

Original Paper

The Use of Big Data Technology in Higher Education Management

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Abstract

With the rapid development of information technology, big data technology has deeply penetrated into all fields of society, including the field of education. In higher vocational education, the use of big data technology is gradually changing the teaching method, improving the quality of teaching, and positively affecting the personalized development of students. This paper will discuss in detail the use of big data technology in higher vocational education and analyze the opportunities and challenges it brings.

Keywords

Higher education, big data technology, innovation pathways, student management,

1. Introduction

As an important channel for cultivating technical and skilled talents, higher vocational education plays a crucial role in the current social and economic development. However, with the rapid development of the society and the continuous updating of technology, the management of higher vocational education is facing increasingly complex challenges. How to effectively manage student information, monitor and evaluate teaching quality, and rationally allocate educational resources has become an urgent problem for higher education administrators.

In this era of informatization and digitization, the rise of big data technology provides new possibilities for solving these problems. Big data technology has injected new vitality into the management of higher education with its powerful data processing ability, intelligent analysis means and accurate prediction ability. Through the collection, integration and analysis of massive data, higher vocational colleges and universities can better understand the learning behavior of students, grasp the teaching effect and optimize the allocation of resources, thus improving the quality and efficiency of education and teaching.

In this paper, we will deeply explore the application of big data technology in higher vocational education management, and analyze it from the aspects of student information management, teaching quality monitoring, and education resource allocation, and we will also discuss the challenges and countermeasures faced by the implementation of big data technology, and look forward to the future development trend of big data technology in higher vocational education management. Through the research of this paper, we can more clearly recognize the importance and value of big data technology in the management of higher vocational education, and provide theoretical support and practical guidance for the modernization and intelligent development of higher vocational education.

2. Status and Challenges of Higher Education Management

Higher vocational education, as an important way to cultivate technical and skilled personnel, occupies an important position in China's education system. However, although higher vocational education has made certain development in recent years, it still faces many challenges and difficulties. The characteristics of higher vocational education include its strong vocationality and practicality, which is closely related to the needs of the industry and cultivates talents with practical operation ability, and therefore is widely recognized and supported by all walks of life, and the employment rate of graduates is high.

However, with the expansion of the scale of higher vocational colleges and universities and the increase in the number of students, the management of student information has become more and more complex. This includes the data management of enrollment and admission, student registration management, academic performance and other aspects have become cumbersome, leading to a decline in management efficiency and confusion in data management. At the same time, the monitoring and evaluation of teaching quality also faces many difficulties. How to comprehensively and objectively assess the quality of teaching and find and solve the problems in the teaching process has always been an important task for the management of higher education. In addition, the rational allocation and utilization of educational resources is also a major challenge. Due to the problems of limited resources and uneven distribution, the utilization efficiency of educational resources is low and it is difficult to meet the needs of higher vocational education.

In the face of these challenges, administrators of higher vocational education urgently need to seek effective solutions to promote the sustainable and healthy development of higher vocational education. In this context, the emergence of big data technology brings new opportunities and possibilities for higher education management. By collecting, integrating and analyzing massive data, big data technology can provide more accurate decision support for higher vocational education management. For example, through the analysis of student information, it can better understand the characteristics and needs of students and provide support for personalized education; through the data analysis of the teaching process, it can timely identify problems in teaching and make targeted improvements and optimization; through the analysis of the utilization of educational resources, it can realize the optimal

allocation of resources and improve the efficiency of resource utilization.

Therefore, big data technology is expected to become an important tool for the management of higher education, providing new ideas and methods to solve the various challenges currently faced.

3. Overview of Big Data Technologies

Big data technology refers to the techniques and methods used to process and analyze large-scale data. With the advent of the information age, it has become a norm to generate massive amounts of data that cover a wide range of information from sensors, mobile devices, social media, internet applications and more. By utilizing advanced computer technology, data processing algorithms and statistical methods, big data technology is able to extract valuable information and insights from these massive data, provide support for decision-making, and discover patterns and trends hidden in the data.

The core features of big data technologies include the following:

Large Data Scale: Big Data technologies usually deal with data scales that are far beyond the capabilities of traditional databases and processing tools. These data volumes are usually measured in TB, PB or even EB, and need to be processed using distributed systems and parallel computing techniques.

