Practical research on the talent cultivation system of big data technology professionals in higher vocational colleges in the construction machinery industry

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Abstract: As an important direction to promote the deep integration of industry and informatization, intelligent manufacturing has become the core driving force for the transformation and upgrading of the global manufacturing industry. It involves the digitalization, networking, and intellectualization of manufacturing processes, with the aim of improving production efficiency, reducing resource consumption, and enhancing product quality. The "14th Five-Year Plan for the Development of Intelligent Manufacturing" jointly issued by the Ministry of Industry and Information Technology and other eight departments has clarified the development goals and key tasks of intelligent manufacturing in the next five years. In the context of the transformation and upgrading of national intelligent manufacturing, the demand for industrial data talents is becoming more and more urgent, and the problems in the training of big data technology professionals in higher vocational colleges are facing problems. Based on the research on the demand for big data technology skills application talents in higher vocational colleges in the construction machinery industry, this paper clarifies the skills and quality requirements of the construction machinery industry for big data technology professional skills application talents in the context of intelligent manufacturing, and constructs the core curriculum system of big data technology according to the technology connection and docking course system. In addition, the construction of experimental training, the optimization of the training system, and the teaching evaluation methods were carried out in practical exploration.

1. Introduction

The 14th Five-Year Plan points out that it is necessary to attach great importance to high-end manufacturing and intelligent manufacturing, and concentrate on overcoming a series of technical problems in high-end manufacturing and intelligent manufacturing.[1] Construction machinery urgently needs to use industrial big data to realize the digital management and improvement of the whole life cycle of product research and development, manufacturing and sales. Based on the accumulated enterprise big data, the construction of the enterprise product knowledge system is completed, and it is continuously iteratively updated, which plays a pivotal role in promoting the intelligent manufacturing of large-scale equipment and the intelligent service in the later stage. The equipment manufacturing industry is facing the problem of how to apply big data technology to realize the transformation and upgrading of enterprises from digital to intelligent. In line with the trend of technological change and industrial upgrading, it has become the primary task of big data talent training to accelerate the cultivation of compound talents with cross-border experience in multiple industries, the integration of innovation theory and process practice, and the equal emphasis on technology and management. Therefore, in order to cultivate the practical talents urgently needed

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by the country, it is of great significance and value to carry out research on the training system of big data professionals in higher vocational colleges.

2. The current situation of the training of big data professionals

Big data cannot exist independently as a service industry, and data must be based on a certain industry to drive industrial development. At present, most schools offer big data majors, but the purpose of training is not clear, focusing on the knowledge of big data technology, ignoring the industrial background and application scenarios, resulting in the emergence of students majoring in big data in most schools, and the employment rate is low, and they can't find jobs that match their skills/qualifications. The training orientation of big data major is not clear. The big data technology professional group has been established for a short time and has a weak foundation, especially the shortage of teachers and training resources [2].

There are some common problems in the talent training of national higher vocational big data technology majors, which are mainly reflected in the following aspects: unclear positioning of talent training objectives, an imperfect curriculum system, insufficient depth in school-enterprise cooperation, a lack of practical enterprise project cases and commercial data for research purposes, training link designs that deviate from actual industry application scenarios, teaching materials that are not integrated with real-world business situations, a lack of teachers with corresponding industry backgrounds, and a relatively simplistic structure of the teaching staff. Furthermore, talent training is often detached from local regional economic development.

3. Improve the industrial talent training mechanism

In order to promote regional economic development, it is necessary to coordinate the planning of industrial development and professional personnel training, reform the talent training model, and cultivate innovative, applied and skilled talents for regional industries. It is necessary to establish a professional-industrial linkage mechanism, take the characteristics of the intelligent reengineering industry and the demand for skilled talents as the guiding compass, optimize the professional settings and adjust the number of majors and enrollment in a timely manner, deepen the integration of industry and education, and jointly compile talent training programs with schools and enterprises, so as to enhance the adaptability of talent training in colleges and universities to the development of regional industries. It also need to integrate curriculum ideology and politics into talent training, promote the spirit of craftsmanship, and always prioritize moral education alongside skill training for talents. In line with the trend of high-tech change and manufacturing industry upgrading, we will accelerate the cultivation of compound talents with cross-border experience in multiple industries, integration of innovation theory and process practice, and equal emphasis on technology and management.

The collaborative education of government, industry, academia and research is coordinated by the government, with universities, enterprises and research institutions as the core to reconnect the original and seemingly unrelated people, fully integrate resources, and form a new community of innovation and development.

