational modernization. The 2019 National Implementation Plan for Vocational Education Reform explicitly called for the "initiation of a digitalization strategy for vocational education." Subsequent policy documents, including the 2022 "Opinions on Deepening the Reform of Modern Vocational Education System Construction," further stressed the critical need to "vigorously promote the digital transition of vocational education." The "Outline of the Plan for Building a Strong Education Nation (2024-2035)," released in early 2025, formally proposed the implementation of a national educational digitalization strategy, underscoring the role of AI in driving educational innovation and the "digital transformation of vocational education." In April 2025, the "Opinions on Accelerating the Advancement of Education Digitalization" provided a systematic deployment plan, highlighting key areas such as vocational education and the innovation of teaching and management models. Furthermore, the July 2025 "Circular on Organizing the Digital Empowerment for Teacher Development Initiative" focused on elevating teachers' digital literacy and integrating AI into pedagogical practices. The digital transformation of higher vocational education is thus both a strategic priority and a practical necessity.

From an industrial perspective, Stanford University's "2025 Artificial Intelligence Index Report" indicates that corporate adoption of generative AI has surged from 33% to 71%, signaling AI's transition from a peripheral tool to a core business driver. As AI enters a phase of "widespread application," it generates urgent demand for new talent structures and professional skills, thereby compelling higher vocational education to accelerate the digital updating of curricula and competency standards. On the educational supply side, national 2024 statistics reveal continued expansion in enrollment and institutional scale

within higher vocational education (including vocational undergraduate and specialized programs), with the average size of higher vocational institutions exceeding 10,000 students. The growth rate of vocational undergraduate programs is particularly notable, reinforcing the role of higher vocational education as the primary training ground for technical and skilled professionals. This context necessitates a data-driven, intelligently-enhanced approach to improve training quality, enable personalized education, and enhance the efficiency of industry-academia collaboration.

Amid the global push for a digital economy, currently characterized by an "AI+" paradigm and data-driven development, higher vocational education systems worldwide are actively exploring digital transformation. However, this process faces challenges such as insufficient innovation in teaching methodologies, uneven distribution of educational resources, and a need for improved digital literacy among educators. The rapid progress in AI technology offers novel solutions to these issues. By deeply integrating AI into teaching, management, and evaluation processes, higher vocational education can achieve intelligent instruction, precise resource allocation, and personalized student learning, thereby effectively driving its digital transformation and elevating the quality of talent cultivation.

2. The Imperative for Digital Transformation in Higher Vocational Education

2.1. Adapting to the Rapidly Evolving Digital Economy

According to the National Development and Reform Commission, the value-added output of China's core digital economy industries accounted for 10.4% of GDP in 2024, establishing the digital economy as a major engine of national economic growth. In this era, industrial digital and intelligent transformation has accelerated, dramatically increasing the need for high-quality technical talent equipped with digital skills and innovative capabilities. As the primary base for cultivating such talent, higher vocational education must accelerate its digital transformation, adjust its program offerings and curriculum systems, integrate digital technology into teaching content, and develop versatile graduates who can meet the demands of the digital economy. For instance, in smart manufacturing, the extensive application of technologies like the Industrial Internet and AI has created a high demand for skilled professionals capable of operating, maintaining, and managing intelligent equipment. Through digital transformation, vocational colleges can establish relevant programs and utilize digital means such as virtual simulation and intelligent teaching platforms to conduct instruction, thereby effectively enhancing students' practical abilities and digital literacy to meet enterprise needs. Educational digitalization is not only an inevitable outcome of technological architectural change and knowledge explosion but also a necessary stage in China's educational informatization construction and a key feature of its modernization [1].

