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Original Paper

The Value Implications, Risk Manifestations, and Governance Strategies of Artificial Intelligence Application in Vocational Education

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Abstract

As the wave of technological revolution driven primarily by artificial intelligence sweeps across all industries, vocational education—as the key arena for cultivating technical and skilled talent—must proactively adapt to contemporary demands. The deep integration of artificial intelligence and vocational education has become the critical pathway to breaking through the developmental bottlenecks. The rapid advancement of artificial intelligence and its widespread application in education present both opportunities and risks in driving high-quality development and digital transformation. By delving into the value implications of AI in vocational education, this paper points out risks such as algorithmic hegemony,diminished subjectivity of teachers and students, data privacy breaches and ethical disorder in security, and digital divide and disparities in educational equity. It proposes countermeasures:reshaping agency and cultivating autonomous abilities, fortify data security defenses and standardize usage processes, and promoting educational equity and balanced resource allocation. These strategies will ensure AI truly empowers vocational education rather than becoming a constraining force.

Keywords

vocational education, artificial intelligence, ethical risks, governance strategies

1. Introduction

In the era of digitalization and informatization, artificial intelligence (AI) technology, as the core engine of the new round of technological revolution, is rapidly integrating into all sectors of the socio-economic system. The development of the digital economy has further heightened the demand for high-quality technical and skilled talents. As a pivotal platform for cultivating such talents, vocational education is in urgent need of breaking the shackles of traditional teaching models. To implement the *The 2024-2035 Master Plan on Building China into a Leading Country in Education*, promote AI-enabled educational reform, and leverage educational digitalization to open up new development tracks and shape new competitive advantages, it is essential to realize mutual empowerment between vocational education and technology. The *Opinions on Accelerating the Advancement of Education Digitalization,* jointly issued by the Ministry of Education and eight other departments in April 2025, outlines implementation pathways centered on three core directions: integration, intelligence, and internationalization. It upholds the principle of expanding the coverage of benefits from high-quality educational resources through digital empowerment, thereby laying a solid guarantee for proactively responding to the new wave of technological and industrial transformation and accelerating the development of an education powerhouse.

Leveraging technological advantages such as personalized teaching, virtual simulation, and employment matching, artificial intelligence (AI) is reshaping the teaching formats, resource allocation methods, and talent cultivation models within the education sector. It has emerged as a pivotal force for driving the high-quality development of vocational education and adapting to industrial upgrading. When introducing AI technology into the education field, it is essential to conduct an in-depth analysis of its inherent logic and carefully assess the potential risks and corresponding governance strategies during the process of their convergence.

2. The Value Implications of Artificial Intelligence Application in Vocational Education

2.1 Personalized Learning Pathways and Dynamic Teaching Strategies

First is personalized learning. Learners exhibit heterogeneous learning abilities, knowledge foundations, learning styles, and preferences due to differences in their growth experiences, competency levels, innate aptitudes, and developmental aspirations. This renders personalized learning an indispensable requirement for vocational education. In traditional vocational education, instructors typically adopt large-scale, one-size-fits-all teaching models with similar content delivery, making it challenging to accommodate individual learner differences. The integration of AI reshapes this scenario: it functions not merely as a "tool" for providing standard answers but rather as a learning companion that supports the learning process.To comprehensively capture students' learning styles, knowledge mastery, and progress, AI leverages interactive data collection and machine learning algorithms to continuously track and analyze learning data—including classroom performance, exercise feedback, and practice outcomes. This enables the precise identification of each student's strengths and weaknesses, thereby facilitating the development of personalized learning plans and targeted instruction. Through this new model of human-AI collaborative teaching, AI-driven large-scale individualized learning (consistent with the educational principle of "teaching students in accordance with their aptitudes") is realized, ultimately enhancing both the efficiency and quality of teaching and learning.A typical example is "Zhixing Grandmaster"—a vocational education-specific large model developed by Guangdong Polytechnic of Science and Technology. With the "Zhixing" model as its foundation, the platform develops intelligent agents such as intelligent study companions and Python programming assistants.And it aims to provide comprehensive, personalized teaching support services covering four dimensions: "AI+Tutoring, Teaching, Training, and Management". Specifically, it supports learners in personalized study, enables teachers to deliver precision teaching, and facilitates intelligent evaluation for both teachers and students.

