

Practice of Cultivating Composite Talents for Intelligent Operation and Management of Urban Railway Transportation under the Trend of Digital Transformation

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Abstract: Digital change has presented new problems and opportunities for talent development in the urban rail transportation industry. How to move the focus of talent development from traditional skill-based abilities to composite talents through human-computer collaboration has become a big and difficult challenge for vocational education today. To begin, the digital transformation trend of China's urban rail transit is elaborated, and the demand features of urban rail transit operation and management talents in the new situation are summarized. Furthermore, based on an analysis of the current state of talent cultivation and the challenges encountered, as well as the college's practice in the talent cultivation process, we share the strategy for cultivating innovative composite talents for intelligent operation and management of urban rail transit, summarize practical achievements and experiences, and provide reference and inspiration for other higher vocational colleges and universities.

Keywords: Digital transformation; Intelligent operation; Composite talent; Talent development innovation

1. Introduction

Urban rail transit has grown rapidly, and the industry as a whole has reached a tipping point, transitioning from quantitative to qualitative transformation. The Overall Layout Plan for the Construction of Digital China, announced in February 2023, emphasizes the importance of holistically empowering economic and social growth, as well as accelerating the implementation of digital technical advancements in transportation and other vital fields ^[1]. Digitalization has infiltrated all sectors of integrated transportation, including urban rail transit. With the advancement of industry technology, the deep integration of computer vision, big data, artificial intelligence, digital twin, and other technologies with urban rail transit business is hastening the comprehensive digital upgrade of rail transit to achieve a safer, more efficient, and more pleasant passenger experience. The implementation of intelligent automatic ticket-checking systems, intelligent customer service robots, face recognition systems, and other intelligent equipment in the industry marks the formal entry of intelligent technologies such as voice control systems, biometrics, and others into the urban rail transit industry, hastening the industry's transformation and upgrading. Digital technology opens up new opportunities for urban rail transit development, with predictions that the future system would evolve toward high intelligence and customisation. This will not only better satisfy the travel demands of customers and improve their travel experience, but it also has the ability to improve operational efficiency and reduce operating expenses.

Digitalization presents both new opportunities and challenges. To effectively address these issues and capture possibilities, intelligent operation management has emerged as a crucial tool, as well as an unavoidable trend for the future development of urban rail transit ^[2]. In the context of digital transformation, intelligent operation management achieves operational intelligence and efficiency through the use of modern information technology and management principles. Intelligent operation management can help to improve operational efficiency, optimize resource allocation, improve service quality, and minimize operating costs while also improving system security.

Vocational education has produced a huge number of high-quality technical and skilled workers for the field of urban rail transit operation and management, spanning practically all positions from entry-

level to executive, and has become a vital backbone in the industry's development. However, as the industry's trend toward digital transformation accelerates, talent training programs must stay up in order to respond to the industry's transformation and upgrade. In the face of this problem, how to move the focus of talent training from traditional skill-based abilities to composite skills through human-computer collaboration has become a big and difficult task for vocational education today.

2. Characteristics of Talent Demand

The digital transformation of the management industry is urgent and significant. With the advancement of transformation, there is a growing demand for composite management expertise. The demand for management talent is shifting from a focus on traditional service skills to a focus on intelligent service composite, presenting three new characteristics: the required knowledge is oriented to the development of composite, the required ability is oriented to the development of innovative, and the required quality is oriented to the development of comprehensive ^[3]. Specifically, the traditional talent training model focuses on the position's fundamental skills, such as platform receiving and dispatching, passenger service and ticketing service, and so on; whereas the cultivation of composite talents focuses on human-machine synergistic service and the ability to innovate services. This move is complemented by the transition of core literacy, or the service concept, from standardization and normalization to personalization and accuracy. Personalization and precision necessitate the use of artificial intelligence technology.

3. Current Status and Challenges in Talent Development

With the continual advancement of technology and the rise of new smart operation and management technologies, the urban rail transportation industry faces a significant problem in keeping up with technological development and putting the new technologies into effect as soon as possible. Data is central to effective operation management. Simultaneously, securing data security, preventing data leakage, and preserving passenger privacy become increasingly vital. The operation of urban rail transit involves numerous agencies and stakeholders, and efficient cross-departmental coordination to enhance smart operations management is one of the most critical issues to address. As smart operation management gets more sophisticated, the requirement for highly trained staff grows, and cultivating and attracting these skills has become a major issue for the development of urban rail transportation.

