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# *Research and Practice of Parallel System Embedded in Intelligent Manufacturing Professional Group Teaching Integration*

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***Keywords:*** online teaching, parallel system technology, intelligent manufacturing, integrated teaching system, efficient collaboration between human, machine and material

***Abstract:*** Taking the research of online teaching mechanism as the main line, aiming at promoting the high-quality development of vocational education, the current situation and existing deficiencies of the online skill training of intelligent manufacturing majors in vocational education in China is analysed and sorted out. Drawing on parallel system technology, construction of a new type of integrated teaching system that integrates into parallel systems is innovatively proposed; the application of key technologies of intelligent manufacturing in teaching is cracked, a new engineering training system operating mechanism with efficient human-machine-material coordination is established, and a guarantee for theoretical and practical research on the construction of a highland for innovation and development of vocational education is provided.

## 1. Introduction

The concept of "big engineering" was first proposed by Moore, Dean of the Massachusetts Institute of Technology in the 1990s. Its essence is to make the "engineering model" educational philosophy system which integrates science, technology, non-technology and engineering practice, with practicality, integration and innovation. The "big engineering concept" takes actual engineering as the background and engineering technology as the main line. Higher vocational education cultivates technical and technical talents with engineering thinking. It is an improvement of the traditional technical and technical personnel training specifications. Craftsman spirit education is integrated. Only by highlighting the cultivation of practical and creative engineering technical skills can we meet the industry demand for high-quality compound technical skills application talents in the context of intelligent manufacturing.

In the field of intelligent manufacturing, more and more information management systems play a more important role than physical hardware systems in various industries. However, under the enthusiasm of online teaching, practical training is still dominated by traditional laboratory teaching, which depends on the quantity and quality of teaching equipment. Even with the rapid development

of informatization, both online theoretical teaching and offline operation are indispensable. In the event of major events, such as large-scale public safety incidents, when schools cannot reopen, the overall quality of online teaching is not high, and the bottleneck of practical training is prominent. The experimental training course mainly adopts the online virtual simulation platform for teaching. The Ministry of Education has opened a large number of free online courses, many internet education companies have provided free teaching resources, and schools have actively contacted publishers to provide electronic teaching materials for teachers and students. However, even well-known platforms such as MOOC still cannot satisfy the cultivation and improvement of students' practical ability. There is an urgent need to create a new practical teaching platform to make online practical training possible.

However, at present, most of the practical training of intelligent manufacturing professional groups focus on the engineering training mode or virtual simulation combining online theory and offline implementation [1-6]. The virtual simulation is mainly based on more mature equipment such as robots, and software needs to be installed [7-10]. Some web design, three-dimensional design and other courses adopt online learning and debugging, which is relatively convenient, easy to implement, and can achieve expected results. Many courses can only be verified by simulation software, which has few projects and occupies a large space; some courses can only debug the software by connecting to the hardware, and the software has frequent problems from downloading and installing to using, which greatly delays the teaching process and increases the number of problems. The workload of teachers weakens the teaching effect and reduces students' interest in learning. Using online software, multiple people control the same training equipment to achieve the goal of talent training has become the key.

## 2. General Framework

We strongly encourage authors to use this document for the preparation of the camera-ready. The parallel training system proposed in this paper serves the majors of intelligent manufacturing. It is taught through online software and does not depend on the input of a large number of training equipment. Different from the previous virtual simulation technology, the parallel training system includes not only the physical training system, but also the artificial training system parallel to the physical training system. Practice (physical training system), so as to realize on-site teaching or remote unmanned training. The parallel training system is not a simple and narrow superposition of traditional training and virtual training, but a generalized fusion of traditional laboratory and online execution.

In view of the many drawbacks of the online training platform in the cultivation of high-skilled talents, the physical equipment and scene (physical training system) and intelligent software (artificial training system) are highly integrated to establish a relationship between intelligent entities including humans, machines and objects. coupling. On the premise of ensuring network security, the parallel system technology is embedded in the integrated teaching of intelligent manufacturing majors, breaking the time and space constraints, solving the educational problems of less equipment and more students, skill training, and integration of all-round teaching to help students quickly master technical knowledge related to intelligent manufacturing, efficient implementation of practical training and teaching, and multi-dimensional promotion of talent training.

In the five-level pyramid of intelligent manufacturing, intelligent manufacturing majors mainly train technical and technical talents for the intelligent equipment layer and intelligent production line layer. The parallel training system proposed in this subject can monitor the physical scene of intelligent manufacturing throughout the process, and engineering training projects (operation of

intelligent equipment, control of actual production lines) are carried out on actual physical equipment (PLC equipment, intelligent production lines). As long as they have a computer and network, students can conduct practical training anytime, anywhere, and even if there is no teacher in the training room, they can successfully complete the practical training. The parallel training system can not only greatly improve the practical skills of students, greatly reduce the workload of teachers, but also significantly improve the utilization rate of equipment. The parallel training system can be used as an intelligent unmanned teaching practice system, which realizes all-round talent training across time and space.