Second, real-time evaluation feedback and dynamic teaching strategies. Artificial Intelligence (AI) technology can leverage various sensors and learning management systems to collect real-time multidimensional behavioral data, including students' operational performance, duration of cognitive pauses, collaborative engagement, and assessment feedback. This data then undergoes continuous pattern recognition and trend prediction (assessing knowledge mastery, cognitive development levels, and actual learning effectiveness), subsequently generating multidimensional student learning diagnostic reports. These reports integrate cognitive diagnostic results, skill gap localization, and development recommendations.A pivotal advantage of this system is its ability to deliver timely feedback and improvement suggestions to students when they encounter comprehension deviations or operational mistakes during the learning process. This support helps students adjust their learning strategies, thereby facilitating early intervention and improving learning efficiency. For educators, learning diagnostic reports enable dynamic adjustments to teaching plans and instructional approaches: instructors can flexibly modify the difficulty of course content, select more contextually appropriate teaching resources, and implement precision instructional interventions. This transformation shifts the traditional remedial model—where issues are addressed only after they emerge in the teaching process—to a proactive growth guidance approach, ultimately enhancing the overall effectiveness of teaching.

2.2 Aligning Talent Development with Societal Demand

2.2.1 Dynamic Alignment of Curriculum Systems with Industry Demands

Emerging industries continue to emerge and grow, with artificial intelligence (AI) integrating into the core links of various sectors. This accelerates the digital and intelligent transformation of industries, directly driving industrial model transformation while triggering continuous changes in talent demand. Vocational colleges should proactively lay out digital-focused programs and disciplines in line with industry needs, strengthen curriculum reform, and empower deep industry-education integration—ensuring that graduates possess core skills meeting market demands.

Leveraging the data-driven nature of AI enables precise alignment between talent development and societal demands. AI organizes and analyzes industrial dynamic data—including corporate recruitment needs, technical patent application documents, and industry development reports—to accurately grasp industry development trends and job skill requirements, thereby developing predictive models for industrial talent demand. Vocational colleges dynamically adjust their program offerings, teaching content, and training plans accordingly, adding relevant digital courses and AI practical projects.Taking the industrial robotics field as an example: when talent demand in this field increases, the smart manufacturing programs of vocational colleges should expand relevant course content and update case studies as well as practical projects in accordance with relevant requirements. Furthermore, enterprises should participate in curriculum design and teaching processes by providing real project cases and practical opportunities. This ensures the timeliness and practicality of teaching content (Cai, 2025), enabling students to acquire knowledge and skills adaptable to future industrial technological transformations. It also guarantees that graduates can quickly qualify for positions after graduation, promoting seamless integration between education and industry.

2.2.2 Developing career Profiles to Enhance Career Fit

Through data processing and analysis, cognition and decision-making, and interaction and execution, artificial intelligence (AI) technology performs two key functions: on one hand, it accurately depicts students' multifaceted competency performances; on the other hand, it conducts in-depth analysis of industry job requirements and dynamic trends. Ultimately, this effectively bridges the matching gap between students' capabilities and industry demands, enhancing students' career fit and employment competitiveness.For instance, the Beisen Career Education Integration Platform (hereinafter referred to as "Beisen Platform") integrates six core functions: "teaching, learning, management, assessment, evaluation, and employment"—offering targeted solutions such as comprehensive student evaluations, online lectures by renowned professors, and intelligent internship matching. This empowers students to develop personalized career plans and embark on their professional exploration journey, ultimately achieving both high employment rates and quality job placements.

Specifically, students upload information including their academic records, practical experience, and skill competition achievements to the intelligent career service platform. The platform then analyzes and integrates this information, extracts students' performance characteristics across various dimensions, and develops individual competency profiles. Using these profiles, the platform dissects the talent requirements and skill demands of corresponding career positions, further identifying the most suitable career fields, position types, and development directions for each student. Additionally, it provides competency improvement plans and career planning recommendations based on students' core competencies and competency gaps.For example, after analyzing a computer science student's data, the platform identifies strong practical abilities in software development, participation in multiple projects, and a keen interest in artificial intelligence. Based on this analysis, the platform recommends AI-related software development positions, providing relevant company recruitment information and job requirements. Simultaneously, it develops a tailored career path based on the student's profile, advising further study in AI to enhance competitiveness in this field.

