

# Research on Precision Teaching Management Methods in Universities in the Era of Big Data Based on Entropy Weight Method

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**Abstract.** The widespread adoption and advancement of big data technology have led to its integration across various industries, offering convenience and efficiency in various tasks. The field of education is no exception, as the integration of modern technology with education becomes increasingly common. Traditional experiential teaching methods are gradually being replaced by data-driven teaching approaches. The establishment of data-driven platforms enables the collection and analysis of teaching materials, injecting new energy into precision teaching. This article focuses on modeling and evaluating the management method of precision teaching in universities during the era of big data, utilizing the entropy weight method for analysis. Specific analyses are conducted to provide a comprehensive understanding of the subject matter.

**Keywords.** entropy weight method; big data; accurate teaching in universities; management

## 1. Introduction

The modernization of education in China is rapidly advancing, not only with the widespread popularity of higher education but also due to the growing demand for skilled individuals. Researchers such as Wu Xiaofan and colleagues discovered in 2022 that teaching and learning methods have undergone significant changes and innovations. The teaching approach has evolved from empirical teaching and research using rudimentary measurement tools in the 1960s to the utilization of intelligent technology, enabling more scientifically precise teaching today [1]. Similarly, Li Zheng and colleagues found in 2019 that precise teaching management can enhance the efficiency of both teachers and students [2]. In 2023, Wang Yan and colleagues conducted a study on the evaluation methods of an academic big data evaluation system, using a specific school as an example. Their research revealed a significant correlation between course evaluation indicators and course GPA [3]. The primary objective of implementing precise teaching

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through big data in universities is to foster further development within these institutions and facilitate the smooth execution of university management tasks [4].

Nevertheless, despite the rapid progress, there are still challenges that need to be addressed in the precision teaching of big data due to inadequate preparation across various aspects. This article aims to analyze and study the management methods of precise teaching in universities at the big data level, employing the entropy weight method. Through this analysis and evaluation, the article seeks to provide assistance in the cultivation of high-quality talents in China.

## **2. The Connotation and Importance of Precise Teaching of Big Data in Universities**

### *2.1. The Classic Connotation of Precision Teaching*

During the 1960s, American scholars introduced the theory of operant conditioning into educational settings, which emerged as one of the approaches to precision teaching. This teaching method involves monitoring and recording students' daily behaviors, enabling educators to make timely and effective teaching decisions to optimize learning outcomes [5]. Precision teaching, as a data-driven system, serves as a valuable teaching program that can complement other methods. However, its wide-scale adoption has been hindered by technological limitations and a constrained technical landscape.

### *2.2. New Explanation of the Era of Precision Teaching*

Enabled by the robust assistance of intelligent information technology, the scope of monitoring learning behavior has expanded beyond the observable stage. Biometric technology now allows for the tracking of students' psychological states, offering valuable insights for future work. The process of establishing teaching data is an extensive endeavor, and universities can systematically organize it to align with the specific requirements of new curriculum standards. This involves constructing knowledge points or a textbook directory that caters to the evolving educational landscape.

### *2.3. The Importance of Realizing Informationization in Precision Teaching in Universities in the Era of Big Data*

The teaching work within universities is a multifaceted and intricate endeavor, encompassing vital components, extensive knowledge, and confidential content. It involves not only university management but also students and parents. From the preparation of professional teaching to the execution of teaching activities, every aspect falls under the purview of university education management. Throughout this entire process, a substantial amount of management information is generated. To effectively handle this wealth of data, universities can leverage big data technology to establish an education and teaching management system based on big data. This system enables unified management of student information within universities and facilitates the collection of teaching resources for enhanced teaching practices.

3. Establishment and Analysis of Precision Teaching System in Universities in the Era of Big Data

3.1. System Establishment

This article summarizes the system indicators into teaching plan management, teaching operation management, teaching administrative management, teaching quality management and evaluation, and teaching basic construction management. As shown in Figure 1.

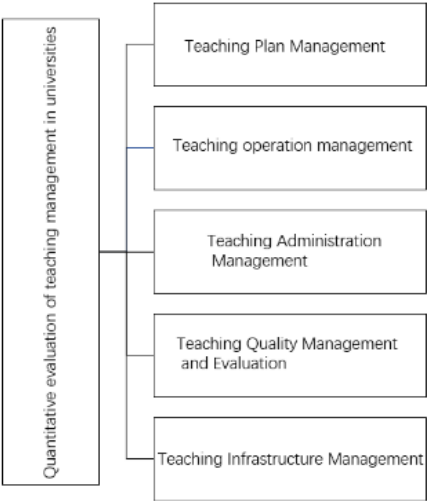


Figure 1. Teaching Management System of Universities

3.2. Weight Calculation

Due to the different meanings and weights of the five indicators, this article uses the entropy weight method to calculate their weights.

