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Numerical and Intelligent Scenarios in Higher Vocational Education in the Era of Artificial Intelligence

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Abstract: ***This article explores the development background, models, practical challenges, and development paths of 'numerical and intelligent scenarios' in China's higher vocational education in the era of artificial intelligence. With the rapid advancement of AI technology, higher vocational education is transitioning from traditional models to numerical and intelligent scenarios, innovating teaching methods through immersive experiences, differentiated education, and interactive teaching. However, challenges such as lagging infrastructure construction, uneven distribution of digital resources, slow transformation of teaching models, and insufficient depth of industry-education integration persist. In response, the article proposes development paths including strengthening infrastructure construction, optimizing digital resource allocation, promoting teaching model innovation, and deepening industry-education integration to provide theoretical references and practical guidance for the construction of numerical and intelligent scenarios in higher vocational education.***

Keywords: Era of Artificial Intelligence, Higher Vocational Education, Numerical and Intelligent Scenarios, Practical Challenges, Development Paths.

1. Development Background of 'Numerical and Intelligent Scenarios' in China's Higher Vocational Education in the Era of Artificial Intelligence

Against the backdrop of deep AI technology penetration and a global wave of digitalization and intelligence, China's higher vocational education is undergoing unprecedented transformational pressures and development opportunities. Designated as the 'Year of Smart Education' in 2025, the Ministry of Education has explicitly proposed strategic directions of 'integration, intelligence, and internationalization' to drive education digital transformation into deeper waters. This policy orientation resonates with the goal in the Outline for Building a Strong Education Nation to achieve full coverage of AI technology in vocational education scenarios by 2025, marking a critical turning point from scale expansion to quality enhancement in vocational education. The National Smart Education Public Service Platform has amassed the world's largest digital education resource library, covering over 220 countries and regions, providing foundational support for the construction of numerical and intelligent scenarios in vocational education.

Simultaneously, the industry's demand for compound technical and skilled talent has surged, with emerging professions such as AI algorithm engineers, data annotators, and intelligent customer service trainers emerging. The traditional 'academic credential compensation' model can no longer meet the 'skill empowerment' demands of the era, compelling vocational education to reconstruct its talent cultivation system.

The dual drivers of technological revolution and industrial transformation have become the core impetus for the construction of numerical and intelligent scenarios. Next-generation information technologies, represented by generative AI, large models, and blockchain, are reshaping the underlying logic of vocational education. For instance, the AI Employment Learning Machine launched by Offcn Education monitors learning concentration through biometric technology and generates personalized knowledge maps with adaptive learning systems, enabling 'thousand-person, thousand-face' teaching path planning. In practical training, VR/AR technologies construct immersive learning environments, enabling 'zero-risk' training for high-risk practical courses such as industrial robot maintenance and AI algorithm debugging.

The 'AI+Vocational Education' Joint Innovation Center, co-established by the Shanghai Pujiang Laboratory and leading enterprises, has formed a complete ecological chain from basic research to scenario implementation, promoting deep coupling between educational scenarios and industrial demands. This technological empowerment not only enhances educational efficiency but also drives the shift of vocational education from 'outcome evaluation' to 'process evaluation,' achieving dynamic matching of student ability profiles with job requirements through multi-modal data fusion.

2. 'Numerical and Intelligent Scenario' Models in China's Higher Vocational Education in the Era of Artificial Intelligence

2.1 Immersive Experience Scenarios: From 'Theoretical Indoctrination' to 'Embodied Participation'

Immersive experience scenarios provide students with simulated work environments close to reality through technologies such as virtual reality (VR) and augmented reality (AR). For example, Jiangxi Tourism and Commerce Vocational College has created a VR-based numerical and intelligent practical training scenario for its hotel management major, enabling students to complete the full-service process from station reception to departure in a virtual environment, achieving seamless integration from theoretical learning to practical operation. This scenario model not only enhances students' learning interest and participation but also significantly improves their vocational skills and adaptability and resilience.

