The Application of Big Data Technology in the Analysis of Education Optimization Management

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Abstract. In order to further optimize the content and design of education, thus improve the management level and efficiency, this article presents the application research of large-scale information technology in education quality management system. This article first analyzes the advantages and disadvantages of large-scale information management of higher education, then studies the main reasons for various problems, and finally focuses on the ways to innovate and optimize the management of higher education in the context of large-scale information processing. The strategy for optimizing the management of higher education in the context of large-scale information is to transform the management thinking of education; Develop a comprehensive information system; Management innovation; Collect information technology major; Information and information is reconstructing the social structure from such aspects as morality, culture, economy, school, and daily life. In this process, large data sets play an important role. The integration of mass information technology into the management of universities can strengthen their management through both theoretical and practical perspectives, ultimately promoting teaching reform in higher education.

Keywords: big data technology; education optimization; management; information platform

1 Introduction

In this evolving landscape, it is imperative for educational institutions to proactively explore and implement cutting-edge information technologies. The seamless integration of big data technology into university management is essential to enhance daily administrative tasks, continually elevate the quality of management practices, and foster the advancement of higher education institutions. Large-scale information technology represents the most recent innovation, emerging in tandem with the ongoing progress in computer and information technology[1]. By analyzing information on Internet by computer, customers can choose the most useful information, thus promoting scientific management and decision-making activities. It is precisely because of the importance of using the importance of large data sets in the analysis and decision-making processes that daily management in many enterprises frequently uses large data sets technology to continue to optimize their existing operations[2-3].Therefore, in the daily management of higher education, it is necessary to use large amount of information, further improve the management efficiency, and promote the development of various kinds of university performance management, as shown in Figure 1. Great information has entered into everyone's ideas and is integrated into every aspect of our lives. Large-scale data, as one of the

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most innovative resources in today's landscape, doesn't just signify a vast volume of data; it also entails substantial data processing and analysis to unlock its true potential. To elaborate further, as computer technology continues to advance rapidly, media information has become increasingly diverse. College students are exposed to a growing influx of information, gradually immersed in internet culture, and their thought patterns are evolving accordingly. Moreover, as information systems undergo reform, there is a shift in the ideological education of college students[4-6]. For example, Table 1 provides an overview of the use of large data sets in educational management.

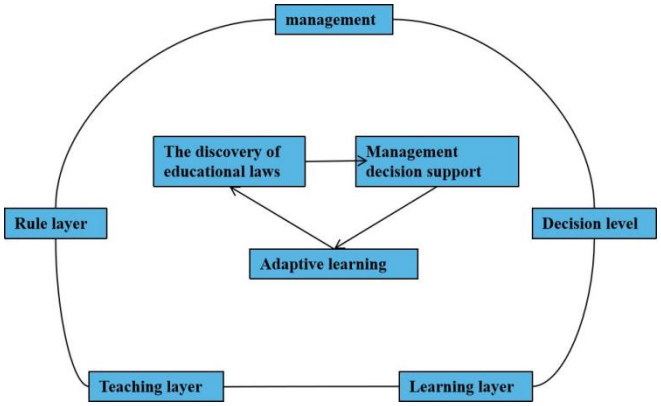

Figure. 1. The Application of Big Data in Education

Table 1. Application of Big Data in Education Management

Media technology	Learning resources	Learning activities	Learning support	Connectivity
Rich in functions	Clear structure	Resource learning	Learning guidance	Network breadth
Design is easy to use	Rich content	Exchange discussion	Q&A feedback	Network depth
Ubiquitous support	Teaching effect	learning effect	Non-academic support	network structure

2 Application of Deep Learning Algorithms in Higher Education Management

Deep learning is a powerful approach that leverages hierarchical feature extraction to create more abstract representations of data, enabling the discovery of distributed feature representations. It is composed of multiple layers, including convolution, pooling, and fully-connected layers. This architecture effectively enhances the training depth of Convolutional Neural Networks (CNNs), leading to improved training accuracy and the ability to flexibly adjust network parameters. Furthermore, deep learning has integrated advanced techniques and technologies into its applications, such as simulated annealing, gradient descent, and information measurement. These advancements not only improve the accuracy of deep learning but also broaden its scope of applications. For instance, it finds practical utility in

diverse domains such as smart grid management, medical image analysis, anomaly detection, and wireless signal forecasting. Consequently, deep learning contributes to the precision of tasks like data mining, pattern recognition, and machine learning. In the realm of higher education management with deep learning, the framework consists of six levels: the input layer, convolutional layer C1, pooling layer S1, convolutional layer C2, pooling layer S2, and fully connected layer. By leveraging principles from convolutional mathematics and neural network learning, this approach enhances the training accuracy of neural network models, thereby improving their capacity to recognize and process information effectively. These levels play essential roles in various aspects of higher education management, optimizing tasks such as data analysis, pattern recognition, and decision-making processes.