## 3. Construction of Parallel Training System

The core courses of intelligent manufacturing majors are based on software learning such as PLC, and students' skills are improved with the help of physical equipment such as production lines and robots. Under the guidance of the concept of large-scale engineering and systematic science, this paper draws on the basic theory of vocational education and the method of analyzing problems, from the perspective of the quality ecosystem of higher vocational education, to discuss the co-evolution of practical training scenes and virtual space, and to a path choice is provided which can diversify the quality improvement and promotion of higher vocational education in the era. Specifically, it is to embed the parallel system technology into the training of intelligent manufacturing professionals for application practice, the problem of online training will be solved, and a complete closed loop of generalized online learning is formed.

The rapid radiation of the new generation of information technology has brought unprecedented changes to the user components, teacher-student relationship, teaching forms, interaction methods, and time and space cycles of vocational education. Online teaching has become one of the indispensable channels for vocational education. Online teaching and traditional teaching are related and complementary to each other. Online parallel training relying on online software and real training rooms has continuously improved the refined, dynamic, and virtual-real interactive intelligent manufacturing talent training cycle, as shown in Figure 1.

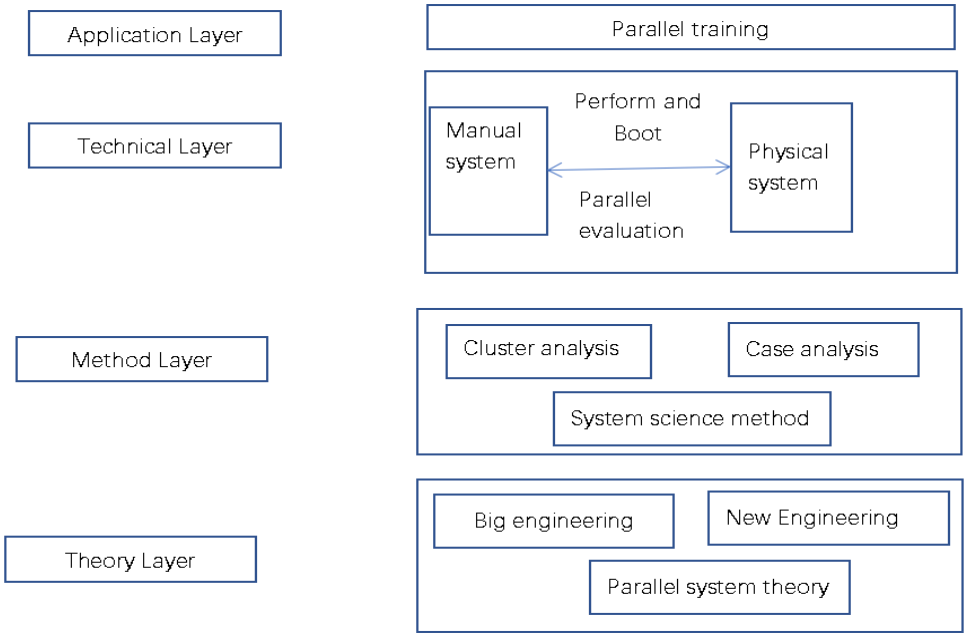


Figure 1: Construction of parallel training system

At the theoretical level, the parallel training system is supported by the concept of large-scale

engineering, new engineering disciplines, and selection system theory.

At the method level, the parallel training system uses cluster analysis, case analysis and system science as methods. Through cluster analysis, it is found that many core courses in the current intelligent manufacturing major, such as "machine tool electrical control and PLC technology", "mechatronics system application", "industrial robot programming and operation", "industrial robot system integration", etc. There is a strong dependence on equipment. PLC equipment, production line equipment, robots, etc. are expensive and small in number. Only a few students can use equipment and software for integrated learning throughout the whole process. Most students can only watch and wait, and the teaching fails to meet expectations. effect, affecting the progress of the course. Therefore, it is urgent to realize the parallel system of integrated teaching to solve the above problems.

Through case analysis, it can be seen that with skills training as the main line, the teaching method of courses should be closely combined with the current situation of the intelligent era, and it can actively explore the application of intelligent technology in intelligent education scenarios, so as to continuously deepen and enrich the connotation of modern vocational education and reshape smart education ecology. In terms of teaching form, the combination of online and offline virtual reality, spanning time and space; in terms of teaching resources, not only has actual training rooms, but also the actual cases or actual scenarios of intelligent manufacturing cooperative enterprises are connected to the parallel teaching system. On the one hand, in terms of teaching methods, teachers include not only school teachers, but also many experts and skilled craftsmen from industry and enterprises who can teach on-site online. Therefore, the construction of parallel training system is very necessary.