2.2. Enhancing Educational Quality and Efficiency

Traditional higher vocational education faces issues in teaching models and resource allocation that hinder improvements in quality and efficiency. For example, the teaching process often employs a "one-size-fits-all" approach, struggling to meet individualized learning needs; educational resources are distributed unevenly, with a relative shortage of high-quality resources in certain regions and institutions; and teaching management methods are often inefficient, lacking precise data support and scientific decision-making. The digital transformation of higher vocational education can effectively address these problems. By comprehensively altering the traditional educational ecology, it strengthens the holistic cultivation of students' knowledge, skills, and comprehensive literacy, enabling vocational colleges to fulfill their mission of producing high-quality technical talent.

2.3. Advancing National Educational Equity

China's vast territory leads to significant disparities in economic development and educational resources between regions, with the uneven development of higher vocational education between regions and between urban and rural areas being particularly pronounced. Some vocational colleges in remote and rural areas suffer from outdated teaching facilities, weak faculty, and limited student access to quality educational resources. To break this imbalance, digital transformation is necessary to achieve the sharing of digital educational resources, such as online courses and virtual simulation experiments, allowing students in remote areas to access high-quality teaching content and enjoy educational opportunities comparable to those in developed regions. Digital governance within higher vocational institutions still faces practical challenges, including obstacles in technical personnel and resource security, imbalances among multiple stakeholders and rights relationships, and conflicts between institutional security systems and organizational structures [2].

3. Current Developments in AI Technology and Its Impact on Education

3.1. The Evolution of AI Technology: From LLMs to Multimodal, Real-Time, and Low-Cost Systems

In recent years, AI technology has exhibited four major development trends: multimodality, powerful inference, low latency, and embodied intelligence. The 2024 release of GPT-4o, an "end-to-end multimodal" model, demonstrates real-time inference across text, image, and speech, with improved performance on non-English texts and complex visual tasks. It also significantly reduces API costs and latency, facilitating classroom interaction, real-time feedback, and assisted assessment scenarios. Concurrently, the open-source ecosystem is developing rapidly. Models like DeepSeek-V3 achieve capabilities comparable to cutting-edge closed-source models at lower training costs, promoting the construction of "controllable, locally deployable, and customizable" teaching, research, and training platforms, thereby reducing R&D costs for colleges and enterprises. Robots integrated with large models are achieving more natural physical interaction, haptic feedback, and dynamic environment adaptation, forming a "perception-thinking-action" closed-loop system that moves intelligence from virtual computation to execution in the physical world, making them highly applicable to vocational education processes.

3.2. The Impact of AI Technology on Education: Systemic Change in Teaching, Learning, Evaluation, and Governance

3.2.1. Driving Innovation in Educational Models

In daily teaching and learning, AI technology utilizes big data analysis and intelligent algorithms to gain precise insights into students' learning progress, abilities, and interests, creating tailored learning paths and feedback for each student. The widespread use of intelligent teaching tools, such as automated lesson planning systems, online learning platforms, and virtual assistants, has greatly reduced teachers' preparatory burdens and increased teaching efficiency. Generative AI enables "human-computer co-teaching," significantly enhancing the efficiency and reach of classroom questioning, formative feedback, and personalized tutoring. Virtual Reality (VR) and Augmented Reality (AR) technologies create immersive and intuitive learning experiences. Through virtual laboratories and classrooms, students can practice and explore in a safe environment, deepening their understanding and retention of knowledge. Multimodal capabilities also enable the simulation of technical skill-based courses, process recording, and instant error correction, narrowing the gap between virtual and real-world training. In 2024, the national smart education platform launched the "AI Learning" column and initiated the "Demonstration Action for Large Model Applications in the Education System," signaling the full-scale implementation of AI-assisted education. The digital transformation of higher vocational

education liberates learning from temporal and spatial constraints, moves beyond theoretical textbook knowledge, and improves teaching efficiency [3].