1. Normalize the raw data, as shown in Eq. (1).

$$x_{ij}^* = \frac{x_{ij}}{\sum_{i=1}^m x_{ij}} \quad j = 1, 2, 3, 4, 5 \tag{1}$$

2. Calculate the information entropy of each indicator, as shown in Eq. (2).

$$H_j = -\frac{1}{\ln m} \sum_{i=1}^m x_{ij}^* \ln x_{ij}^* \quad j = 1, 2, 3, 4, 5 \tag{2}$$

3. Use the TOPSIS evaluation method to calculate the course evaluation score, and calculate the positive and negative ideal solutions constructed from the preprocessed data, as shown in Eq. (3).

$$\begin{cases} x_j^+ = \max\{x_{ij}^*\} \\ x_j^- = \min\{x_{ij}^*\} \end{cases} \quad j = 1, 2, 3, 4, 5 \quad (3)$$

4. Calculate the weighted distance by combining weights, as shown in Eq. (4).

$$\begin{cases} d_i^+ = \sqrt{\sum_{j=1}^5 W_j (x_{ij}^* - x_j^+)^2} \\ d_i^- = \sqrt{\sum_{j=1}^5 W_j (x_{ij}^* - x_j^-)^2} \end{cases} \quad (4)$$

5. Calculate the score for the evaluation course, as shown in Eq. (5).

$$f_i = \frac{d_i^-}{d_i^+ + d_i^-} \quad (5)$$

### 3.3. Model Establishment

Use correlation analysis and cluster analysis to model the data. Based on evaluation data, K-means clustering method is used for course classification. It can be expressed as Eq. (6).

$$\min \sum_{i=1}^k \sum_{j \in C_i} (f_i - C_i)^2 \quad (6)$$

Using heuristic algorithms to solve the above problems:

The Pearson correlation coefficient [6] is used to analyze the correlation degree of course evaluation scores, and the Eq. (7) is:

$$r = \frac{\sum_{i=1}^m (f_i - \bar{f})(g_i - \bar{g})}{\sqrt{\sum_{i=1}^m (f_i - \bar{f})^2 \sum_{i=1}^m (g_i - \bar{g})^2}} \quad (7)$$

Calculate the correlation between the course evaluation score and various indicators, and then calculate the correlation coefficient between each evaluation indicator score of the course and the student's course grade point, as shown in Eq. (8).

$$\gamma_j = \frac{\sum_{i=1}^m (t_{ij} - \bar{t}_j)(g_i - \bar{g})}{\sqrt{\sum_{i=1}^m (t_{ij} - \bar{t}_j)^2 \sum_{i=1}^m (g_i - \bar{g})^2}} \quad (8)$$

3.4. Modeling Analysis

This article analyzes and processes the academic evaluation data and student GPA data of a certain semester in a certain university [7].

1. Data processing

Cleaning the original data, removing abnormal data, and then converting it. Data can be obtained for the course in five indicators. Based on Eq. (2), the coefficient of variation and entropy weight coefficient of each indicator can be obtained, as shown in Table 1.

Table 1. Coefficient of Variation and Weights

|                                  | Teaching<br>Plan<br>Management | Teaching<br>operation<br>management | Teaching<br>Administration<br>Management | Teaching<br>Quality<br>Management<br>and<br>Evaluation | Teaching<br>Infrastructure<br>Management |
|----------------------------------|--------------------------------|-------------------------------------|------------------------------------------|--------------------------------------------------------|------------------------------------------|
| Coefficient<br>of<br>variation   | 0.9823                         | 0.9852                              | 0.9803                                   | 0.9836                                                 | 0.9842                                   |
| entropy<br>weight<br>coefficient | 0.2011                         | 0.1958                              | 0.1996                                   | 0.2036                                                 | 0.1999                                   |

2. Find the SSE value

The results are shown in Figure 2. Through the elbow method, it can be found that 2 is the optimal number of clusters.