2.3 Immersive Learning Environments and Blended Reality Training

Intelligent interactive technologies enable the construction of immersive learning environments for vocational education through real-time interactivity and visualization. During theoretical teaching, Virtual Reality (VR) and Augmented Reality (AR) technologies can transform abstract knowledge into observable, interactive knowledge scenarios or 3D models,complementing traditional static explanations to deepen students' concrete understanding of complex concepts.For instance, in a Mechanical Fundamentals course, students scanning textbook illustrations with AR software can intuitively observe the structural composition and meshing process of gear transmissions by adjusting perspectives. Instructors, meanwhile, can create disassembly/assembly demonstration videos of flange couplings using virtual simulation software, showcasing operational details of sequence and critical steps to help students rapidly grasp component assembly relationships.

In traditional vocational education practical training, physical experimental equipment and real-world work scenarios serve as indispensable core pillars,which not only imposes pressure on teaching costs but also imposes significant constraints on time and space. Intelligent interactive technologies address this issue by creating realistic virtual vocational environments,enabling students to conduct practical operations under safe, controlled conditions while providing real-time operational guidance and feedback.In virtual training, Shanghai Nanhu Vocational & Technical College has widely applied 5G+XR (Extended Reality) technology across four professional clusters. The "5G+XR" teaching and training content for new energy vehicles consists of three modules: virtual courseware, training videos, and virtual-physical interactive training. In this teaching environment, after completing the corresponding vehicle computer modeling and equipping students with XR headsets, students log in with their credentials to participate in training and assessments covering modules such as high-voltage protection, structural disassembly, assembly and maintenance, and drive motors for intelligent new energy vehicles."5G+XR" provides step-by-step operational guidance through holographic virtual images, enhancing the realism of the training. For example, when students need to install a component at a specific location during maintenance, the system automatically displays the component's image, along with information about the required tools and installation methods. Additionally, multi-user interaction is supported: teachers, students, and trainees can share the images displayed on the XR headsets, facilitating real-time communication and targeted guidance on specific issues.

2.4 Automated Generation and Intelligent Sharing of Teaching Resources

Traditional vocational education exhibits notable shortcomings in the generation and sharing of teaching resources.On one hand, traditional resource development relies heavily on the experience and time investment of instructors or experts,which not only consumes significant time and effort but also leads to delayed content updates and disconnects between textbook content and actual production technologies. On the other hand, high-quality resources are concentrated in a small number of key institutions or large enterprises, creating prominent resource barriers between regions, as well as between schools and enterprises. Consequently, many vocational colleges struggle to access cutting-edge educational resources due to resource constraints.

In the field of automated resource generation, artificial intelligence (AI) possesses robust text-generation capabilities, enabling it to produce teaching resources tailored to the needs of educators and students. The automated generation of teaching resources not only reduces resource development costs but also achieves real-time synchronization with industry technologies, ensuring the timeliness of teaching content. Specifically, when users input specific topics and demand instructions, AI adheres to the core of the needs, systematically integrates knowledge in relevant fields, adjusts linguistic styles based on the application scenarios appropriate for the content, and generates high-quality, diversified learning resources that precisely meet the specified requirements.In practical teaching, leveraging generative AI technology, educators can efficiently create diversified teaching materials such as reference lesson plans, practice questions, and skill-training videos. This reduces the time and effort invested in lesson preparation, allowing teachers to focus on personalizing the learning process and providing skill guidance. For students, AI tools like NOLEJ enable the rapid generation of digital learning capsules—these capsules include rich content such as interactive videos, vocabulary lists, practice exercises, and summaries of target topics.

In the field of resource sharing, AI can support the construction of platforms such as Smart Education of China to integrate premium digital courses across disciplines, virtual simulation practical training centers, and programs for teacher competency enhancement and Intelligent Teaching and Research. This enables impoverished regions to timely access cutting-edge teaching resources, thereby breaking traditional resource barriers. Meanwhile, AI's intelligent and automated resource generation capabilities facilitate wider dissemination and sharing of high-quality teaching resources. This not only effectively alleviates resource shortages in vocational colleges in underdeveloped regions but also narrows educational disparities between regions and between schools and enterprises, ultimately ensuring that the outcomes of educational development benefit all teachers and students.

3. Risk Manifestations of Artificial Intelligence Application in Vocational Education

3.1 Algorithm Hegemony and Diminished Subjectivity

When AI reaches an intelligent level capable of "understanding and creating," it deeply intervenes in teaching as an autonomous and proactive educational element, restructuring the "teacher-machine" and "student-machine" interaction relationships (Yang, 2023). This triggers significant ethical dilemmas. The growing dependence of educators and students on AI not only weakens their subjective initiative but also gradually undermines their decision-making capabilities and creativity.