For urban rail transit operation and management majors in higher vocational institutions and universities, the current condition of talent nurturing in the context of digital transformation is summarized ^[4], involving four fundamental aspects: First, the talent cultivation mode is behind. Many institutions continue to use traditional training methods, stressing the transfer of fundamental information and skills while overlooking the need of digital transformation and intelligent operations management. Second, the curriculum is obsolete. The curriculum has not been updated in a timely manner and is not in line with the needs of industry development under the trend of digitalization and intelligence, resulting in students' knowledge not being tightly integrated with their actual work. Third, the practical teaching relationship is inadequate. Although higher vocational colleges and universities place a premium on practical education, students' experience and successes in practical sessions are limited due to equipment, location, and teacher constraints. Finally, the faculty is weak. The scarcity of teachers with digital and intelligent backgrounds makes it difficult for professional teachers to cover relevant subject in depth.

In the process of cultivating talent, vocational institutions and universities face four challenges: the first is a considerable shift in skill needs. With the advancement of digital transformation and intelligent operation and management, professional skill needs have shifted, and students are urgently required to acquire a higher degree of information technology and data processing abilities. Second, the need for interdisciplinary integration has become increasingly apparent. Intelligent operation management requires students to have an integrated knowledge system, which sets higher standards for curriculum design and teaching. Third, the demand for practical educational content and genuine work fit has increased. Because of the changes caused by the industry's rapid expansion, practical teaching links must be more closely connected with the needs of actual work, allowing students to quickly adapt to their positions. Fourth, the level of school-business collaboration is insufficient. Higher vocational colleges and firms must work together more closely to better understand industry dynamics, pool resources, and cultivate talents in line with market need ^[5].

4. Talent Cultivation Innovative Practices

Amidst the industry's period of transition, there has been a shift in the demand for talent, a rapid acceleration in changes to enterprise positions, an urgent need for digital transformation, and an irreversible trend in the entire talent training chain. In the context of a dynamic environment characterized by both challenges and opportunities, vocational colleges play a crucial role as the primary providers of professional talent training in urban rail operation and management. It is imperative for these institutions to reevaluate their talent training specifications, evaluate the effectiveness of their training objectives, and explore strategies for fostering the intelligent utilization of diverse skill sets. The investigation of the aforementioned situation will enhance talent training objectives in order to effectively respond to the industry's "digital" advancements, while also enhancing talent adaptability. The vocational college in the transportation industry, with its extensive historical foundation, continually emphasizes the importance of practical application and innovation. The institution features cutting-edge practical training facilities and a faculty with extensive expertise. By systematically developing intelligent operational and managerial abilities, this program not only addresses the demands of the business but also establishes a strong basis for students' prospective professional trajectories.

4.1. Construction and Practice of Interdisciplinary Curriculum System

Utilizing the enterprise practice base for vocational education teachers is essential in the field of professional education to develop a diverse range of skills that align with the work demands of smart metro stations. Therefore, the "visiting engineer" program is implemented for backbone teachers, wherein they are assigned to smart stations for the purpose of job shadowing and practical experience. This program aims to enhance their understanding of the typical job tasks, work processes, and vocational ability requirements associated with their respective positions. Additionally, it seeks to redefine the objectives of talent training and establish a model for evaluating the quality of -type abilities. Closely focusing on the development needs of the industry, we reconstruct the curriculum system based on the new connotation of jobs, improve the matching degree between the curriculum system and job requirements, update the syllabus and standards, inject new ideas and vitality, and realize the docking between the teaching content and the real jobs; we optimize the professional development courses, set up additional courses on information technology, big data technology, etc., cultivate students' digital literacy and competence, and strengthen students' digital sensitivity.

In terms of cultivation goals, it is necessary to nurture professionals who understand relevant information technology, data analysis, and other multidisciplinary abilities. As a result, it transcends traditional disciplines, combines the contents of related courses to create an interdisciplinary curriculum system, and enables students to master interdisciplinary knowledge and skills in practice by establishing interdisciplinary elective modules, case studies, and project practice.

In terms of practical sessions, interdisciplinary teaching teams are formed, courses are co-developed in collaboration with businesses, real-world cases and demands are introduced, and students are encouraged to participate in practical projects, such as the design and optimization of intelligent scheduling systems and the analysis and prediction of passenger flow, to exercise their interdisciplinary abilities. Furthermore, an evaluation system for interdisciplinary courses is designed to completely evaluate students' abilities and attributes, ensuring that they are prepared with interdisciplinary skills to handle future difficulties.