Local governments, colleges and universities, industry enterprises and research institutions give full play to their respective advantages around collaborative education and establish a collaborative innovation model of integrated development: first, through the government-led convergence of regional resources and the establishment of a reasonable evaluation mechanism, higher vocational colleges further clarify the goal of compound talent training and establish a talent training system; Second, industry enterprises will further participate in the formulation of practical teaching and professional standards, and scientific research institutions will further establish the concept of collaborative innovation, establish an application-oriented team coordination mechanism, and jointly build a diversified collaborative education framework. Docking with the intelligent manufacturing industry chain in Hunan Province, we will form a deep integration model of industry-education-research collaboration, with the government, enterprises, universities, and scientific research institutions as the core participants. This model will bridge colleges and universities, scientific

research institutions, and industry enterprises, aiming to establish a new talent training system tailored for industrial development. Furthermore, we will construct a distinctive management system to guarantee the success of this multi-collaborative education "community", promote reforms in the operating mechanisms and cooperation modes, adhere to a student-centered approach in talent training, and take the needs of regional society as our guiding principle. Through these efforts, we aim to realize transformations in educational concepts, training models, and teaching methods, and explore a feasible path for cultivating talents [3].

4. Measures for the construction of big data professional curriculum system in the context of intelligent manufacturing

4.1. According to the development of regional industries and the advantageous industries in the province, determine the positioning of big data majors

Combining the talent training system with the career planning of students, relying on the leading position of Sany Group in the construction machinery industry, the training system of big data technology skills application talents based on the construction machinery industry is studied, and the long-term planning of big data application talent training in the construction machinery industry is studied. Focusing on the massive data collection, processing, analysis, data visualization, electronic kanban and so on in the construction machinery industry, we will carry out the cultivation of professional skills and application-oriented talents, and provide a reference for the cultivation of big data skills application-oriented talents in the construction machinery industry. Determining the orientation of big data technology application-oriented talent training within the context of the construction machinery industry: It should be employment-oriented, relying on the specific needs of the construction machinery industry. By analyzing the vocational abilities required for typical work tasks in this field, we can establish the training objectives for big data technology skills tailored to the construction machinery industry. The goal is to cultivate talents who are well-suited for applying these big data technology skills within the industry.

With the continuous improvement of big data infrastructure, the demand for big data-related talents is also increasing. According to the survey data, the employment direction of big data technology major is positioned in the direction of big data collection, development, operation and maintenance, and visualization, and the description and proportion of typical employment positions, requirements and proportions are shown in the following table(see table1 and table2).

Table 1: Big Data Technology Professional Job Requirement Table

serial number	Job category	Post	Job Description	ratio
1	Software Engineer	Big Data Development Engineer	Responsible for large-scale business behaviors such as the development, tuning, data maintenance and monitoring of big data clusters, log analysis and statistics; Develop large-scale data business processing processes based on Hadoop and Flink platforms; Provide data API services for the business middle office; Solve technical difficulties and problems in big data projects	29%
		Data Acquisition Engineer	Responsible for data collection and development; Familiar with mainstream crawler tools and their principles, formulate data collection scheme design, and complete the data crawling and processing work arranged by superiors.	29%
		Data Visualization Engineer	Responsible for providing product-level solutions for data visualization and quickly building data visualization and analysis interfaces, so that internal and external users can display, understand, and mine media data efficiently and cost-effectively.	32%
2	IT Operations positions	Big data operation and maintenance engineer	Responsible for customer demand analysis and big data planning scheme landing design, complete big data product planning and design, installation and deployment; Assist customers or partners in solving big data development support and performance tuning problems;	10%