3.1.1 Diminished Subjectivity

First, the undermining of students' learning autonomy. Learners' initiative, creativity, and critical thinking abilities are core competencies in vocational education talent cultivation, which determine whether high-quality digital technical and skilled talents adaptable to social needs can be cultivated. When students use intelligent education systems for learning, the systems generate optimal learning paths based on their interests and needs. However, these predefined paths force students to cede their autonomy in learning decision-making to algorithms, further fostering the"comfort zone effect"—a phenomenon where learners gradually lose active control over their learning processes due to over-reliance on system-recommended learning plans, resulting in deficiencies in higher-order cognitive abilities such as in-depth understanding, critical thinking, and analytical reasoning (Zhou, 2023). By simplifying the knowledge acquisition process when generating teaching content, AI traps students in a long-term comfort zone. This not only deviates from the essence of exploratory learning emphasized by Dewey’s "experience growth" theory but also reduces students' learning interest and intrinsic motivation. If such cognitive inertia persists into the vocational competency cultivation stage, it will directly lead to students lacking the critical awareness and innovative drive to break through existing frameworks when facing complex workplace problems in the future.

The second is the deterioration of the professional capabilities of educators. The core manifestation is the dissolution of autonomy in teaching decision-making and the decline in innovative motivation. When intelligent education systems mass-produce standardized lesson plans, student learning diagnostic reports, and even classroom interaction scripts, teachers may gradually rely on technical outputs to replace their own professional judgments. This causes the atrophy of their ability to deliver personalized teaching based on insights into student learning situations, while suppressing their enthusiasm for exploring innovations in teaching methods and content. Teachers' uncritical adoption of "ready-made solutions" from intelligent systems not only erodes the humanistic warmth of teacher-student interaction in traditional education and inhibits their intrinsic motivation to dynamically innovate teaching methods in combination with industry practices but also poses a challenge to the core goal of vocational education—cultivating innovative skilled talents.

3.1.2 The Phenomenon of "Technological Instrumentalization"

The high efficiency and convenience of technology have gradually led people to develop an unconscious dependence on it. Over time,the expanding reliance plunges vocational education into a crisis of "technological instrumentalization", whereby both instructors and students come to regard technology as an indispensable or even default tool for problem-solving—ultimately making them subservient to technology rather than its masters. Habermas's concept of "communicative rationality" is increasingly supplanted by instrumental rationality in intelligent teaching scenarios. Teacher-student interactions devolve into information transmission mediated by technology and vocational education's traditional "apprenticeship system" also is significantly undermined and weakened. The nature of the classroom undergoes alienation, transforming into an assembly line for producing "technologically compliant entities." In this process, students become such entities rather than "professional creators" (Jiao, 2023). At the core of this alienation lies the deconstruction of vocational education's fundamental goal of "whole-person development" at the technological level—the true purpose of vocational education is to cultivate individuals' comprehensive abilities to adapt to dynamic occupational environments. Therefore, in constructing an intelligent education ecosystem, it is essential to establish a dynamic balance mechanism between technology-assisted learning and autonomous learning. This approach must leverage the advantages of intelligent teaching while preserving necessary cognitive challenge space for learners.

3.2 Data Privacy Breaches and Ethical Disorder in Security

3.2.1 Boundary Disorder in Data Collection

The effective application of artificial intelligence (AI) in vocational education relies on massive volumes of multi-source data. However, the issue of excessively intrusive data collection has become increasingly severe, threatening students’ privacy security and undermining educational public trust. Some vocational colleges have introduced intelligent teaching devices to collect real-time student behavioral data, analyzing students' focus through physiological signals such as pupillary focus, facial micro-expressions, and heart rate changes.For instance, a vocational and technical college in Ningbo installed digital cameras at workstations in its Refrigeration and Air Conditioning Training Center and New Energy Vehicle Engineering Training Center to continuously record students' practical operations. AI-powered classroom instructional behavior analysis systems assess individual and class-wide in-class attentiveness, students' positive behaviors, and emotional states to support instructional reflection. While this technology enables the observation, recording, and evaluation of the entire student learning process—further facilitating precision teaching and optimized learning pathways—the actual data collection process lacks clear regulations regarding its scope and scale. Critical questions remain undefined: whether data collection is based on lawful authorization, and whether informed consent has been obtained from students.

