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Construction and Practical Exploration of a Quality Management System for Higher Vocational Education Driven by Big Data

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Abstract: This article focuses on the construction and practical exploration of a quality management system for higher vocational education driven by big data. Through innovative thinking and methods, this paper deeply analyzes the application value of big data in quality management of higher vocational education, explores the path to building a scientific and reasonable quality management system, and proposes targeted countermeasures for the problems faced in practice, aiming to improve the quality of higher vocational education.

Keywords: Big data; Higher vocational education; Quality management system; Construction; Practical exploration

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1. Introduction

In the digital age, big data has brought new opportunities and challenges to the quality management of higher vocational education. How to use big data to build an efficient quality management system has become an important issue in the current reform and development of higher vocational education.

2. Overview of big data and quality management in higher vocational education

2.1. Characteristics and connotation of big data

Big data refers to a collection of data that cannot be captured, managed, and processed using traditional data processing tools within a specific time frame. Its core essence lies in the deep mining and analysis of massive heterogeneous data, extracting valuable information to support decision optimization. Big data has distinct characteristics, manifested in the exponential growth of data scale, covering various types of data such as structured, semi-structured, and unstructured; High speed performance is manifested in the real-time generation and transmission of data, requiring data processing technology to have fast response capabilities;

Value emphasizes mining potential correlations and patterns from massive amounts of data to achieve the transformation of data into knowledge; Diversity is reflected in the wide and diverse sources of data, including behavioral data, interaction data, environmental data, and other dimensions [1].

2.2. The importance of quality management in higher vocational education

The quality management of higher vocational education is the core support for ensuring the high-quality development of vocational education, which is directly related to the quality of talent cultivation and social service capabilities. As a key battlefield for cultivating technical and skilled talents, vocational education's quality management level determines the degree of adaptation between talent supply and industry demand. High-quality management can ensure that vocational education cultivates talents with professional skills and professional qualities that meet industry standards. From the perspective of educational ecology, a sound quality management system can standardize educational behavior, optimize the allocation of educational resources, enhance the strength and core competitiveness of vocational colleges, and promote the healthy and sustainable development of the vocational education system [2].

3. Ideas for building a quality management system for higher vocational education driven by big data

3.1. Construction principles

The construction of a quality management system for higher vocational education driven by big data needs to follow four core principles: precise guidance, collaborative integration, safety and controllability, and dynamic adaptation. The principle of precision orientation emphasizes data mining as the foundation, focusing on the core aspects of talent cultivation, ensuring that quality management can accurately match teaching needs and industry standards, and enhance the pertinence and effectiveness of management. The principle of collaborative integration requires breaking down data barriers within various departments and links within the institution, achieving deep integration of data from multiple fields such as teaching, academic affairs, student management, and logistics services. At the same time, it promotes data sharing between the institution and industry enterprises, and builds a comprehensive quality management data system. The principle of safety and controllability emphasizes the security guarantee of the entire process of data collection, storage, and analysis, clarifies the boundaries of data use, prevents data leakage and abuse risks, and protects the personal privacy of teachers and students [3]. The principle of dynamic adaptation requires the system to have flexible adjustment capabilities and to be able to optimize data indicators and analysis models in real time according to vocational education development policies, industrial technological changes, and changes in educational and teaching practices, ensuring the system's adaptability to the times.

3.2. Overall architecture design

The overall architecture of the quality management system for higher vocational education driven by big data adopts a hierarchical design pattern, constructing a four-level closed-loop architecture of "data collection layer — data processing layer — analysis application layer — decision feedback layer." As the foundational layer, the data collection layer is responsible for integrating multiple data collection channels, comprehensively collecting various types of data such as teaching processes, student learning, teacher construction, and industry demand, and forming a massive database of raw data resources. The data processing layer undertakes tasks such as data

cleaning, transformation, and integration, eliminates data heterogeneity through data standardization processing, improves data quality, and builds a structured quality management data center. The analysis application layer is the core layer, relying on big data analysis technology and algorithm models to carry out special applications such as teaching quality diagnosis, learning effect evaluation, and teacher ability analysis, and extract valuable management information [4].

3.3. Data collection and integration strategy

The core of data collection and integration strategy lies in building a comprehensive, efficient, and standardized data resource system, providing solid data support for the quality management system. The data collection adopts the strategy of "full coverage+precise focus", which integrates multiple channels of collection points such as university management information systems, teaching platforms, learning terminals, industry enterprise databases, etc., to achieve comprehensive capture of the entire process of education and teaching and industry demand data; Precise focus focuses on the core indicators of quality management, with a focus on collecting key data such as teaching behavior, learning outcomes, skill assessments, and enterprise evaluations to enhance the specificity of data collection. The data integration adopts the mode of "standardization processing+correlation fusion", establishing a unified data standard and coding specification, standardizing the processing of data from different sources and types, and eliminating data conflicts.