Table 2:Big Data Technology Job Quality Requirements Table

Typical work tasks	Work process	Ability and quality requirements
Industrial data annotation	1. Collect and organize samples. 2. Label sample-related content according to business requirements. 3. Input according to the text on the sample.	1. Be able to use basic computer software. 2. There is a certain sensitivity to the data. 3. Have a certain ability to read documents, and be able to read and understand the description of data calibration rules independently. 4. Be responsible, be able to complete the assigned data calibration work on time, and be able to continue to complete high quality annotations.
Data acquisition	1. Responsible for the design and implementation of distributed crawler system architecture and data storage. 2. Establish a complete data acquisition, analysis, warehousing and monitoring process, and continuously Optimization, iteration and improvement. 3. Responsible for the analysis of various network requests, exploring and researching efficient solutions. 4. Understand the system data processing process and business function requirements; 5. Ensure the integrity and accuracy of data and ensure the stability of data collection	1. Proficient in database technologies, including HBase, Redis, Mysql, Oracle, etc. 2. Proficient in database data warehouse hierarchical design, wide table design, star model design shell, Hive、Hadoop、Spark、kafka、ETL。 3. Familiar with the data acquisition of mainstream CNC systems, familiar with TCP/IP protocol and communication mechanism. 4. Proficient in Python programming language, proficient in JavaScript, HTTP protocol and HTML In-depth understanding.
Big data development	1. Participate in the data development and optimization of platform products. 2. Participate in the engineering and productization of artificial intelligence algorithms on the big data platform. 3. Through data analysis and data mining, support refined operations and decision-making.	1. Strong programming skills. 2. Familiar with the basic knowledge and big data related components in the field of big data and distributed computing, For example, Hadoop/Spark/Kafka/HBASE/Hive/Storm/HAWQ/ AMBARI/Solr. 3. Familiar with databases and data warehouses, have experience in massive data processing, and be proficient in using MySQL and noSQL, with certain SQL tuning capabilities.
Data O&M	1. Responsible for the deployment, management, optimization, monitoring and alarm of the big data platform Platform services run stably and efficiently. 2. In-depth understanding of big data platform architecture, find and solve performance bottlenecks, and support Rapid growth in business and data volumes. 3. Develop scripts related to big data automatic operation and maintenance, monitoring and alarming, and fault handling and tools. 4. Responsible for Hadoop/Hbase/Spark/Kafka and other cluster services, business monitoring, Continuous delivery, emergency response, capacity planning, and more	1. Proficient in Java, Scala and related frameworks, proficient in common data structures and algorithms. 2. Familiar with the environment construction of computing and data processing engines such as Spark, Storm, Flink, Impala, etc. Development and management. 3. Familiar with the principle of message queues, proficient in using Flume, Kafka, Activemq, and Rabbitmq and other commonly used message queues. 4. Master the basic process of data analysis, and be good at data collection, cleaning, analysis and other links. 5. Proficient in the operation and use of Linux
Industrial data visualization	1. Responsible for providing product-level solutions for data visualization and quickly building data solutions Visualize the analytics interface to enable internal and external users to display media efficiently and cost-effectively Data, understand data, mine data. 2. Responsible for the design and implementation of data visualization components with designers. 3. Complete user documentation and product development documentation.	1. Have a passion for data visualization, understand the development status and trends of the industry, and be familiar with relevant tools and tools technology, and have some personal insights into data visualization. 2. Proficient in various web front-end technologies (HTML/CSS/Javascript), understand SVG, Canvas, WebGL technology. 3. Have a theoretical foundation in computer graphics, and be familiar with the basic algorithms related to data visualization.

4.2. Construction machinery industry higher vocational big data technology professional course system

In response to the construction machinery industry's demand for higher vocational skills in big data technology and application-oriented talents, we aim to explore effective training modes for big

data technology professionals. Additionally, enterprises will actively explore big data applications in this field. The knowledge and skills required by professional students are mainly reflected in solid computer professional theory and operational skills, followed by strong logical thinking skills and big data platform tools with ability.

Enterprises require basic abilities from students, and when it comes to professional skills, they value these even more. The emphasis is on students' hands-on ability and job adaptability. In terms of generic skills, enterprises place more emphasis on students' teamwork and learning abilities. As for ideology and morality, enterprises pay greater attention to students' sense of integrity and hard-working spirit. Based on the technology chain docking course system, and through the analysis of the needs of the intelligent manufacturing industry, it can be seen that the technology chain is divided into four links: big data collection technology, big data development technology, big data platform operation and maintenance technology, and data visualization technology, which together form the curriculum system of big data technology.

5. Experimental training construction

Build a three-dimensional resource of "one library, two bases and four platforms" to promote the improvement of students' knowledge and skills. 1. Library: Teaching Resource Library; Two bases: industrial robot training base and industrial Internet training base; Four platforms: industrial Internet training platform, head song training platform, data collection training platform, edge computing training platform.