Furthermore, to achieve precise career guidance, many vocational institutions collaborate with career planning platforms that excessively bridge educational settings with private domains. Beyond collecting essential information like academic records and vocational certificates, they unlawfully gather sensitive private data such as students' social media accounts, family financial status, and relatives' occupations. Over time, this will trigger a crisis of trust in data processing among students, infringe upon their privacy rights, and generate psychological pressure during their studies. This will limit their initiative and creativity in learning while undermining confidence in vocational education.

3.2.2 Trust Crisis in Data Circulation

In the data storage process, some vocational colleges exhibit significant security vulnerabilities. These institutions demonstrate weak data security awareness and inadequate technical support capabilities. When selecting storage services, they commonly adopt low-cost public cloud services, yet fail to implement essential data encryption measures or establish comprehensive access permission management mechanisms.Regarding specific data, sensitive data—such as skill training data, learning records, and teaching feedback—is extensively collected for training and optimizing AI-generated content (Wu, 2024). In contrast, core data (e.g., biometric data, geographic locations) is often stored on servers without permission tiering, resulting in a state of "unprotected data exposure". More critically, the lack of a technical protection system turns the storage process into a risk exposure point. Hackers can easily tamper with or steal information such as students' learning records and exam scores through basic network attacks, directly leading to a sharp increase in data leakage risks. This risk is particularly prominent in professional fields with extremely high data sensitivity, such as "medical care," "commerce," and "finance."

During data sharing, some school-enterprise cooperation projects see enterprises prioritize commercial interests over the public welfare nature of education, violating the cooperative public welfare principle stipulated in the Vocational Education Law. A typical manifestation is "secondary use" of data beyond educational contexts: institutions share student data with enterprises to enhance graduate employability, yet some companies, driven by commercial gain, repurpose or resell this data to third parties without authorization.For example, educational data—such as vocational competency assessments and practical training operations—is improperly used for non-educational purposes, including commercial marketing, employee screening, and even production line optimization. In one school-enterprise cooperation project, a company used students' machine tool operation data to optimize its own production line efficiency calculations, yet failed to pay any compensation to the data contributors, triggering disputes over "digital labor" rights. This ambiguity in data usage boundaries and imbalance in benefit distribution not only contradicts the original intent of industry-education integration in vocational education but also substantially impairs the legitimate rights and interests of students as data subjects.

3.3 Digital Divide and Disparities in Educational Equity

Artificial intelligence (AI) acts as a double-edged sword for educational equity. On one hand, it lowers barriers to accessing educational resources, enabling high-quality resources to transcend geographical and institutional boundaries for more equitable distribution, thereby injecting new momentum into educational equity. On the other hand, the rapid iteration of AI technology and disparities in its application may emerge as new variables affecting educational equity.

3.3.1 The Matthew Effect of the Digital Divide

As digital technology becomes deeply integrated into education, disparities in digital infrastructure and data literacy between regions and groups are exhibiting a Matthew Effect-style divergence—a pattern where "the rich get richer and the poor get poorer." In terms of infrastructure, vocational colleges in economically developed regions have greater funding and resources to invest in digital infrastructure, such as metaverse-based training labs, AI tutor systems, virtual simulation experiment systems, and intelligent training platforms. In contrast, institutions in economically underdeveloped regions struggle to afford advanced technological equipment and software due to funding shortages, remaining reliant on traditional teaching methods. Even within the same region, digital resource allocation varies significantly between schools: key vocational colleges often receive greater policy support and social resources, while ordinary vocational schools face resource scarcity. For instance, during the COVID-19 pandemic, at least 30% of students globally (500 million) were unable to benefit from remote education—predominantly those in impoverished and rural areas (Wu, 2024). This creates unequal access to quality educational resources, further widening the educational gap between regions and schools.

In terms of data literacy, as AI technologies undergo continuous updates and iterations, students' digital literacy must also develop in tandem to better adapt to the demands of technological change. Urban students have greater access to diverse digital technologies and tools, cultivating strong core competencies in information acquisitiyton, analysis, and technical application through prolonged practice. In contrast, rural students face limitations due to family environments and school educational conditions, resulting in fewer opportunities to engage with digital technologies. This leads to relatively lagging development in data literacy—particularly in the critical processing and innovative applications of digital information—creating a significant capability gap compared to their urban peers.