Data diversity: Big Data includes not only structured data (such as tabular data in relational databases), but also semi-structured data (such as XML, JSON, and other format data) and unstructured data (such as text, images, audio, video, etc.). Therefore, Big Data technologies need to have the ability to handle multiple data types.

Data timeliness: As the speed of data generation accelerates, the need for real-time processing and analysis of data is becoming more and more urgent. Big data technologies usually have the ability to process real-time data, and can analyze and mine data in real-time while it is being generated.

Data Valorization: Big data technology not only focuses on the collection and storage of data, but more importantly on how to extract valuable information and insights from massive amounts of data and apply them to decision-making and business in order to create greater value.

The core components of big data technology include data collection, data storage, data processing and data analysis. The data acquisition phase acquires data from different sources through various means and tools; the data storage phase utilizes distributed storage systems (e.g., Hadoop, HBase, Cassandra, etc.) for data storage; the data processing phase uses distributed computing frameworks (e.g., MapReduce, Spark, etc.) to process and compute the data; and the data analysis phase uses data mining. The data analysis stage analyzes and mines the data through data mining, machine learning and other technologies to discover valuable information and laws.

In general, the application of big data technology in the management of higher vocational education will help to better understand the learning behavior of students, grasp the teaching effect, optimize the allocation of resources, so as to improve the quality and efficiency of education and teaching.

4. The Application of Big Data Technology in Higher Education Management

Big data technology has a wide range of application prospects in the management of higher education, which can help school administrators better understand students' learning behavior, grasp the effectiveness of teaching, and optimize the allocation of resources, so as to improve the quality and efficiency of education and teaching.

4.1 Student Information Management and Personalized Education

Student information management and personalized education is one of the important applications of big data technology in higher education management. The application aims to provide personalized teaching services and learning support for schools using multi-dimensional data such as students' personal information, learning data and behavioral patterns.

Student Data Analysis and Prediction

Higher education institutions usually collect a variety of data such as students' personal information (e.g., gender, age, major), academic information (e.g., grades, rankings), and learning behavior data (e.g., course access records, homework completion). Big data technologies can help schools integrate these data and build a database of student information.

Using big data analytics, schools can deeply mine and analyze student data to understand students' learning habits, behavioral patterns and characteristics. Through data mining and machine learning algorithms, the patterns and trends hidden in the data can be discovered to predict students' future learning needs and development direction.

Personalized learning path design and recommendation system:

Based on students' personalized data and learning needs, schools can design personalized learning paths for each student. By analyzing information such as students' subject interests, learning abilities and learning goals, the school can tailor the course schedule and learning plan for students in order to improve the relevance and effectiveness of learning.

Using big data technology to build a personalized course recommendation system to recommend courses, textbooks and learning resources that meet students' learning needs and interests. The recommendation system can provide students with personalized learning suggestions and resource recommendations based on their historical learning data and behavioral patterns, helping them learn and grow more efficiently.

Through student information management and personalized education, schools can better understand the learning needs and characteristics of each student and provide them with personalized learning support and guidance. This not only improves students' motivation and enthusiasm for learning, but also promotes improved performance and holistic personal development. At the same time, personalized education also helps to reduce students' learning pressure, enhance their interest and self-confidence in learning, and promote their all-round development and personal growth.

4.2 Teaching Quality Monitoring and Evaluation

Teaching quality monitoring and assessment is one of the key applications of big data technology in the management of higher vocational education. By collecting, analyzing and evaluating data on the teaching process and students' learning, it helps schools and teachers to fully understand the effectiveness of teaching and learning, and to identify problems in time and make improvements and optimizations.

Online learning behavior analysis:

In higher vocational education, many courses are taught using online learning platforms, and students' learning behaviors on the platforms are recorded, including access to the courses, learning hours, homework submission, and interactive exchanges.

Using big data technology to analyze students' behavioral data on online learning platforms, we can understand students' learning habits, learning styles and learning attitudes. For example, by analyzing students' course access records and study hours, it is possible to understand which courses receive students' attention, which courses have a high level of learning enthusiasm, and whether any students have poor learning habits.