At the technical level, the artificial system and the physical system of the parallel training system are integrated.

At the application layer, the parallel training system realizes all-round teaching and evaluation of intelligent manufacturing professional and technical talents.

With the advent of the intelligent era such as artificial intelligence, big data, and the industrial internet, the deep integration of people and cyber-physical systems has given birth to social-physical information systems. The integrated system of teaching and doing is a typical CPSS. The parallel system provides clear new ideas, methods and implementation approaches for CPSS, and solves the current situation that experimental training is overly dependent on the number of equipment, student training is severely time-constrained, and on-site social training is prone to many safety problems.

The parallel training system is actually a digital quadruple architecture, and the virtual space is interactively optimized with the physical space through platform components such as scene generators, visualization tools, and algorithm analysis tools. Through the docking, upgrading and updating of hardware and network platforms, students can interact with online training service platforms, unmanned training rooms, mobile Internet platforms, etc. Transformation of innovative practical training teaching methods. As an important part of the teaching process, teachers play the functions of supervision, management, evaluation, and decision-making in the parallel system. Therefore, the parallel training system can help improve the effect of training preview, training teaching effect and teaching integration effect.

The parallel training system works in opposite directions from the perspectives of pedagogical laws and data aggregation. It uses the objective behavior data and status data recorded by the platform to build a scientific and feasible student evaluation system, and it conducts evaluation, diagnosis, prediction, and intervention to form logic. A flexible and intelligent learning monitoring system provides support for subsequent learning design.

## 4. Innovation Points

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### 4.1. Theoretical Innovation of Online Teaching in Vocational Education

We apply the educational theories such as "big engineering concept" and "new engineering" to the construction of the professional training platform for high-level workers, innovate and propose a parallel training system, so the formation of a new engineering training model is explored, and new technologies, new industries, new economic development is actively adapted. The parallel system theory is integrated into the whole process of higher vocational education, it strengthens the management and control of online learning, reconstructs the teaching ecology, improves the level of engineering teaching, and innovates the high-quality cycle of talent training that is refined, dynamic, and virtual-real interaction.

### 4.2. Innovation of Intelligent Manufacturing Compound High-Skilled Personnel Training Mode

The parallel training system proposed in this paper breaks the simple simulation of traditional virtual simulation technology, surpasses the rigid virtuality of digital twins, and innovatively proposes a flexible and open intelligent manufacturing professional talent training model that integrates virtual and real, which largely solves the problem of online practical teaching and training. Through the guidance and assistance system, the learning path is independently planned to achieve complete self-organized learning. It supports fragmented and collaborative learning that is not limited by time and space, and it is progressively advanced vertically, and horizontally and vertically. It is implemented in intelligent manufacturing majors (mechatronics technology, electrical automation technology, intelligent control technology, etc.).

### 4.3. Practical Teaching Realizes Innovation on the Path

On the basis of the previous practical teaching methods and accumulation of resources, we systematically researched the effective carrier of online teaching and skill training, and innovatively proposed a parallel practice solution of intelligent collaboration and virtual-real integration. The realization path expanded from traditional laboratory teaching to parallel training has opened up a new path for the symbiotic development of teaching integration and online learning, meeting the needs of interaction and integration between real equipment and online software, creating collaborative management of human, machine, and objects, and cultivating all-round and multi-angle needs to upgrade to the industry chain technical skills.

## 5. Conclusion

Connecting to the whole industrial chain of intelligent manufacturing, in-depth integration of production and education, the teaching ecology of practical training is comprehensively reformed, it is all-round controled of reality by virtual, and it is not limited by time and space. The shortage of traditional experimental teaching equipment is made up. Students' experimental ability is cultivated and improved, and it can inspire students active learning willingness, reasonable arrangement of experiment time, effective improvement of teaching efficiency, etc. In the future, the parallel system will be extended to other majors or other schools in the school for promotion and application. Normalized and integrated parallel teaching will be carried out in the post-epidemic era.

To a certain extent, the parallel training system promotes the innovation of the content and approaches of the integration of production and education, provides useful ideas and solutions for vocational training in schools, accelerates curriculum and professional reform, and boosts innovation and entrepreneurship. The promotion and application is also suitable for enterprises to conduct parallel training for employees. We can arry out multi-faceted docking between government, business, school, enterprise, teacher, and apprentice, set up enterprise-named classes, and conduct orderly rotation of course teaching in schools, cross-enterprise teaching workshops, and enterprise bases, and implement online multi-base rotation training for different enterprises and positions.

The in-depth and extensive application of parallel system technology in education will completely change the time and space scenarios and supply levels of education, information sharing, data integration, business collaboration, and intelligent services will be realized, the change of the overall operation process of education will be promoted, and personalized and diversified education becomes possible, and a new flexible, open and lifelong personalized education ecosystem is built.

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