Students with high data literacy can use intelligent learning systems to efficiently develop personalized plans and participate in virtual training projects, thereby achieving precise enhancement of vocational skills. Conversely, students with low data literacy may fall into "technology dependence" or "operational gaps", placing them at a disadvantage in digital training participation and vocational competency assessments. Over time, the gap between these two groups in career development progress and educational outcomes will continue to widen. As scholars have noted: ChatGPT's sophistication amplifies existing disparities between individuals. Students with strong critical thinking and innovation skills will derive greater benefits, while those lacking these abilities may still gain some advantage. However, they are more likely to fall into the trap of mediocrity by relying on ChatGPT's outputs, or even be misled by erroneous or biased information provided by the AI (Wu, 2024).

3.3.2 Transmission of Bias in Algorithmic Decision-Making

AI-driven algorithmic decision-making heavily relies on massive data inputs and complex algorithmic models. Its biases and risks primarily stem from biases in training data and preset biases in algorithm design.Large-scale text and multimodal datasets, constructed based on historical education and employment data, inevitably carry inherent societal biases—such as unequal representations across dimensions like gender, race, and geography (He, 2024). For instance, the historical gender imbalance in the mechanical manufacturing industry—characterized by disproportionately low female representation—if such data is directly incorporated into the training dataset of career-matching algorithms, the algorithms will statistically default to reducing the compatibility weighting for women in this occupation. When new student data is input, guided by these historically biased parameters, algorithms result in implicit exclusion in career development assessments and learning path recommendations. This places female students at a disadvantage in initial competency evaluations for mechanical manufacturing fields.This process of transforming historically discriminatory data into technical decision-making logic essentially consists of embedding societal structural biases into educational evaluation systems through algorithmic coding. It forms a bias transmission chain of "data bias→algorithmic bias→decision bias," posing a technical threat to educational equity and the freedom of career choice.

In the digital realm, algorithms function both as technical tools and hidden carriers of power. When designing algorithms, developers may define algorithmic rules and weightings based on their own cognition, experience, or specific objectives. However, the algorithmic decision-making process is difficult for external parties to understand and supervise, resulting in the existence of an algorithmic black box. This makes human-implanted biases difficult to detect and correct, thereby leading to bias implantation and the reproduction of discrimination.With respect to resource allocation algorithms in vocational education, if algorithms are based on biased data and design, they may allocate more high-quality resources to students from specific groups. Due to the existence of the algorithmic black box, this unfair allocation cannot be detected and stopped in a timely manner. This further exacerbates inequality in educational resource allocation, inflicting sustained discrimination on disadvantaged student groups and impacting their educational opportunities and career development.

4. Governance Strategies for Artificial Intelligence Application in Vocational Education

4.1 Reshaping Agency and Cultivating Autonomous Abilities

4.1.1 Student Agency: Fostering Autonomous Decision-Making and Critical Thinking

First, the auxiliary role of AI in educational settings should be clearly defined—limiting the decision-making weight of intelligent systems while upholding the teacher-led instructional model and student-centered learning status. Specifically, teachers can leverage their professional knowledge and teaching experience to screen and adjust instructional recommendations generated by AI, ultimately formulating appropriate teaching plans. Furthermore, to strengthen human-led oversight, an "human intervention interface" should be embedded in intelligent systems, allowing teachers and students to adjust the weight of algorithm recommendations at any time. For instance, incorporating a manual review stage in learning path recommendations ensures that AI-generated plans reserve at least 30% space for independent exploration, enabling students to enhance their decision-making skills by completing non-recommended tasks.

Second, vocational colleges should appropriately restrict technology use through curriculum design and teaching practice to maintain students' learning initiative and strengthen critical thinking training. At the level of instructional activity design, teachers can develop open-ended questions, project-driven learning, and inquiry-based learning activities. Simultaneously, they can integrate scenario analysis and case discussion sessions to guide students in critically evaluating solutions provided by AI and proposing constructive optimization suggestions. In vocational skill training courses, teachers can guide students to define project objectives, plan implementation steps, and address issues encountered during practical operations.