4. Application dimensions of big data in quality management of higher vocational education

4.1. Quality monitoring of the teaching process

The application of big data technology in quality monitoring of the teaching process has achieved refined control over the entire teaching process. By collecting real-time data on teachers' teaching behavior, teaching resource utilization, classroom interaction, and practical training operations, combined with preset quality standard models, the teaching process is dynamically monitored and evaluated in real-time. Be able to accurately identify weak points in the teaching process, such as the disconnect between teaching content and industry needs, inadequate practical guidance, and insufficient classroom interaction, and promptly push optimization suggestions to teachers. At the same time, by comparing and analyzing teaching data from different classes and courses, educators summarize excellent teaching experiences and models to provide data support for teaching reform. Based on historical teaching data and industry development trends, it is also possible to predict changes in teaching quality, develop targeted quality improvement plans in advance, promote continuous optimization of teaching process quality, and ensure that teaching content and methods meet the requirements of cultivating technical and skilled talents.

4.2. Evaluation of student learning effectiveness

The evaluation of student learning effectiveness driven by big data has broken through the limitations of traditional single-exam evaluation and constructed a diversified and process-oriented evaluation system. By collecting multidimensional data such as students' classroom learning behavior, self-directed learning data after class, practical training performance, stage assessment scores, and vocational skill certificate acquisition, a comprehensive evaluation model for students' learning effectiveness is established. It can comprehensively and accurately reflect students' learning status, knowledge mastery level, skill improvement trajectory, and

professional development level, avoiding the neglect of students' learning process in traditional assessments. Based on the evaluation results, accurate diagnosis of students' learning problems can be achieved, providing personalized learning guidance plans for students with different learning foundations and styles, and helping students make up for their learning shortcomings. Meanwhile, through longitudinal tracking and analysis of student learning effectiveness data, the implementation effect of talent training programs can be evaluated, providing a scientific basis for the optimization and adjustment of talent training programs [5].

4.3. Evaluation of teacher teaching quality

Big data technology is driving the evaluation of teachers' teaching quality towards objectivity, comprehensiveness, and precision. The evaluation data is no longer limited to student evaluation and peer review, but extends to multiple dimensions such as teaching process data, student learning effectiveness data, industry feedback data, etc., including core indicators such as teaching content adaptability, teaching method effectiveness, training guidance quality, student skill improvement rate, and enterprise evaluation of graduates. By using big data analysis models to comprehensively analyze multidimensional data, it can objectively reflect the teaching ability, professional competence, and educational effectiveness of teachers, avoiding the subjective bias of traditional evaluations. Based on the evaluation results, it is possible to accurately identify the strengths and weaknesses of teachers in teaching, provide personalized professional development suggestions and training programs for teachers, and help them improve their teaching level. At the same time, by summarizing and analyzing the teaching quality data of teachers, it can provide data support for the planning of faculty team construction, the formation of teaching teams, and the allocation of teaching resources in colleges and universities, and improve the overall quality of the faculty team.

5. Issues faced by quality management practices in higher vocational education driven by big data

5.1. Data security and privacy issues

Data security and privacy protection are the primary challenges faced in the quality management practices of higher vocational education driven by big data. Massive educational data contains a large amount of sensitive personal information of teachers and students, such as identity information, learning records, assessment scores, family backgrounds, etc. These data are at risk of being leaked, tampered with, or abused during the collection, storage, transmission, and analysis process. Some universities have incomplete data security protection systems, lack professional security protection technologies and equipment, have non-standard data management processes, and have not established effective data access control and security audit mechanisms, further exacerbating data security risks. At the same time, the current laws, regulations, and industry standards related to data security are not yet perfect, and the boundaries of data collection and use are not clearly defined, leading to compliance difficulties for universities in data management practices. The issues of data security and privacy not only harm the legitimate rights and interests of teachers and students, but also affect their trust in the big data quality management system and constrain its effective implementation.

5.2. Data analysis techniques and talent bottlenecks

The shortage of data analysis technology and professional talents has become the core bottleneck restricting the practice of big data-driven quality management. At the technical level, the existing data analysis techniques lack

compatibility with vocational education quality management, and there is a lack of specialized analysis models and algorithms tailored to the characteristics of vocational education teaching and skill development laws. This makes it difficult to achieve deep mining and accurate analysis of complex educational data, resulting in the underutilization of data value. The construction of big data analysis platforms in some universities is lagging behind, and the technical architecture is not perfect, making it difficult to support the efficient processing and real-time analysis needs of massive data. At the talent level, there is a lack of composite talents who are proficient in big data technology and familiar with vocational education management. Most existing management personnel lack systematic knowledge and skills in big data and are unable to effectively carry out data collection, analysis, and application work. The shortage of professional and technical talents makes it difficult to ensure the stable operation and technological upgrading of big data platforms, resulting in the difficulty of implementing and achieving effective quality management models driven by big data.