1)Input layer

We have chosen text vectorization as the initial step in processing data for our Convolutional Neural Network (CNN). This method involves mapping the vast input information into an n-dimensional vector space using word embedding techniques. Subsequently, we integrate all the input data into a cohesive representation.Set the data format of the input learning materials as $(\text{useri}, \ \text{ci0} \oplus \text{ci1} \oplus \cdots \oplus \text{c}_{\text{in}}, \frac{1}{\text{n}} \sum_{\text{j=1}}^{\text{n}} \text{o}_{\text{ij}})$, $\oplus$ represents learning information connected by convolution symbols user information could be gained as $(\text{user}_{\text{i}}, \text{g}_{\text{i}}, \bar{\text{o}}_{\text{i}})$. The symbol gi encompasses all the information related to the learning material, while the symbol $\bar{\text{o}}_{\text{i}}$ represents the entirety of the learner's information. Through the application of text vectorization technology, we consolidate and represent all this information into a single vector, referred to as veci, as shown in Formula (1):

$$\text{vec}_{\text{i}} = \text{Doc 2Vec C}(\text{g}_{\text{i}}) \tag{1}$$

The function Doc2VecC takes the input data and transforms it into an n-dimensional vector using Formula (1). Then, we represent all user information by calculating the simple average of text embeddings. This approach allows us to capture the semantic content of the entire information during training and learning. Finally, through text quantization technology, we convert the user sample information into the format described in Formula (2)：

$$\text{A} = (\text{user}_{\text{i}}, \text{vec}_{\text{i}}, \bar{\text{o}}_{\text{i}}) \tag{2}$$

2)Convolutional Layer

The text-processed input information undergoes convolution using a representation matrix. It's important to note that the convolution process for textual data differs from that of images and can be conducted along a one-dimensional space. We use cj∈R1 to denote the resulting feature after text convolution, and the specific convolution formula is illustrated in Equation (3)：

$$\text{c}_{\text{i}}^{\text{j}} = \text{f}\left(\text{W}_{\text{c}}^{\text{j}} * \text{g}_{(:\text{i}:(\text{i}+\text{Ws}-1))} + \text{l}_{\text{c}}^{\text{j}}\right) \tag{3}$$

In Equation (3), the symbol $*$ signifies the convolution operation. The term clj$\in$ R denotes the bias vector, and the function f refers to the Rectified Linear Unit (ReLU) activation function used in the convolution layer. The inclusion of the ReLU activation function is essential as it effectively prevents the vanishing gradient problem.

Eigenvector is $c \in R^{i-WS+1}$, the convolution formula (4) using the convolution kernel Wjc is as follows：

$$c^j = \left[c_1^j, c_2^j, \cdots, c_i^j, \cdots, c_{i-wS+1}^j\right] \tag{4}$$

By following the steps described above, we employ multiple sets of convolution kernels to extract convolutional features related to university talents' information.

3)Pooling Layer

The pooling layer is applied to reduce the dimensionality of the features generated by the convolutional layer. This helps retain the most relevant features within the convolutional neural network while reducing the risk of overfitting. Use $K_t = \{k_1, k_2, \cdots, k_{z-s+1}\}$ and qt to represents the feature map obtained by the t th convolution layer and the result of pooling. Kt is selected as the maximum value in the pooling layer, and the pooling layer processing formula of convolutional neural network is as follows (5)：

$$Q_t = \max(K_t) = \max\{k_1, k_2, \cdots, k_{z-s+1}\} \tag{5}$$

4)Fully connected layer

The information that comes out of the pooling layer is fed into the fully connected layer. Within this layer, we have m neurons, and we apply the Rectified Linear Unit (ReLU) function as the activation function. This operation results in the creation of a stable vector vi, serving as the representation of hidden features associated with university talent information. You can find the calculation formula for this fully connected layer in Equation (6)：

$$v_i = \text{Relu}\ (w_t Q_t + l_t) \tag{6}$$

The vector vi belongs to the m-dimensional space Rm. Additionally, Qt signifies the output from the pooling layer of the convolutional neural network, wt represents the weights used in the fully connected layer, and lt denotes the bias coefficient.