Third, AI-related courses should be offered to both teachers and students. These courses should cover the practical use of AI tools—such as operating intelligent teaching platforms and interpreting learning data—to help teachers and students master "how to use" intelligent tools. Additionally, the courses should explain technology application strategies for different needs: for instance, how to select intelligent tools based on teaching objectives, and how to optimize learning plans according to recommendations from AI. This guides teachers and students to understand "how to use AI well." A module on digital ethics and self-regulation should also be included. Through case analysis, this module reveals the risks of over-reliance on technology, teaches anti-addiction methods (e.g., time management and attention allocation), and cultivates awareness of rational technology use. Through this series of curriculum designs, the digital literacy of both teachers and students is comprehensively enhanced—enabling them to efficiently leverage AI to empower teaching and learning while maintaining autonomous control over technology.

4.1.2 Teacher Agency: Rebuilding Autonomy in Instructional Decision-Making and Innovation Momentum

To address the risk of professional competence erosion among teachers, instructional autonomy should be reshaped through three dimensions: technological engagement, traceable decision-making, and innovation incentives. First, technological engagement. Teachers must deeply participate in algorithm calibration and scenario adaptation for intelligent teaching systems. For instance, mechanical and electrical engineering instructors should translate the latest equipment maintenance experience from enterprises into training data, ensuring system recommendations conform to industry realities.Second, traceable decision-making. In lesson plan design, "blank spaces for teacher professional judgment" should be designated, mandating secondary decision-making on AI-generated suggestions and documentation of adjustment rationales. For example, automotive repair instructors should supplement the "engine fault diagnosis process" generated by intelligent systems with special troubleshooting steps for locally common vehicle models (e.g., range-extended engines in new energy vehicles). Third, innovation incentives. A "Teacher Original Resource Library" and innovation incentive mechanisms should be established, incorporating the development of characteristic teaching modules into assessments. Examples include customized practical training projects based on real enterprise cases. Through joint school-enterprise teaching and research, as well as cross-institutional case sharing, teachers are stimulated to break through the limitations of intelligent lesson plan templates. By integrating cutting-edge industry technologies with traditional pedagogical wisdom, the iterative vigor of teaching content and methods is maintained

4.2 Fortify Data Security Defenses and Standardize Usage Processes

Data security constitutes a critical risk in the application of AI to vocational education. To address issues related to data privacy and security, rigorous management and safeguard mechanisms should be established throughout the entire data lifecycle—from collection, storage, and transmission to utilization—for the effective protection of the rights of both teachers and students.

4.2.1 Standardize Data Collection Boundaries

In the data collection phase, relevant authorities must update laws and regulations, and issue dedicated regulations and guidelines for vocational education data collection. These documents should clarify the scope, purpose, and methods of data collection to ensure its legality and transparency. Vocational colleges and enterprises shall strictly adhere to the "minimum necessary principle" and implement data classification management:General data (e.g., academic performance, attendance records) requires one-time authorization;Sensitive data (e.g., psychological assessments, family background) requires secondary authorization;Core data such as biometric data is prohibited from collection or restricted exclusively to research purposes.Prior to collecting student data, vocational colleges must provide detailed explanations to students and their guardians regarding the purpose of data use, storage duration, and scope of sharing—ensuring fully informed consent. Students should be enabled to adjust the scope of authorization or withdraw consent without affecting access to normal educational services. During collection, colleges and enterprises shall encrypt stored data and conduct anonymization processing to achieve "data availability without traceability". For colleges and enterprises that engage in unauthorized data collection or over-range data use, punitive measures such as heavy fines and suspension of information technology project approvals shall be imposed in accordance with the law to form an effective deterrent.

4.2.2 Strengthen Data Storage and Transmission Security

In the data storage phase, colleges should increase investment in data security technologies. Advanced encryption algorithms shall be adopted for the encrypted storage of sensitive data, ensuring that only authorized personnel can access such data. An access control system shall be established using multi-factor authentication and access logging. Meanwhile, colleges must establish data security monitoring and early warning mechanisms to detect and address data security risks in a timely manner, and conduct regular vulnerability scans and repairs on data storage systems to reduce the risk of cyberattacks. During data transmission, colleges and enterprises shall use secure transmission protocols (e.g., SSL/TLS protocols) to prevent data from being stolen, tampered with, misused, or used for commercial purposes. For colleges that use public cloud services, cloud service providers shall be required to provide data security assurance schemes and undergo regular security audits.