5.3. Adaptability of management concepts and mechanisms

The lag and unsuitability of management concepts and mechanisms seriously hinder the promotion of big data-driven quality management practices in higher vocational education. Some management teams of universities still adhere to traditional experiential management concepts, with insufficient understanding of data-driven quality management models and a lack of profound understanding of the value of big data technology. They have failed to integrate big data concepts into the entire quality management process. The existing management mechanism has many drawbacks, including serious data barriers between departments and a lack of effective collaborative work mechanisms, making it difficult to achieve cross departmental integration and sharing of data; The quality management process is rigid and has not been optimized and adjusted according to the needs of big data applications, making it difficult to quickly respond to quality improvement suggestions derived from data analysis; The incentive mechanism is not perfect, and there is a lack of effective incentives for innovative practices and research related to big data applications, resulting in low enthusiasm for teachers and management personnel to participate, making it difficult to form an endogenous driving force to promote the development of big data-driven quality management.

6. Countermeasures for quality management of higher vocational education driven by big data

6.1. Improve the data security protection system

Improving the data security protection system is the core countermeasure to solve data security and privacy issues, and it is necessary to build a comprehensive protection system of “technical protection+institutional norms+compliance supervision.” At the technical level, strengthen the research and application of big data security protection technology, deploy advanced technologies and equipment such as data encryption, access control, intrusion detection, and security auditing, and build multi-level data security protection barriers; Establish data backup and disaster recovery mechanisms to ensure data integrity and availability. At the institutional level, establish and improve data security management regulations, clarify the security requirements and operational norms for various links such as data collection, storage, use, and transmission; Establish a data classification and management mechanism, focus on protecting sensitive data, and strictly define data access permissions. At the level of compliance supervision, strictly follow relevant laws and regulations on data security, strengthen communication and cooperation with regulatory authorities, and ensure that data

management practices are compliant and legal. Establish a data security risk assessment mechanism, conduct regular security inspections and risk assessments, and promptly identify and rectify security risks.

6.2. Strengthen the research and development of data analysis technology and talent cultivation

Breaking through the bottleneck of technology and talent requires collaborative efforts from both technology research and development and talent cultivation. In terms of technological research and development, increase investment in specialized big data analysis technology for vocational education, collaborate with research institutions and technology enterprises to develop analysis models, algorithms, and software platforms that are suitable for the quality management needs of vocational education, and enhance the compatibility between technology and practice; Promote the upgrading and transformation of big data analysis platforms in universities, optimize technical architecture, and improve the efficiency and accuracy of data processing and analysis. In terms of talent cultivation, educators will build a diversified and composite talent cultivation system, cooperate with universities and enterprises to carry out customized training, and enhance the big data application capabilities of existing management personnel and teachers; Incorporate big data related majors into the vocational education talent training system, and cultivate professional talents with dual literacy in big data technology and educational management; Improve the talent introduction mechanism, attract outstanding big data technology and management talents in the industry to join, build a professional big data management team, and provide talent support for the operation of the system.

6.3. Innovative management concepts and optimized management mechanisms

Reforming management concepts and optimizing management mechanisms are important guarantees for promoting the implementation of big data-driven quality management. In terms of conceptual innovation, educators will strengthen the training of big data concepts for the management and faculty of colleges and universities. Through special lectures, case sharing, practical discussions, and other forms, educators will enhance their understanding and recognition of the data-driven quality management model, and establish a scientific management concept with data as the core; Promote the transformation of management thinking from experience-driven to data-driven, and integrate big data applications throughout the entire quality management process. In terms of mechanism optimization, breaking down departmental data barriers, establishing cross departmental collaborative management mechanisms, setting up specialized big data management agencies, coordinating data collection, integration, and application work, and achieving data resource sharing; Optimize the quality management process, simplify the approval process, establish a rapid response mechanism, and ensure that data analysis results can be promptly transformed into management decisions and practical actions; Improve incentive mechanisms, incorporate the effectiveness of big data applications into the performance evaluation system, commend and reward innovative practical achievements, and stimulate the enthusiasm and initiative of all employees to participate in big data-driven quality management.

7. Conclusion

In summary, the construction and practical exploration of a quality management system for higher vocational education driven by big data is an important way to promote the high-quality development of higher vocational education. By solving practical problems and taking effective measures, educators can fully leverage the

advantages of big data, continuously improve the quality management system, and enhance the quality and level of higher vocational education.

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