2.2 Differentiated Education Scenarios: From 'Mass Irrigation' to 'Precision Drip Irrigation'

Differentiated education scenarios leverage big data analytics and AI technologies to achieve precise identification of individual student differences and personalized teaching. By collecting and analyzing students' learning behavior data, the system can provide customized learning resources and path recommendations. For instance, a higher vocational college utilizes a Learning Management System (LMS) to track students' online learning behaviors, including study time, access frequency, and answer accuracy rates, to analyze their learning habits and weaknesses and recommend targeted learning materials and practice questions. This scenario model breaks away from the traditional 'one-size-fits-all' teaching approach, allowing each student to grow at their own pace and in a manner suited to them, enhancing the pertinence and effectiveness of education.

2.3 Interactive Teaching Scenarios: From 'One-Way Transmission' to 'Multi-Dimensional Interaction'

Interactive teaching scenarios construct multi-dimensional interaction spaces between teachers and students and among students through online platforms, social media, and other tools. For example, Hunan Automotive Engineering Vocational College has created an online classroom scenario based on a 5G 'cloud platform,' enabling real-time Q&A, discussions, and interactions between teachers and students through 'cloud learning' and 'cloud meetings.' This scenario model not only facilitates knowledge sharing and collision but also cultivates students' teamwork abilities and innovative thinking. Additionally, some higher vocational colleges have introduced intelligent teaching assistants that use natural language processing technologies to engage in real-time communication with students, answer questions, and provide learning advice, further enhancing the interactivity and immediacy of teaching.

3. Practical Challenges Faced by 'Numerical and Intelligent Scenarios' in China's Higher Vocational Education in the Era of Artificial Intelligence

3.1 Lagging Infrastructure Construction, Failing to Meet Numerical and Intelligent Demands

Despite progress in smart campus construction at some vocational colleges, overall infrastructure construction still lags behind the demands of numerical and intelligent teaching. Vocational colleges in economically underdeveloped regions generally face issues such as insufficient network bandwidth and outdated teaching equipment, making it difficult to effectively implement numerical and intelligent teaching methods like virtual simulation teaching.

For instance, when a higher vocational college attempted to introduce VR practical training equipment, network bandwidth limitations caused device operation lag, affecting teaching effectiveness. Additionally, some institutions' information management systems suffer from imperfect functionalities and data silos, unable to achieve effective coordination among teaching, management, and service links, constraining the overall efficacy of numerical and intelligent scenarios.

Another higher vocational college encountered frequent card lag and disconnections when students used the online learning platform due to insufficient campus network bandwidth during the promotion of numerical and intelligent teaching, severely impacting the learning experience. Simultaneously, data barriers existed between the institution's educational administration management system, financial system, and student management system, leading to poor information flow and low management efficiency.

3.2 Uneven Distribution of Digital Resources, Constraining Educational Quality Enhancement

Uneven distribution of digital resources is a significant factor constraining the construction of numerical and intelligent scenarios in higher vocational education. Notable disparities exist among regions, urban-rural areas, and institutions in terms of intelligent teaching facilities, high-quality faculty, and corporate cooperation opportunities, making it difficult for some institutions to obtain sufficient digital resource support and affecting the overall enhancement of educational quality.

For example, some higher vocational colleges can secure more government funding and corporate cooperation opportunities, enabling them to introduce advanced numerical and intelligent teaching equipment and technologies, while others face resource scarcity. Additionally, imperfect development and sharing mechanisms for high-quality digital resources lead to severe resource duplication and waste.

A higher vocational college in the east established deep cooperation with multiple well-known enterprises, jointly developing several numerical and intelligent teaching projects and providing students with rich practical opportunities and employment resources. In contrast, a central and western higher vocational college struggled to attract corporate cooperation due to geographical and resource limitations, resulting in relatively weaker practical experience and employment competitiveness among its students.

3.3 Slow Transformation of Teaching Models, Failing to Adapt to Technological Development

Traditional teaching models still dominate higher vocational education, with slow transformation in teaching methods that fail to adapt to the cultivation demands for innovation abilities and practical skills in the AI era. Some teachers lack the capabilities to design, develop, and implement numerical and intelligent teaching, leading to a disconnect between teaching content and industrial development and affecting students' employment competitiveness.

For instance, some teachers continue to adopt a 'chalk and talk' teaching approach, neglecting students' subjectivity and individual needs, resulting in low learning interest and poor teaching effectiveness. Additionally, some institutions exhibit a tendency to 'prioritize technology over education' in promoting numerical and intelligent teaching, overly pursuing the advancement of technological means while neglecting the essence of education and the realization of talent cultivation goals.