Regarding corporate data usage, the following measures shall be implemented. Formulate data management specifications for school-enterprise cooperation. These specifications shall clearly define the rights and obligations of enterprises in data usage, stipulating that data may only be used for education-related purposes and prohibiting its use in non-educational scenarios such as commercial marketing.Second,Establish an approval and filing system for data usage in school-enterprise cooperation. Before using student data, enterprises must submit applications to colleges and relevant regulatory authorities, and may only use the data after obtaining approval. When signing data usage agreements, colleges and enterprises shall clearly specify the remuneration standards for data contributions to safeguard students' legitimate rights and interests. Finally, Establish a supervisory team composed of representatives from educational authorities, colleges, enterprises, and students. This team shall conduct regular inspections of data usage in school-enterprise cooperation and handle violations strictly.

4.3 Promoting Educational Equity and Balanced Resource Allocation

4.3.1 Narrowing the Digital Divide and Promoting Balanced Resource Allocation

The application of artificial intelligence (AI) in education risks expanding "digital deserts." *Ethical Guidelines for New-Generation Artificial Intelligence* advocates for inclusive and equitable AI development, emphasizing not only equal access to technology but also efforts to bridge knowledge and skill gaps across different groups (Zhi, 2024).

First, increase funding investment in vocational colleges in economically underdeveloped regions. Governments should assume the leading responsibility by increasing financial support for these colleges—specifically through establishing special construction funds—to help them build digital infrastructure systems in a targeted manner.Second, establish a differentiated educational funding guarantee mechanism. Vocational colleges across regions vary significantly in school-running scale, development level, resource conditions, and practical needs. A differentiated funding model can accurately target the actual needs of each college, scientifically plan the scale and direction of funding allocation, maximize the efficiency of limited educational resources, and fully release the potential value of funding investment. During specific implementation, a bottom-line mindset must be firmly established: priority should be given to vulnerable groups to help them achieve the leap from "having nothing" to "having something"; on this solid foundation, sustained efforts should be made to advance high-quality development from "having something" to "having excellence," continuously improving educational quality and enriching teaching resources. Third, upgrade the National Vocational Education Digital Resource Repository in an intelligent manner. This upgrade aims to break down inter-school barriers and ensure the circulation of high-quality digital resources among different colleges. To address disparities in students' digital literacy, develop hierarchical digital literacy training courses. Given the large population of rural students, schools can collaborate with communities to carry out digital skills popularization activities; students from economically disadvantaged families can access free digital device rental services to gradually improve their digital literacy.

4.3.2 Addressing Algorithmic Bias to Ensure Educational Equity

First, consolidate data diversity to guarantee the quality of algorithm training. Algorithmic bias often stems from unbalanced or incomplete processing of training data (Xu, 2024). Currently, most advanced large models widely used globally are developed by foreign institutions, relying on overseas big data for pre-training—which results in poor compatibility with China's education system. Therefore, there is an urgent need to develop AI models with independent intellectual property rights that meet the practical needs of China's vocational education. During data collection, it is essential to fully cover information on students of different genders, ethnicities, and regions to avoid inherent biases in data at the source. Meanwhile, establish a multidisciplinary expert team consisting of education experts, data scientists, and frontline teachers to conduct strict review and cleaning of collected data—thoroughly identifying and removing erroneous information, eliminating potential biases, and ensuring data quality and reliability. These measures lay a solid data foundation for building scientific and reasonable algorithm models.

Second, develop transparent and explainable algorithms and establish accountability mechanisms.

Develop explainable algorithm models for vocational education to break the "algorithmic black box". Disclose the algorithm's design principles, selection of operational logic, model parameters, and key decision points during training. Establish a dedicated AI review mechanism or introduce third-party evaluation institutions to conduct special assessments and supervision of AI applications in the vocational education field; supervise and audit algorithm decision-making processes to promptly identify and correct biases and discriminatory issues.

4.3.3 Improving Policies and Regulations to Standardize Technology Application

General Secretary emphasized: "We must integrate multidisciplinary efforts to strengthen research on legal, ethical, and social issues related to artificial intelligence, and establish sound legal frameworks, institutional systems, and ethical standards to ensure the healthy development of AI." (Liu, 2024). The opportunities and challenges brought by AI in the education field require a legal response. The state should accelerate the improvement of the policy and regulatory system, issue relevant policies to clarify the application standards of digital technologies in the vocational education field and the responsible entities, and guide the healthy development of the industry. When issues such as algorithmic discrimination arise, vocational colleges can promptly take corrective measures in accordance with these policies and regulations.

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