Teaching Effect Evaluation and Optimization:

Using big data technology to analyze students' test scores, homework scores, etc., we can assess the effectiveness of teaching and students' learning level. By analyzing the distribution of students' grades, trend changes, etc., problems and deficiencies in teaching can be found.

Big data technology is used to collect students' feedback and suggestions, and to understand students' evaluation of teaching content, teaching methods and teachers, so as to provide reference for the improvement and optimization of teaching.

Real-time monitoring and feedback mechanism:

Big data technology can realize real-time monitoring of the teaching process and timely discover problems and abnormalities in teaching. For example, by monitoring students' online learning behavior and learning progress, problems such as learning stagnation and learning withdrawal can be detected in time.

Based on the results of big data analysis, schools and teachers can establish an effective feedback mechanism to provide timely feedback and suggestions to students and teachers. For example, timely encouragement, guidance and assistance will be given to students in terms of their learning situation and performance; timely improvement suggestions and teaching support will be provided to teachers in terms of their teaching effectiveness and teaching methods.

Through teaching quality monitoring and assessment, schools can fully understand the teaching process and student learning, find problems and make timely adjustments and improvements to improve teaching quality and student satisfaction. At the same time, the application of big data technology can also provide teachers with more teaching support and guidance to improve their teaching level and teaching effectiveness.

4.3 Educational Resource Management and Allocation

Educational resource management and allocation is another important application field of big data technology in higher education management, which improves the efficiency of resource utilization and the quality of teaching by collecting, analyzing and optimizing the allocation of data on educational resources.

Optimized allocation of teacher resources:

Big data technology is utilized to comprehensively assess the data of teachers' teaching effectiveness, teaching evaluation, and scientific research achievements, so as to comprehensively understand the teaching level and ability of teachers. By analyzing teachers' performance data, teachers can be classified and rated, providing a reference basis for teachers' career development and position allocation.

Teachers' teaching tasks and workload are rationally arranged according to their professional background, teaching ability and teaching needs. Through big data technology, dynamic allocation and adjustment of teachers' tasks can be realized to ensure the full utilization and rational allocation of teachers' resources.

Teaching facilities utilization efficiency is improved:

Big data technology is used to analyze classroom usage, utilization rate and other data to understand the busyness and utilization efficiency of classrooms. By analyzing the utilization rate and vacancy of classrooms, classroom resources can be reasonably arranged to optimize the efficiency of classroom use.

Analysis of laboratory equipment usage: Higher education institutions usually have various types of laboratory equipment, such as experimental instruments and computer equipment. Using big data technology to analyze the use of laboratory equipment, utilization rate and other data, we can understand the busyness and efficiency of the use of laboratory equipment, rationalize the arrangement of laboratory resources, and improve the efficiency of the use of laboratory equipment.

Intelligent decision support for resource allocation:

Based on the results of big data analysis, school administrators can develop more scientific and reasonable resource allocation strategies and planning programs. By analyzing data on resource utilization, teaching needs and school development planning, intelligent support for resource allocation decisions can be realized, improving the accuracy and efficiency of decision-making.

The use of big data technology to predict and analyze the number of students and curriculum needs in the future provides a reference basis for the school's future resource planning. Through predictive resource planning, resources can be rationally allocated and prepared in advance to provide a guarantee for the sustainable development and teaching work of the school.

Through educational resource management and allocation, schools can utilize and manage educational resources more scientifically, improve the efficiency of resource utilization, optimize the teaching environment, and improve the quality of teaching and service level. At the same time, the application of

big data technology can also provide school managers with more decision-making support and management guidance, promoting the sustainable development of schools and the healthy development of education.

5. Challenges and Countermeasures in Implementing Big Data Technology in Higher Education Management

The implementation of big data technology in the management of higher education faces a number of challenges, and corresponding countermeasures need to be developed for these challenges to ensure the effective application and smooth promotion of big data technology.