3.2.2. Facilitating a Shift in Teacher-Student Dynamics

In the AI era, the teacher's role is substantially transformed from a mere knowledge transmitter to a guide and collaborator in the student learning process. Teachers can leverage intelligent tools and resources to conduct instructional design, delivery, and assessment more efficiently, while devoting more energy to monitoring students' learning processes and overall development. Intelligent teaching systems offer students convenient access to ask questions and seek help from teachers anytime, anywhere. Teachers, in turn, can use these systems to understand student needs and difficulties promptly, providing effective support and guidance. This new form of interaction fosters a more democratic, equitable, and participatory educational process. For example, by analyzing student behavioral data, AI systems can accurately identify individual learning personalities and characteristics, providing early warnings for potential issues and offering teachers deeper insights into student situations, along with relevant recommendations.

3.2.3. Optimizing Education Management

The application of AI technology promotes the development of education management toward greater intelligence and efficiency. Institutions can use big data and AI to conduct comprehensive monitoring and in-depth analysis of students' academic performance, behavioral conduct, mental health, and other aspects, providing a scientific basis for educational decision-making and improving the implementation of management strategies. Simultaneously, AI can offer scientific references for education policy development. Through the comprehensive analysis and evaluation of educational data, it enables a more accurate understanding of the current state and needs of education, thereby facilitating the formulation of more scientific and rational education policies [4].

4. Pathways for AI-Empowered Digital Transformation in Higher Vocational Education

With the goal of improving student learning effectiveness and employment competitiveness, we propose building three foundational pillars—data, algorithms, and computing power—to support the transformation. This involves forming a standardized and credibly shared data repository, deploying an algorithm base powered by a general large model plus education-specific models, and adopting a flexible, cost-effective computing power base. These support six major application areas: curriculum and teaching, evaluation and assessment, practical training and industry-academia integration, teaching research and teacher development, educational governance and quality assurance, and open education and lifelong learning. The transformation is guided by several principles: the unification of generative lesson planning and personalized learning paths; the integration of process evidence and competency certification; the creation of a data closed-loop through virtual-real combination and school-enterprise collaboration; the trinity of AI literacy, subject teaching, and industry practice; a shift from empirical to evidence-based decision-making; and the expansion of a symbiotic system for "academic + vocational" provision. The transformation focuses on four key directions: constructing an intelligent teaching system, strengthening teachers' digital literacy, improving smart education management, and promoting the digital development of industry-academia integration, all underpinned by two guarantees: ethical governance and ecological synergy [5].

4.1. Constructing an Intelligent Teaching System

4.1.1. Developing Intelligent Curriculum Resources

Aligning with industry needs and professional characteristics, develop diverse and rich intelligent curriculum resources using AI technology. Create virtual training courses

based on VR and AR technologies, allowing students to practice in virtual environments and enhance their hands-on and problem-solving abilities. Utilize AI tools to produce micro-lectures, instructional animations, and other digital teaching resources to enrich content delivery. Establish a curriculum resource sharing platform to enable the sharing of high-quality resources between institutions and regions, improving resource utilization efficiency. Digital transformation provides higher vocational education with more diversified teaching resources and methods, facilitating the alignment of talent cultivation with market demands.

4.1.2. Implementing Personalized Teaching

The learning analysis system collects and analyzes data on students' learning behaviors, achievements, and interests to build a learning profile for each student, identifying their learning styles and needs. Based on these profiles, teachers formulate personalized teaching plans and programs, pushing suitable learning resources and tasks to students.

4.1.3. Conducting Intelligent Teaching Evaluation

Establish an intelligent teaching evaluation system to conduct comprehensive, all-round, and whole-process assessments of students' learning processes, outcomes, practical abilities, and innovation skills. Collect and analyze learning process data, such as classroom participation, online learning duration, and homework completion, to understand students' learning attitudes and efforts, providing real-time assessment and timely feedback on learning effectiveness.

4.2. Enhancing Teachers' Digital Literacy Training

4.2.1. Implementing Digital Literacy Training Programs

Incorporate digital literacy training into teachers' professional development plans, creating systematic training programs. Organize thematic training sessions on the application of AI in education, inviting experts and scholars to give lectures and share cases, helping teachers understand AI application scenarios and methods in teaching [6]. Provide training on the use of digital teaching tools, such as online teaching platforms, intelligent teaching software, and VR equipment, to improve teachers' proficiency with these tools. Through training, teachers will master the methods and skills of digital instructional design, enabling them to create teaching plans that meet the requirements of digital education based on learning objectives and student characteristics [7].

