Analysis of Application of Big Data in College Education Management

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Abstract: As big data technologies gradually mature, big data and the field of higher education are more and more closely merged. By analyzing the characteristics of data and application process of higher education, it is found that the big data plays a supporting role in education policy-making, operations management of teaching processes, education evaluation and learning autonomy of students. However, universities should focus on the problems of security management, privacy protection and business model that exist in the application of big data technologies. Additionally, universities could establish security defense architecture of big data, integrative data platform and U-G-E (university, government, enterprise) multiparty collaborative innovation to protect data and solve those problems.

1. Introduction
As the big data technologies become gradually mature, they see wider application in all aspects of production, which reveals that more and more researchers begin to study the application of big data in the field of higher education. China has promoted the strategies in the big data education, continuously launching some important initiatives, such as Action Plan for Promoting Big Data Development (2015), the 13th Five-Year Plan for Educational Informatization (2016) and Education Informatization 2.0 Action Plans (2018). Big data has promoted the reform and innovation of higher education and it is increasingly becoming the key to deepen the comprehensive reform of education in universities.

2. Characteristics and application process of big data in higher education

2.1. Definition and characteristics of big data in higher education
Big data in higher education refers to data sets generated in teaching, scientific research, daily management and other practical activities of the higher education, including the data of teaching, scientific research, management, logistics services. Besides having the general characteristics of big data, higher-education big data has its own characteristics due to its involving subjects and content, such as fragmentation, continuity, multiple-dimension and complexity [1]. The characteristics of fragmentation mean that as the fragmentation reading, fragmented learning and dispersion behavior of individual occur, lots of scattered, disordered and unsystematic data are generated in the teaching processes. Continuity reflects the regularity of teaching activities and the data generated in the teaching processes has certain periodicity, which requires long-time and continuous monitor of data. Multiple-dimension shows the total states of the involving subjects in teaching processes, which is composed of learning data, social data, economic consumption data, thought state data and other
different levels of data. Complexity reflects the diversity of teaching activities, including the regular structured data, such as grade, course selection, attendance, and non-structured data such as multimedia video and audio resources.

2.2. General processes of big data processing in higher education

Through statistics, it is known that in 2018, the number of regular institutions of higher education reached 2663 and the population of students in all kinds of higher education reached 8.33 million, which resulted in a large amount of teaching and managing data. How to effectively apply big data and determine the steps of big data analysis is great of significance (seen in Figure 1). Moreover, with the rise of online education and large-scale open web-based courses in recent years, the key technologies such as the collection, processing, analysis and visualization of large-scale data have been widely used in the domain of higher education.

![General processes of big data processing](image)

Figure 1. General processes of big data processing

3. Important application fields of big data in education management

3.1. Decision-making based on big data

Before the occurrence of big data, educational decisions were made according the experience of managers. And sometimes, the management decisions were made based on the support of data, most of which were static and local, resulting in non-obvious effects. For example, when making the strategies to optimize students’ time, the available data that could be adopted directly in the past, were only limited in the aspects of students' class, catering, resting and book borrowing. Due to lacking the understanding of entertainment, social situation and other information of students, the accurate judgment of decision-making would be influenced. However, in the big data age, not only the collection of educational data, the mining and analysis of educational data as well as the visualization of educational data can track, monitor and predict the data for a long time, but also the visualization technology could help to find the inherent laws implied in the data, thus assisting the management team of high school to make the scientific decisions and avoiding the problem of extensive educational decision-making.

Big data could improve the quality of educational policies at different levels. From the microscopic angle, teachers could master the learning needs, characteristics and effect of each student in the class via educational data mining and analysis techniques, thus providing data support for personalized teaching. In the medium aspect, management departments in university could use big data to optimize and improve teaching and researching management, personnel management, enrollment management, employment management and other aspects of decision-making. For instance, Bucknell University adopted big data to mine and analyze data collected from each department, thus making global or local strategic planning and decisions. At macro level, countries and regions could adopt big data technologies to monitor, warn and predict the scale, structure adjustment and allocation of funds based on the overall situation of the development of higher education.

3.2. Management of teaching operation based on big data

Big data technologies could promote the management of teaching processes, such as professional direction recommendation, course learning management, credit management. In the aspect of professional direction recommendation, universities could use data analysis and prediction
technologies to suggest students to choose the major suitable for themselves according to the course grades and interests of students. For curriculum management, the management departments and course teachers could monitor the whole studying processes of students via MOOC study platform or online course platform, including the starting and ending time for logging platform of students, the viewing frequency of a certain knowledge point, the learning progress and the course grade. Moreover, based on the early warning information, teachers could guild students to study in time. On credit management, universities could confirm how many credits students should earn in each semester through big data platform. If the students could not meet the requirements, the data platform would provide the prompt and early warning to the teaching management departments and students.

