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Innovative Pathways and Paradigm Innovation for the "Digital-Intelligent" Transformation of Practical Training Teaching in Vocational Education

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Abstract: With the deep integration of digital technology and intelligent technology, practical training teaching in vocational education is facing unprecedented pressure for transformation and development opportunities. Based on the perspective of digital-intelligent integration, this paper systematically analyzes the practical problems existing in the concepts, content, platforms, and faculty of current vocational education practical training teaching. It proposes transformation paths for practical training teaching centered on digital-intelligent integration, the combination of virtual and real, and industry-education collaboration. Furthermore, it explores a new paradigm for practical training teaching that combines platformization, modularization, and personalization. The aim is to promote the adaptation of the vocational education practical training teaching system to the needs of the digital economy development, and to enhance the training quality and employment competitiveness of technical and skilled talents.
Keywords: vocational education, practical training teaching, digital-intelligent transformation, transformation path, teaching innovation

1. Introduction

1.1 Research Background

Currently, digital technologies represented by big data, artificial intelligence, and cloud computing are profoundly reshaping the industrial landscape and the job market. According to the "China Vocational Education Development Report" released by the Ministry of Education in 2023, the talent gap for positions related to the digital economy continues to widen, and is expected to reach 30 million by 2025. Against this backdrop, vocational education, as the main front for cultivating technical and skilled talents, sees the quality of its practical training teaching directly related to whether it can provide sufficient talent support for industrial upgrading. However, the traditional practical training teaching model shows obvious inadequacies in teaching content, teaching methods, and teaching resources, urgently needing to promote a digital-intelligent transformation to meet the challenges brought by the new round of technological revolution.

1.2 Research Purpose and Significance

This research aims to deeply analyze the key problems faced by vocational education practical training teaching during the process of digital-intelligent transformation, systematically construct the reconstruction path of the practical training teaching system, and explore innovative paradigms for practical training teaching that align with Chinese characteristics. From a practical perspective, the research results can provide specific and feasible implementation plans for vocational colleges to advance practical training teaching reform. From a theoretical perspective, it can enrich the theoretical system of the digital transformation of vocational education and provide reference for the formulation of relevant policies.

2. Impact of the Digital-Intelligent Era on Practical Training Teaching in Vocational Education

2.1 New Requirements for Practical Training Content from Industrial Technological Upgrading

With the deep advancement of intelligent manufacturing, traditional mechanical operation positions are transforming towards equipment maintenance, process optimization, etc. Taking industrial robot applications as an example, enterprises require operators not only to master basic programming skills but also to possess comprehensive abilities such as fault diagnosis and system optimization. This requires practical training content to shift from single-skill training to compound ability cultivation, increasing the proportion of modern technical elements such as data analysis and system integration.

2.2 Digital Reconstruction of Practical Training Teaching Methods

The popularization of digital technology provides strong support for the innovation of practical training teaching methods. For example, virtual simulation technology can simulate real work scenarios, allowing students to repeatedly practice complex operations in a safe environment; cloud computing platforms can enable cross-regional sharing of teaching resources, solving the problem of insufficient practical training equipment in some areas. The application of these new technologies not only expands the spatiotemporal boundaries of practical training teaching but also greatly improves teaching efficiency.[1]

2.3 Intelligent Transformation of the Practical Training Evaluation System

Traditional practical training evaluation mostly relies on teachers' subjective judgments, making it difficult to fully reflect students' true levels. By using learning analytics technology, students' operation processes can be recorded in real-time, and their skill mastery analyzed through data mining; intelligent assessment systems can objectively score students' work based on preset standards. This data-driven evaluation method makes teaching feedback more timely and accurate, helping teachers adjust teaching strategies.

3. Realistic Dilemmas in the Digital-Intelligent Transformation of Practical Training Teaching in Vocational Education

3.1 Lagging Practical Training Concepts and Weak Awareness of Digital-Intelligent Integration

Surveys show that over 60% of vocational colleges still position practical training teaching towards the cultivation of skill proficiency, paying insufficient attention to soft skills such as digital literacy and innovative thinking. Some teachers hold conservative attitudes towards new technologies and are accustomed to using traditional teaching methods, leading to a disconnect between practical training content and actual industry needs. This conceptual lag is the primary obstacle restricting the transformation of practical training teaching.

3.2 Isolated Practical Training Platforms and Lack of Resource Sharing Mechanisms

Currently, practical training platforms in most vocational colleges remain isolated. Due to the lack of unified technical standards, data interoperability between different systems is difficult. Taking a provincial vocational education park as an example, five colleges built virtual simulation practical training platforms respectively, but due to differences in system architecture, resource sharing cannot be achieved, resulting in repeated construction and resource waste.