4.2.2. Establishing Incentive Mechanisms for Digital Literacy Improvement

Link teachers' digital literacy levels to professional title evaluations, performance assessments, and merit recognition, rewarding those who excel in digital teaching. Establish digital teaching innovation projects to encourage teachers to engage in digital teaching reform practices and research.

4.2.3. Promoting Digital Teaching Exchange and Collaboration

Organize digital teaching seminars, teaching observation activities, and other events, providing opportunities for teachers to share experiences and insights from digital teaching practices and learn from each other. Establish teaching teams and encourage cross-disciplinary and cross-specialty collaboration among teachers to jointly develop digital courses and conduct teaching reform research, enhancing their digital literacy and teaching capabilities through teamwork.

4.3. Improving Intelligent Education Management

4.3.1. Building an Intelligent Campus Management Platform

Increase investment in intelligent campus management platforms, integrating various institutional systems such as teaching management, student management, and logistics management to achieve data interconnection and sharing. Through this platform, schools can monitor and manage the teaching process, student behavior, campus safety, and other aspects in real time. For example, use intelligent attendance systems to track student attendance in real time; employ campus security monitoring systems combined with AI image recognition technology to warn of and address safety hazards promptly. The platform also provides data support for institutional decision-making, offering a scientific basis for development planning and resource allocation through the analysis of various data types.

4.3.2. Enabling Data-Driven Management Decisions

Leveraging big data and AI technology, support institutional management decisions by collecting and analyzing data on teaching, students, faculty, and other areas, uncovering patterns and trends behind the data. For example, analyze student employment data to understand market demand for different specialties, informing program establishment and adjustment; analyze teaching quality data to identify issues in instruction and provide targeted suggestions for teacher training and development.

4.3.3. Optimizing Educational Resource Allocation

Analyze and evaluate the use of educational resources to achieve optimal allocation. For instance, analyze data on the usage frequency and failure rate of teaching equipment to rationally plan procurement, maintenance, and renewal; analyze classroom usage data to optimize scheduling and improve classroom utilization rates.

4.4. Promoting the Digital Development of Industry-Academia Integration

Build a digital industry-academia integration platform to enable information sharing, resource exchange, and cooperation between schools and enterprises. Integrate enterprise production practice resources and technology R&D capabilities with school teaching and talent resources, providing students with more practical opportunities and internship positions. Through the platform, facilitate the alignment of enterprise projects with school curricula, allowing students to participate in the development and implementation of real enterprise projects, enhancing their practical abilities and professionalism. Utilize virtual simulation training platforms to enable students to conduct production internships and job training in virtual environments, thereby mitigating issues such as limited internship availability and workplace safety concerns [8].

5. Conclusion

The rapid development of AI technology presents unprecedented opportunities for the digital transformation of higher vocational education. Through pathways such as constructing intelligent teaching systems, strengthening teachers' digital literacy, improving smart education management, and promoting the digital development of industry-academia integration, higher vocational education can significantly enhance its quality and efficiency, cultivating high-quality technical talent capable of meeting the demands of the digital economy era. However, the process of AI-empowered digital transformation also faces challenges, including security and privacy protection in technology application, teacher adaptation to new technologies, and imperfect synergy mechanisms in industry-academia integration. In the future, it is necessary for the government, schools, enterprises, and other stakeholders to collaborate, strengthening policy support and guidance, in-

creasing investment in technology R&D and application, enhancing teacher training, improving industry-academia integration mechanisms, and promoting the deep integration of AI and higher vocational education to achieve high-quality development. Simultaneously, further research on the application of AI technology in education is essential to explore its application rules and patterns, providing a more solid theoretical foundation for the AI-empowered digital transformation of higher vocational education.

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