4.2. School-Enterprise Cooperation and Industry-Education Integration of Nurturing Models

On the one hand, it establishes in-depth cooperative relationships with enterprises, promotes the docking of teaching standards with the employment standards of enterprises, takes the lead in the joint formulation of talent cultivation programs by schools and enterprises, develops curricula and teaching materials, collaborates in teaching implementation, and promotes the integration of school and enterprises in "co-management of schooling, common cultivation of talents." Furthermore, docking the unique demands of enterprises, tailor-made talent training programs, and order-based training, to meet the aim of enrollment (recruitment) and graduation (employment). At the same time, allow students to work in the enterprise under the supervision of the master to gain practical experience, complete modern apprenticeship training, and improve vocational skills and professionalism. At the same time, increasing external exchanges and collaboration, selecting and sending the college's exceptional teaching team to enterprises to study new technologies, and selecting and sending outstanding students to enterprises for paid internships, short-term exchanges, or training. We implement the introduction of enterprises into

teaching, support enterprise technical and management personnel to teach in schools, integrate enterprise culture, practice talent training programs in real teaching environments, evaluate the effect of talent training, provide feedback, and iteration of the talent training curriculum system, and refine the results of exchanges.

On the other hand, through the integration of industry and education, the concepts, technologies, and resources of the industry are integrated into the training of talents, the construction of practical conditions, the enhancement of teachers, technological innovation, and social services of the institutions, and cooperation in the areas of professional co-construction and the cultivation of order classes are carried out. The integration of industry and education promotes exchanges and cooperation between teachers and enterprise experts and improves teachers' practical teaching ability and industry cognition. At the same time, guide and standardize industry enterprises to declare vocational skill level evaluation organizations. Promote the joint development of evaluation resources by schools and enterprises, jointly create curriculum systems, prepare training materials, build case banks and examination question banks, set up competition and training platforms, and carry out staff skill competitions and teacher training.

4.3. Practical Teaching System Based on Real Scenarios

Constructing real practice scenarios. The practical teaching system based on real scenarios aims to cultivate students' practical operation ability, teamwork ability, and innovative thinking ability. It is necessary to clarify the practical teaching objectives that match the actual needs of the urban rail transportation industry to ensure that students can quickly adapt to their workplaces after graduation. The production resources of operating enterprises are introduced into the campus, and the training bases jointly built by the university and enterprises are utilized to innovatively construct the "task-driven, ability progression" practice teaching system and "on-campus and off-campus linkage, virtual and real combination" practice teaching environment. To provide students with real practice scenarios, we have implemented three specific measures, such as simulation of station and train operation environment, introduction of actual operation data, simulation software, and virtual reality technology. First of all, establish a smart station training room similar to the actual operating environment of urban rail transit, including platforms, tracks, signal systems, train models, etc., to simulate the station and train operating environment and improve the proficiency of operating skills. Further, the actual operation data is introduced into the teaching, and the actual operation data of urban rail transit is introduced into the teaching, such as passenger flow data, train operation schedule, equipment failure records, etc. By analyzing these data, the students can better understand the actual problems in operation and management, and put forward effective solutions. Then, simulation software and virtual reality technology are used to simulate the operation scenes and emergencies of urban rail transit, so that students can carry out practical operations and emergency drills in the simulation environment to improve their ability to deal with complex situations.

Reconstructing the content of practical teaching. In the basic skills training, train driving, signal operation, ticketing management, and other basic skills are included to ensure that students master the basic operational skills of urban rail transit operation and management. In the comprehensive practice session, comprehensive practical projects such as train operation chart preparation, passenger flow analysis and prediction, and emergency plan formulation are designed to enable students to comprehensively apply what they have learned in practice and improve their ability to solve practical problems. In the innovative practical activities, students are encouraged to participate in the design and optimization of intelligent dispatching systems, research on energy-saving and consumption reduction programs, and design of interactive interfaces for human-machine cooperative operating systems, to cultivate students' innovative thinking and practical ability.

Improving the practice evaluation system. A practical teaching evaluation system is established based on real scenarios, focusing on the organic combination of process evaluation and result evaluation. By evaluating the standardization of students' practical operation, the effectiveness of teamwork, the innovativeness of problem-solving, etc., the comprehensive quality of students is comprehensively measured.