3 Reasons for problems in the management of higher education in the new era

3.1 Information technology is not fully grasped

Colleges have not recognized the importance of educational information management, and there are some deficiencies in the construction of plans and decision-making procedures. They have also not prepared qualified personnel according to actual needs. At the same time, there is no scientific and information management team, which leads to the inefficient operation and the inability to use information technology and large-scale information for management. It can be seen that the imbalance of information resources from colleges is the main reason for the problems in educational administration in colleges in the new period. Although some managers know that computers can replace traditional operating systems, some managers do not understand the information technology, which makes the technology not integrated into actual operating systems.

3.2 Limited investment in education funds

The educational management system is a comprehensive entity comprising a range of software and hardware components. Leveraging big data for educational and instructional management necessitates significant financial resources and technological capabilities as essential support. However, some colleges and universities have difficulties in running school management funds, and they cannot guarantee sufficient funds, thus limiting the development and implementation of informatization in education management. During this period, the top leaders made few adjustments, and the information capital construction lacked coordination and mutual assistance, this resulted in a significant delay in the development of information infrastructure and resource management in universities, limiting the capabilities of educational institutions to manage their operations due to financial and technological constraints.

4 Strategies for Optimal Management of Higher Education under the Background of Big Data

4.1 Change the thinking of education management

The reform of thinking mode is the prerequisite for the reform. In order to adapt to the new challenges of the mass information of the times, higher education should actively change its thinking and use mass information to analyze and solve problems. In the education management team, the management team of university teachers is the backbone and plays an important role in all aspects of education and teaching management. The quality of teachers to some extent determines the level of educational administration.In order to exert the role of major information resources in educational administration, teachers should change their thinking and become the main users of information resources thought to solve the construction of educational administration. Firstly, fully leverage the positive role of mass data. Given that the use of large amount of information in educational administration is still in the exploration stage, teachers should change their thinking, accept new things, and actively exert their advantages. Secondly, teachers should drive the dissemination of the massive information demand theory, submit the application strategy of the massive information to all teachers and students, and establish a large database for the mass information resources. Thirdly, teachers should actively improve their ability of recognition. When understanding the quality of large data, it is necessary to make clear the shortage of large data and to establish a sense of risk prevention[7-8].

4.2 Training Big Data Technology Talents

It is necessary to change the traditional teaching management idea and continuously improve the knowledge innovation ability in the field. For example, in the daily work, the teaching managers should widely collect and pay attention to the innovation of content management, and continue to study so as to keep pace with the times and enhance the innovation of the management.In view of students' learning characteristics, personality and other factors, we can make a deep understanding, adopt the mode of combining openness, flexibility and dynamic management in management, and integrate innovative activities and tasteful cultural activities to create a relatively relaxed learning environment for students[9]. In terms of teaching management objectives and quality, colleges and universities should take innovation as a

measure, optimize teaching management, strengthen its application in teaching management, and carry out extensive publicity in teaching, with optimizing management as the main content, improve the quality of teaching management, and at the same time actively enhance students' innovative ability. In order to be effective and innovative, the college management team should form a team with new spirit, so that the teachers can pay more attention to cultivating students' innovative ability and do better the students' management of the system design. Under the background of mass information, colleges and universities should strengthen the cultivation and education of human and scientific knowledge to enhance their innovation ability. In the previous management model, teachers paid great attention to teaching content while ignoring students' self-study and psychological development, making some students lack this and restricted their development. As shown in Table 2, it is characteristic of studying large data sets[10].

Table 2. Characteristics of Education Big Data

Compared with traditional education data	Compared with big data in other fields
Continuous and comprehensive collection	Gathering educational big data is a challenging and intricate process.
Natural state, dynamic real-time	Leveraging educational big data demands a significant level of creativity.
Deep multivariate analysis, diversified data	Pay attention not only to correlation, but also to causality.
Macro+meso+micro, prediction+early warning	-

5 Conclusion

This article introduces the application research of information technology major in the research of educational administration and proposes the following points: educational reform theory is the prerequisite for the reform. In order to adapt to the new challenges faced by higher education in the era of mass information, colleges should actively change their thinking and use mass information for analysis and resolution.In the education management team, the management team of university teachers is the backbone and plays an important role in all aspects of education and teaching management.The quality of teachers to some extent determines the level of educational administration.It is necessary for colleges to jointly develop large-scale online information resources for colleges, train new and perfect talents of colleges by means of online consultation, complete social interaction, and complete teaching and learning activities. At the same time, in this process, colleges should foster the idea of building information network in the major information universities, and promote further changes in the thought of university leaders, teachers and students.

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