Furthermore, big data technologies could promote the transformation of the assessment styles in teaching, that is from fuzzy macro evaluation to quantitative and accurate evaluation. Taking the participating research as an example, Zhao Lei, the PhD of Huazhong University of Science and Technology, thinks that big data could improve the drawbacks of traditional teaching evaluation and transformation from result evaluation to process evaluation, thus promoting the diversification and scientization of teaching evaluation [2]. The management practice of Xi'an Jiaotong University fully proves the view of Zhao Lei. Xi'an Jiaotong University has established big data platform for teaching quality monitoring and integrated the data sources of teaching quality (such as student attendance records, classroom teaching videos) and evaluation data sources (such as student evaluation, supervision and evaluation, leadership listening), thus achieving the transformation of classroom teaching evaluation through the correlation analysis of big data [3].

3.3. Management of student autonomous learning
In operation and management of teaching, big data platforms, such as study management system and MOOC platform, store and collect a large amount of individual information, learning behavior information, performance information and human-computer interaction of students, which completely describes the learning growth track of students and provides a good interactive platform for both students and teachers. For students, they could review the learning track, knowledge palm and performance via data platform, thus finding their study weaknesses and promoting self-learning and growth. From one empirical survey on the understanding and use of online autonomous learning, it is found that self-learning under the environment of big data could improve the study efficiency comprehensive practical ability of students [4].

4. Key methods to promote application of big date of higher education
Form the analysis above, combined with the characteristics of big data in education, big data technologies play an important role in educational decision-making, quality management of teaching process, education evaluation, learning and development of students. However, universities should concern about the security management, privacy protection and business model generated in the application of big data technologies and adopt some key measures to prevent and respond.

4.1. Establishing security defense system of big data and taking multiple measures to ensure data security
The security management of big data in education is the important premise to apply the big data in educational environments. To protect the privacy of teachers and students, universities should establish security defense system of big data. First of all, in the technology, universities need to upgrade the date protection technologies, such as identity authentication, data encryption, firewall, virus detection, access threshold, anonymity and blur processing. Apart from this, universities should develop and introduce new data protection technology, such as blockchain technology and technique desensitization approach [5]. Nest, in management policies, universities should perfect and improve data security and confidentiality system and standards, making system management and protective technology complement each other. By improving and implementing safety protection system, the management and safety responsibility of secret departments and staff should be expressly stipulated,
the data management processes should be normalized, the collection, using, sharing and destroying of data should be implemented and the tracking mechanism should be established so that the responsibility could be claimed based on associated audit technique when the problems occur. Eventually, universities should construct the security risk assessment as well as improved mechanism, found specialized data review departments to regularly conduct assessment analysis, security vulnerability monitoring, data backup and normalization audits, thus guaranteeing the continuous improvement of data security protection system.

Moreover, the methods that Marist College uses in data security and privacy protection, could offer us lots of inspirations. To protect personal privacy of students, Marist College deletes the sensitive information that indicates the identity of a student and replace it by unrelated numbers. When decoding the information of students, the electronic security secret-keys rendered by three different authorized users should be obtained at the same time. In addition, Marist College sets up Institutional Review Board, which takes responsibility of supervising the whole process of students' data collection, storage, analysis and use, thus further guaranteeing the data safety of students [6]. Therefore, in the big data age that the difficulty factors of data security protection are increasing constantly, Marist College combines the technology as well as management, and adopts anonymization, data encryption, decentralized control, special review and other methods to protect students’ data.

4.2. Establishing educational big data platform and U-G-E tripartite collaborative innovation

To integrate and optimize the existing information management platforms of university and obtain high-quality educational data, it is necessary to establish integrative big data platform for education, which should have functions of collecting, storing and deeply analyzing school business system data (such as teaching, scientific research, personnel and other business data), student behavior data, out-of-school data and other data. The architecture of this platform is shown in Figure 2 [7].

In platform establishment and operation mode, universities could make full use of their own resource based on the actual need, cooperate with government and enterprises, together create U-G-E collaborative innovation model (dominated by government, enterprises establish platform and universities apply). This model could make full use of the resources of three parties, thus forming a joint force in platform operation, data processing, analysis and application. At the same time, three parties would play an important role in cultivating talents in the field of big data technologies and improving data information literacy of educational management staff (data thinking, data processing and analysis capabilities).

![Figure 2. Architecture of big data platform for education](image-url)
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