4.4. Innovative Teaching Methods and Tools

The introduction of the case teaching method, project teaching method, simulation teaching method, mixed teaching method, and other innovative teaching methods, as well as the use of modern educational technology, means, to stimulate the student's learning interest and initiative, and improve the teaching

effect. Through the case teaching method, typical cases of urban rail transit operation and management are introduced to guide students to analyze and discuss, so that students can master theoretical knowledge and cultivate their problem-solving ability. Through the project teaching method, students are guided to complete the actual projects in the form of teams, such as the preparation of train operation map, passenger flow analysis, and prediction, etc., to exercise the practical ability of the students and cultivate their teamwork ability and innovation ability. Through the simulation teaching method, using simulation stations, simulation software, and other tools, simulate the actual operation scene of urban rail transit, so that students can carry out practical operations in the simulation environment, improve operation skills and the ability to deal with complex situations. Through the hybrid teaching method, online courses, virtual reality technology, and other tools are utilized to integrate online quality resources with offline practical teaching, providing richer and more diversified learning experiences and improving teaching effects.

5. Practical Results and Lessons Learned

After a series of practices, the college has carried out in-depth exploration in the cultivation of composite talents for intelligent operation and management of urban rail transit and achieved a series of remarkable results. First, the quality of talents has been improved. By optimizing the curriculum and strengthening practical teaching, the comprehensive quality and professional skills of students have been significantly improved, and the graduates have performed well in the field of intelligent operation and management, which has been widely recognized by industrial enterprises. Secondly, school-enterprise cooperation has been deepened. The college has established close cooperative relationships with many urban rail transit enterprises to jointly carry out talent training, scientific research projects, and technological innovation. This in-depth cooperation mode effectively promotes the integrated development of production, learning, and research, and improves the relevance and practicality of talent training. Thirdly, the strength of teachers has been enhanced. By encouraging teachers to participate in training and academic exchange activities and introducing teachers with industry backgrounds, the faculty strength of the college has been further enhanced, which provides a strong guarantee for improving the quality of education. Fourth, innovation and entrepreneurship education has achieved results. The college actively encourages students to participate in innovation and entrepreneurship programs and provides them with necessary support and guidance. Some students have successfully transformed their creative ideas into actual projects and won prizes in innovation and entrepreneurship competitions. This not only enhances the comprehensive quality and employment competitiveness of students but also injects new vitality into the development of the industry.

Practical experience is summarized. First, interdisciplinary integration is the key. Interdisciplinary integration is crucial in the process of cultivating intelligent operation and management composite talents, which should focus on the setting of information technology, data analysis, and other related courses to cultivate the comprehensive quality and interdisciplinary ability of students. Second, practical teaching cannot be ignored. Practical teaching is the key link to improving students' practical operation ability and problem-solving abilities, which should increase the proportion of practical teaching, establish practical training bases, and actively cooperate with enterprises to provide students with more practical opportunities. Thirdly, school-enterprise cooperation is a win-win road. Through school-enterprise cooperation, resource sharing and complementary advantages can be realized, which should provide a stronger power guarantee for school-enterprise cooperation to realize a breakthrough in the situation of school-enterprise cooperation. Fourth, teacher training needs continuous investment. An excellent teacher team is an important guarantee for cultivating excellent talents, and teachers should be continuously invested in teacher training and encouraged to participate in training and academic exchange activities to improve their teaching level and professionalism. Fifth, innovation and entrepreneurship education need to be encouraged and supported. Stimulating students' innovative spirit and practical ability is crucial for cultivating intelligent operation and management composite talents, and students should be provided with the necessary guidance and support for innovation and entrepreneurship and encouraged to transform their ideas into practical projects.

6. Conclusions

Through the exploration and practice of interdisciplinary integration, practical teaching, school-enterprise cooperation, teacher training and innovation, and entrepreneurship education, the college has delivered a large number of high-quality talents to the industry and made positive contributions to the

development of urban rail transit. Meanwhile, the experience summary also provides useful reference and inspiration for other higher vocational colleges and universities. In the future, it can continue to give full play to its advantages, constantly innovate the talent training mode, and provide more excellent talents for the development of the industry. At the same time, it is recommended to further pay attention to the development trend of the industry, continue to optimize the curriculum and practical teaching system, strengthen the construction of faculty, and actively explore scientific research projects and technological innovations related to intelligent operation and management, to promote the integrated development of industry, academia, and research and promote the transformation, upgrading and sustainable development of the industry.

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