5.1 Data Quality and Integrity Issues

The issue of data quality and completeness is one of the important challenges in implementing big data technologies in higher education management, and the lack of high quality and complete data can affect the accuracy and validity of data analysis. The following are specific countermeasures to this challenge: Schools should establish a perfect data quality management system, including the whole process management of data collection, storage, processing and analysis. Formulate corresponding data quality standards and specifications to clarify the source, format, content and other requirements of data to ensure the accuracy, consistency and credibility of data. During the data collection and integration stage, the university should strengthen the cleaning and pre-processing of data, discover and repair errors, anomalies and deficiencies in the data in a timely manner, and ensure the completeness and accuracy of the data. Data cleaning and processing tools are adopted to automatically identify and correct data errors and improve data quality. The university should establish a data monitoring and evaluation mechanism to monitor and evaluate data quality on a regular basis. Utilizing data quality indicators and evaluation systems, quantitative and qualitative analysis of data is carried out to identify data quality problems and take corrective measures in time to improve the level of data quality. Strengthen data security management: Data security is one of the important guarantees for data quality and integrity. Schools should strengthen the security management of data and establish a sound data security protection mechanism and privacy protection policy to protect the confidentiality, integrity and availability of data and prevent data from being tampered with, lost or leaked. Schools can expand data sources, enrich data types, and improve data integrity and diversity by sharing data resources with industry partners, other universities and research institutions. Establish data sharing platforms and mechanisms to promote data sharing and exchange, and enhance the efficiency of data management and utilization.

Through the implementation of the above countermeasures, the school can effectively deal with data quality and integrity issues, improve the accuracy, credibility and usability of data, and provide good data support and guarantee for the application of big data technology in higher education management.

5.2 Privacy Protection and Information Security Risks

Privacy protection and information security risks are one of the key challenges in implementing big data technologies in higher education management. Privacy protection and information security need to be highly emphasized when handling large amounts of personal information of students and teachers. The following are countermeasures to this challenge:

Schools should formulate clear privacy protection policies and norms that specify the principles of collecting, using, storing, and sharing students' and teachers' personal information to protect their privacy rights and interests. Schools should implement a strict data access rights management system to control the rights of sensitive personal information so that only authorized personnel can access relevant data.

For sensitive personal information and confidential data, data encryption technology is used for protection, and data security is guaranteed during data transmission and storage. At the same time, data is desensitized to remove or replace personally identifiable information to reduce the risk of data leakage. Strengthen network security measures, including the establishment of firewalls, intrusion detection systems, security audit systems, etc., to prevent network attacks and the risk of data leakage.

Provide regular training and education on privacy protection and information security awareness to faculty and staff to enhance their understanding of and compliance with privacy protection policies and security norms, and improve their security awareness and ability to handle personal information and sensitive data. Establish reporting channels and mechanisms to encourage employees to take the initiative to report security issues and privacy breaches, and to identify and address potential security risks in a timely manner. Implementation of data tracking and monitoring: Establish a data usage and access log recording system to conduct real-time monitoring and tracking of data usage and access behaviors, discover abnormal behaviors and security threats, and take timely countermeasures. Regularly assess data processing and information security risks, identify and resolve potential privacy leaks and information security issues, and ensure that data processing and management efforts comply with laws, regulations and compliance requirements.

Data security is one of the important guarantees of data quality and integrity. The university should strengthen the security management of data, establish a sound data security protection mechanism and privacy protection policy, protect the confidentiality, integrity and availability of data, and prevent data from being tampered with, lost or leaked.

5.3 Insufficient Technical Personnel and Specialized Capacity

Insufficient technical talent and professional competence is a major challenge in implementing big data technology in higher education management. Lack of specialized technical talent can affect the development, operation and management of big data projects, which in turn affects the effectiveness and outcomes of the projects. The following are specific responses to this challenge:

Schools can develop and implement a big data technology training program for faculty and staff, providing training courses including data analysis, data mining, and artificial intelligence to improve

the level of data technology among faculty and staff. The school can introduce external talents with professional background and experience in big data technology, including data analysts, data scientists, data engineers, etc., to provide professional support and technical guidance for the school's big data program.