One higher vocational college found that after introducing an intelligent teaching system, some teachers, lacking relevant training, were unable to effectively utilize system functionalities for personalized teaching and continued to teach in traditional ways, leading to system resource idleness and no significant improvement in teaching effectiveness.

3.4 Insufficient Depth of Industry-Education Integration, Failing to Achieve Collaborative Education

Industry-education integration is an important direction for the construction of numerical and intelligent scenarios in higher vocational education, but the current depth of integration remains inadequate. Cooperation between industry enterprises and vocational schools often remains at the agreement or labor employment level, rarely involving deeper content such as major construction and curriculum systems. Simultaneously, imperfect communication and coordination mechanisms and benefit-sharing mechanisms constrain the sustainable development of industry-education integration.

For instance, although some enterprises have signed cooperation agreements with vocational schools, during actual cooperation, the lack of effective communication channels and benefit distribution mechanisms leads to difficulties in advancing cooperation projects and achieving win-win outcomes for both parties.

One higher vocational college signed a cooperation agreement with a manufacturing enterprise to jointly develop a smart manufacturing curriculum. However, during cooperation, disagreements arose between both parties regarding curriculum objectives, teaching content, and implementation methods, and the lack of an effective communication and coordination mechanism led to slow curriculum development progress and failure to meet expectations.

4. Development Paths for 'Numerical and Intelligent Scenarios' in China's Higher Vocational Education in the Era of Artificial Intelligence

4.1 Strengthening Infrastructure Construction, Enhancing Numerical and Intelligent Support Capabilities

Governments and schools should increase investment in the digital and intelligent infrastructure construction of vocational education, improving network environments, updating teaching equipment, constructing smart classrooms, and virtual simulation practical training bases. Specific measures include upgrading campus network bandwidth to ensure the smoothness of numerical and intelligent teaching, introducing advanced numerical and intelligent teaching equipment such as VR/AR practical training devices and intelligent interactive flat panels, constructing smart classrooms to achieve intelligent management of teaching environments, and establishing virtual simulation practical training bases to provide students with simulated real-world work environment simulations.

Simultaneously, encourage schools to cooperate with enterprises and introduce social capital to participate in infrastructure construction, jointly creating advanced numerical and intelligent teaching environments. For example, a higher vocational college co-invested with government funding and enterprise cooperation to construct a smart manufacturing virtual simulation practical training base. Equipped with advanced VR/AR devices and intelligent interaction systems, the base can simulate real smart manufacturing production processes, providing students with an efficient practical operation platform. Through learning and practical training at the base, students' practical and innovative abilities have significantly improved.

4.2 Optimizing Digital Resource Allocation, Promoting Balanced Educational Development

Strengthen the development and sharing of high-quality digital resources, establish cross-regional and cross-institutional digital resource libraries, and promote balanced distribution of digital resources. Specific measures include encouraging teachers and enterprises to jointly develop high-quality numerical and intelligent teaching resources such as online courses and virtual simulation experimental projects, establishing digital resource sharing platforms to enable online retrieval, downloading, and use of resources, and promoting cooperation and exchanges among institutions to facilitate the mutual exchange and sharing of high-quality resources.

Through policy guidance and resource allocation, narrow the digital divide among regions, urban-rural areas, and institutions to ensure that every student can enjoy high-quality numerical and intelligent educational resources. For instance, the education department of a province took the lead in establishing a vocational education digital resource sharing platform, aggregating high-quality numerical and intelligent teaching resources from multiple higher vocational colleges in the province. Through the platform, students can select suitable courses and learning resources based on their needs and interests, achieving optimized resource allocation and efficient utilization. Simultaneously, the platform has promoted exchanges and cooperation among institutions, driving the overall enhancement of vocational education levels.

4.3 Promoting Teaching Model Innovation, Cultivating Talents Adapted to Era Demands

Encourage teachers to actively explore numerical and intelligent teaching models and methods, integrating new technologies such as AI and big data into the teaching process to achieve personalized teaching and precision education. Specific measures include conducting numerical and intelligent teaching skill training to enhance teachers' numerical and intelligent literacy and teaching abilities, encouraging teachers to engage in practical training at enterprises to understand the latest dynamics and technological demands of industrial digital and intelligent transformation, establishing a teacher numerical and intelligent teaching ability evaluation mechanism to incorporate numerical and intelligent teaching abilities into teacher assessment indicators, and promoting the application of new teaching models such as blended teaching and project-based teaching to enhance teaching interactivity and practicality.