In order to comprehensively improve students' professional skills and practical abilities, we strive to build a comprehensive provincial teaching resource library. Combined with the industrial robot training base and the industrial Internet training base, as well as the industrial Internet cloud platform, the training platform, the data collection training platform, and the edge computing training platform, we aim to jointly construct a complete and efficient teaching and learning system. It not only provides students with abundant practical training resources, but also builds a solid bridge between the physical world and the digital world, seamlessly connecting and interlinking the two. Utilizing efficient data collection and transmission technologies, the real-time information of the physical world is accurately mapped to the digital world, creating an interconnected, efficient, and intelligent integrated teaching environment. This teaching model, which is closely linked to the real industrial environment, aims to provide students with a deep understanding and mastery of real-world workflows, develop their abilities to collect, process, and analyze industrial data, cultivate their digital literacy in practice, and lay a solid foundation for their future career development.

6. Optimization of the cultivation system

6.1. Innovation in teaching methods

In the process of cultivating big data technology professionals, higher vocational colleges should actively seek innovation in teaching methods to adapt to the rapid changes in the development of the industry and the continuous updating of technology. Diversified and practical teaching methods not only help to stimulate students' interest in learning, but also improve their practical skills and problem-solving skills.

Educators should carry out project-driven teaching, transform real projects from construction machinery enterprises into teaching projects, and have students participate in the entire process of data collection, processing, analysis, and report writing for these projects in groups under their guidance. Through the implementation of the project, students can have an in-depth understanding of the specific application of big data technology in the construction machinery industry, and improve their practical operation ability and teamwork ability.

6.2. The school and enterprise jointly build a training base

In the training system of big data technology professionals, our school attaches great importance to the important role of internship and practical training to enhance students' practical ability. In order

to deepen this link, we actively seek to establish close cooperative relations with leading enterprises in the construction machinery and information technology industry, and have reached school-enterprise cooperation with Sany Heavy Industry, Tree Root Internet and Zhongke Great Wall Marine Information System Co., Ltd. to jointly build a high-level training base.

The cooperation with Sany Heavy Industry enables our students to go deep into the practice of the construction machinery industry and experience the wide application of big data in intelligent manufacturing, equipment monitoring and other fields, so as to deepen their understanding of the needs of the industry. As a leader in the industrial Internet, Tree Root Internet provides our students with a practical platform for the deep integration of the Internet of Things, cloud computing and big data, which helps students master cutting-edge technologies and improve their practical capabilities. At the same time, the cooperation with the Great Wall Marine Information System of the Chinese Academy of Sciences has opened up a new way for students to explore the application of big data in the fields of marine information monitoring, processing and analysis.

In these training bases, students will not only have access to state-of-the-art equipment and technology, but will also participate in real-world projects, from data collection and cleaning to processing and analysis. Experienced mentors will provide students with guidance throughout the process to help them improve their skills. In addition, students will work closely with employees to gain an in-depth understanding of industry culture and workplace rules, so as to enhance professionalism and teamwork skills.

In order to ensure the effectiveness of internship training, our school will strengthen the supervision and management of internship training, and invite enterprises to participate in the evaluation and feedback of internship training, so as to adjust teaching strategies in a timely manner. Through the in-depth cooperation with Sany Heavy Industry, Tree Root Internet and the Great Wall Marine Information System of the Chinese Academy of Sciences, the training base of our school will give full play to its important role in the training of big data technology professionals, and provide high-quality talents with practical ability for the industry.

6.3. Construction of teaching evaluation system

Based on the "student growth system", quantitative assessment indicators, using "6C portraits" (Content,Communication, Cooperation, Confidence, Critical Thinking, Creativity), establish a comprehensive evaluation system of "three stages and three degrees": the pre-class platform automatically forms knowledge assessment data to examine the "degree of cognitive achievement"; During the class, the teacher evaluates the students' learning process, and the students' self-evaluation and group mutual evaluation are recorded on the platform to examine the "knowledge acquisition". After class, professional teachers and enterprise tutors jointly evaluate the practice results and examine the "practice participation". Relying on the '6C portrait' for student value-added evaluation, we have set up six value-added indicators and early warning indicators. We draw a student value-added radar chart to monitor growth and changes, and provide timely encouragement or warnings based on the students' progress. Furthermore, we continuously optimize and adjust teaching strategies according to the learning situation to achieve our teaching goals.

7. Conclusions

In order to improve the adaptability of the training of big data technology professionals to regional industries, in the process of training big data technology talents, it is necessary to rely on the industry and take the market as the guide, strengthen school-enterprise cooperation, continuously explore and innovate the training mode of big data technology professionals, and optimize the training system of big data technology professionals.

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