The school can establish a sound talent selection and incentive mechanism to emphasize and cultivate talents with big data technology capabilities and potential, and provide good promotion and development opportunities. Encourage interdisciplinary cooperation, establish multidisciplinary and multidisciplinary teams, attract talents from different fields to participate in big data projects, give full play to their professional advantages, and enhance the comprehensive strength and competitiveness of the projects. Schools can establish cooperative relationships with enterprises, research institutions, etc., to jointly carry out big data technology projects, and utilize external resources and technical support to improve the technical level and effect of the projects. The school can establish a technical exchange platform, organize technical seminars, academic forums and other activities to promote exchanges and cooperation among technical talents, and improve their professional ability and innovation capacity.

For some specific technical needs, schools can consider outsourcing services to entrust professional third-party organizations or companies to carry out technical development and project implementation to meet the needs of schools and save human resource costs. Schools can utilize the big data services provided by cloud service platforms, such as cloud computing and data analysis, to quickly build big data environments and platforms and reduce the difficulty of technical talent demand and project implementation.

Through the implementation of the above countermeasures, schools can effectively respond to the challenges of insufficient technical talents and professional capabilities, establish a professional technical team and project management system, and promote the smooth implementation and application of big data technology in higher education management.

5.4 Management Systems and Cultural Shifts

Management system and culture shift is one of the important challenges in implementing big data technology in higher education management. Traditional management systems and cultures may not be conducive to the application and promotion of big data technologies and need to be transformed and adapted accordingly. The following are specific responses to this challenge:

School leaders should provide clear support and commitment to incorporate big data technologies into the school's development strategy and planning, and provide the necessary resources and support for the advancement of big data projects. Schools can optimize their organizational structure and set up a special big data management department or position to coordinate and harmonize the implementation and management of big data projects, with clear responsibilities and authorities.

Schools should advocate a culture of innovation, encourage faculty and staff to experiment and innovate, and raise their awareness of accepting and applying new technologies. Establish an incentive mechanism to reward individuals and teams with outstanding performance in big data projects and

stimulate their enthusiasm and motivation for innovation. Establish an information-sharing platform to promote information sharing and exchange among departments within the school and among faculty and staff, and improve the efficiency of information flow.

Strengthen communication and collaboration within and outside the university, and actively carry out cooperation with enterprises and research organizations to jointly promote the application and innovation of big data technology. Establish a data-based decision-making mechanism, promote school administrators and faculty to make decisions based on data, and improve the scientificity and accuracy of decision-making.

Actively publicize and promote successful cases of big data technology in other schools or industries to stimulate the interest and confidence of school administrators and teaching staff, and to promote the transformation of the management system and culture.

Establish a feedback mechanism to regularly collect and analyze feedback and suggestions from users, so as to timely adjust and improve the implementation and management of Big Data projects. School administrators and staff should maintain an attitude of continuous learning to update their knowledge and skills and adapt to the needs of the development and change of big data technology.

Through the implementation of the above countermeasures, the school can gradually promote the transformation of the management system and culture, create a favorable environment conducive to the application and innovation of big data technology, and provide strong support for the modernization of higher education management and the development of information technology.

6. Result

Comprehensive analysis shows that big data technology has important application prospects and potential in higher vocational education management. Through the application of student information management, teaching quality monitoring, educational resource management and other aspects, it can realize the intelligence, refinement and personalization of educational management, providing new ideas and means to improve teaching quality and optimize resource allocation. However, the implementation of big data technology also faces a series of challenges, such as data quality and security, shortage of technical talents, management system and cultural transformation. In response to these challenges, schools need to continuously strengthen the cultivation and introduction of technical talents, establish a sound data management and security protection mechanism, and promote the transformation of the management system and culture. Meanwhile, with the progress of technology and the accumulation of application experience, the application of big data technology in higher education management will continue to deepen and expand, injecting new vitality and momentum into the modernization and informatization development of higher education.

Looking ahead, with the continuous development and application of big data technology, higher vocational education management will usher in a broader development space and opportunities. It is foreseeable that big data technology will become one of the core driving forces of higher education

management, providing solid support for the continuous improvement and enhancement of higher education. Schools should actively grasp the opportunities brought by big data technology, strengthen the cultivation and introduction of technical talents, continuously explore and innovate, promote the transformation and upgrading of the education management mode, promote the higher vocational education in the direction of more scientific, intelligent and efficient, and contribute to the cultivation of more high-quality application-oriented talents.

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