3.3 Insufficient Digital Competence of Faculty, Lack of Support for Teaching Transformation

A survey targeting teachers in vocational colleges showed that only about one-third of teachers could skillfully use virtual simulation software for teaching, and the proportion of teachers capable of data analysis was even lower. The lack of digital skills makes it difficult for teachers to effectively use new technologies to improve teaching methods, also affecting the quality improvement of practical training teaching.

3.4 Slow Update of Practical Training Content, Disconnected from Job Requirements

Due to the long cycle of textbook compilation and publication, practical training content often lags behind technological development. Taking industrial robot technology as an example, while enterprises commonly use a new generation of collaborative robots, some colleges are still teaching outdated serial robot technology. This disconnect directly affects students' employment competitiveness.

4. Pathways for the Digital-Intelligent Transformation of Practical Training Teaching in Vocational Education

4.1 Concept First: Establishing a Digital-Intelligent Integrated View of Practical Training Teaching

Vocational colleges should elevate the digital-intelligent transformation to a strategic level and formulate medium- and long-term development plans. Specifically, teachers can be helped to update their teaching concepts by organizing participation in new technology training, inviting enterprise experts to give lectures, etc. Meanwhile, digital literacy should be incorporated into talent training schemes, clarifying the digital skill standards that students in various majors should master.[2]

4.2 Platform Reconstruction: Building Smart Practical Training Bases

It is recommended to adopt an architecture coordinating cloud, edge computing, and terminal equipment to build smart practical training bases. The cloud is responsible for resource storage and data processing, edge computing nodes provide localized services, and terminal equipment offer immersive practical training experiences. For example, a smart manufacturing virtual simulation practical training base built by a vocational technical college connects practical training equipment distributed across multiple campuses via a 5G network, achieving unified management and scheduling of resources.

4.3 Content Upgrade: Developing Modular Practical Training Resources

Vocational colleges should cooperate with enterprises to develop a library of practical training projects based on real work scenarios, organizing teaching content according to the structure of basic modules, professional modules, and extension modules. Taking the new energy vehicle maintenance major as an example, basic modules include electrical and electronic technology, professional modules cover battery management system fault diagnosis, and extension modules can set content related to intelligent connected vehicle technology. This modular design ensures the systematic nature of teaching while enhancing the flexibility of content.

4.4 Faculty Empowerment: Building Dual-Qualified Teaching Teams

Establish a faculty development mechanism combining school training and enterprise practice. On the one hand, regularly send teachers to partner enterprises for temporary posts to understand the latest technological trends; on the other hand, hire enterprise technical backbone personnel as part-time teachers to participate in practical training course design and teaching implementation. A vocational technical university significantly improved teachers' practical teaching ability by implementing a teacher enterprise workstation project.

5. Paradigm Innovation in Vocational Education Practical Training Teaching

5.1 Spatiotemporal Paradigm Innovation: Constructing a Virtual-Real Integrated Practical Training System

Break the spatiotemporal limitations of traditional practical training and establish a new practical training model combining online and offline, virtual and real. Students can first familiarize themselves with operational procedures in a virtual environment, then practice on physical equipment, and finally enter real enterprise positions for internships. This stepped training method ensures teaching safety while improving learning efficiency.

5.2 Teaching Paradigm Innovation: Strengthening the Student-Centered Position

Change the teacher-centered teaching model and implement project-based and inquiry-based teaching methods. For example, in intelligent control technology practical training, students can be allowed to complete a full project development process in groups, from requirements analysis to system implementation, comprehensively enhancing their problem-solving ability and team spirit.[3]

5.3 Evaluation Paradigm Innovation: Establishing a Comprehensive Ability Assessment System

Construct a diversified evaluation indicator system, combining process evaluation and summative evaluation. In addition to assessing skill operation levels, attention should also be paid to students' innovative performance and team contributions in projects. A practical training ability profiling system developed by a vocational college generates personalized ability development reports by collecting students' performance data in various links, providing a basis for teaching improvement.

6. Conclusion and Outlook

The digital-intelligent transformation of practical training teaching in vocational education is a systematic project that requires coordinated advancement from multiple dimensions such as concepts, platforms, content, and faculty. In the future, with the maturation of new technologies such as the metaverse and generative artificial intelligence, practical training teaching will present a more intelligent and personalized development trend. Vocational colleges should maintain an open attitude and actively embrace new technologies, while also focusing on the essence of education and avoiding the pitfall of technology supremacy. Only by organically combining technological innovation with educational principles can high-quality technical and skilled talents meeting the requirements of the digital era be cultivated.

At the practical level, it is recommended to prioritize pilot demonstrations in key areas of the digital economy, summarizing experience before gradual promotion. At the policy level, it is necessary to increase funding, improve standards and norms, and create a favorable environment for transformation. It is believed that through the joint efforts of all parties, the practical training teaching of vocational education in China will be able to successfully complete the digital-intelligent transformation and provide strong talent support for the construction of a manufacturing powerhouse.

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