Through these measures, cultivate a high-quality faculty team adapted to the demands of the AI era, providing strong talent support for the construction of numerical and intelligent scenarios. For instance, some higher vocational colleges regularly organize teachers to participate in numerical and intelligent teaching skill training, inviting industry experts and technicians to lecture. Through training, teachers have mastered new technologies such as big data analytics and AI applications and integrated them into the teaching process. For example, a teacher introduced a big data analytics tool in the Marketing course, providing students with personalized marketing strategy recommendations by analyzing their consumption behaviors and preferences, significantly improving teaching effectiveness.

4.4 Deepening Industry-Education Integration, Constructing a Collaborative Education Mechanism

Promote deep cooperation between industry enterprises and vocational schools, establishing long-term communication and coordination mechanisms and benefit-sharing mechanisms. Specific measures include strengthening communication and contact with industry enterprises to understand their technological and talent demands, jointly formulating talent cultivation plans and teaching programs to ensure close alignment between teaching content and industrial demands, jointly constructing practical training bases and research and development centers to provide students with real practical environments and project opportunities, and sharing technological and talent resources to achieve mutual benefit and win-win outcomes for both parties.

Through these measures, form a community of shared future for schools and enterprises, driving industry-education integration to deeper levels. For instance, a higher vocational college established deep cooperation with a well-known internet enterprise. Both parties jointly formulated talent cultivation plans and teaching programs, integrating the enterprise's cutting-edge technologies and real-world cases into the teaching content. Simultaneously, both parties jointly constructed practical training bases and research and development centers, providing students with real project development and practical opportunities. Through learning and practical training at the base, students' practical and innovative abilities have significantly improved, and graduates have directly entered the enterprise for employment, achieving mutual benefit and win-win outcomes for both parties.

5. Conclusion and Outlook

In the era of artificial intelligence, the construction of 'digital and intelligent scenarios' in China's higher vocational education has shifted from conceptual exploration to practical deepening. Its core value lies in reconstructing the educational ecosystem through technological empowerment, addressing structural contradictions in traditional models, such as outdated teaching content, insufficient practical training resources, and superficial industry-education integration. Currently, digital and intelligent scenarios, represented by VR/AR practical training, AI learning situation analysis, and blockchain-based credit certification, are driving the transformation of vocational education from a 'teacher-centered' to a 'student-centered' approach, enabling personalized learning path planning and dynamic matching of job competencies. However, issues such as uneven regional distribution of digital resources, insufficient digital literacy among teachers, and data security risks still hinder the large-scale implementation of these scenarios. In the future, it is essential to take 'technology-education-industry' collaborative innovation as a breakthrough point, build a digital and intelligent scenario system covering the entire teaching process, and promote the transformation of vocational education from 'scale expansion' to 'quality-driven internal development,' providing talent support for the construction of a manufacturing powerhouse and an education powerhouse.

Looking ahead to 2030, vocational education digital and intelligent scenarios will exhibit three major development trends. First, the depth of technological integration will further intensify. Cutting-edge technologies such as 5G + holographic projection and brain-computer interfaces will drive the evolution of practical training scenarios from 'virtual simulation' to 'real perception.' For example, digital twin technology will enable 'zero-error' training for industrial robot maintenance. Second, the scope of scenario applications will extend from teaching to the industry-education integration ecosystem. The deep coupling of real enterprise production data with AI algorithms will give rise to a full-chain closed loop of 'demand forecasting-curriculum development-skill evaluation.' For instance, smart automotive programs can dynamically adjust talent development plans by accessing real-time data from automotive production lines. Third, an ethical and security framework will become the cornerstone of sustainable scenario development. Technologies such as blockchain-based evidence storage and federated learning will establish data privacy protection barriers, ensuring that technological applications remain true to the essence of 'education for nurturing.' During this process, it is crucial to guard against the erosion of educational essence by technologism and avoid falling into the trap of 'emphasizing tools over substance.' Only by adhering to the principle of 'technology as a means, education as the soul' can we achieve the leap from 'tool innovation' to 'paradigm reconstruction' in digital and intelligent scenarios, ultimately establishing a modern vocational education system highly compatible with the digital economy.

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