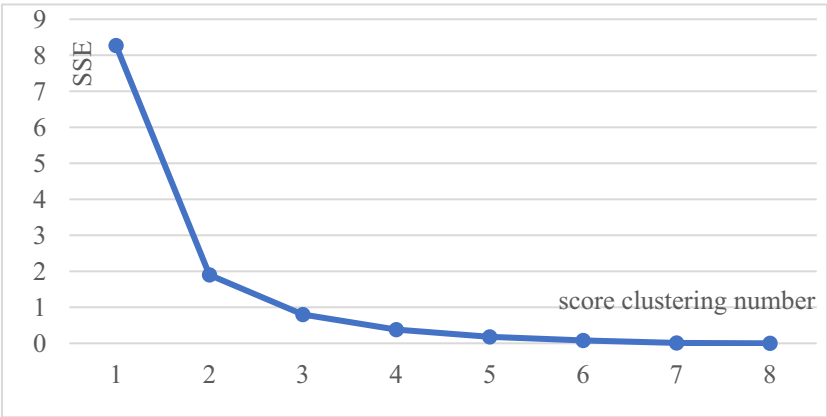


Figure 2. Relationship between the number of course score clusters and SSE

3. Course Analysis

Divide the course into three categories. The average scores of the five indicators of the three course centers are expressed by radar chart. The results are shown in the following figure. The scores of the three courses are similar, but the difference is not significant, as shown in Figure 3.

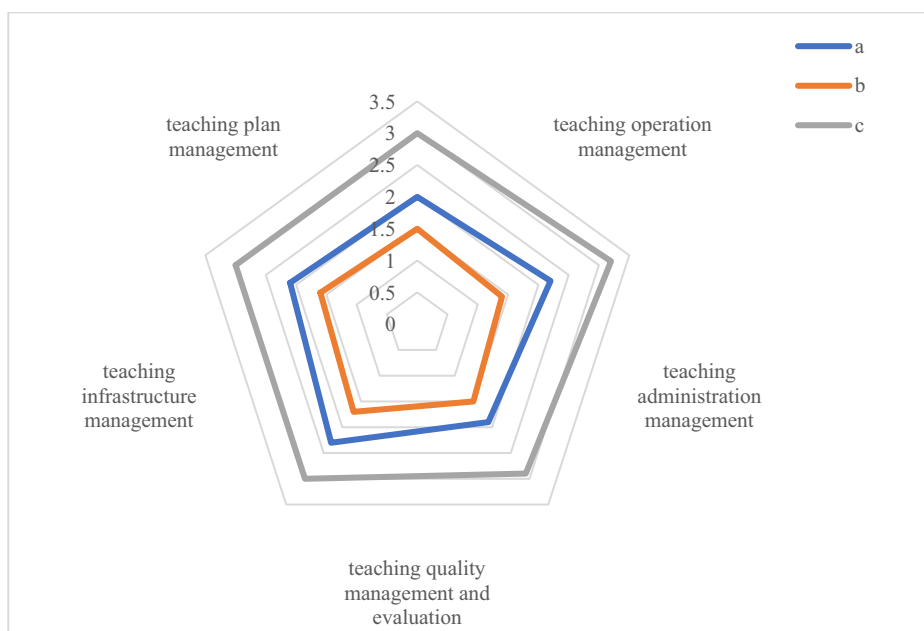


Figure 3. Index radar Chart of Class 1 Courses

#### 4. Difficulties Faced by Precision Teaching Management of Big Data in Universities

1. Supporting teaching resources cannot meet actual needs.
2. Lack of necessary data and theoretical literacy.
3. "Tailored" causes moral controversy.

#### 5. Precision Teaching Management Methods for Universities Based on Big Data

To enhance the overall informatization through the informatization of teaching management, the following is the flowchart of precision teaching management methods in universities under big data [8], as shown in Figure 4.

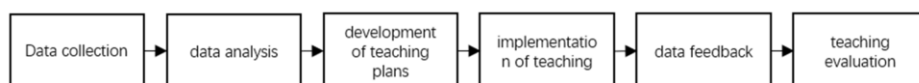


Figure 4. Flow chart of precise teaching management methods in universities

1. Intelligent big data promotes the transformation of teaching management.
2. Precision teaching design and evaluation.
3. Scientific implementation of teaching resource management work.
4. Improving the teaching quality management system based on big data.
5. Improving the theoretical literacy of the group.
6. Deepening the sense of responsibility of "people-oriented".

## 6. Conclusion

In summary, the analysis mainly focuses on the precise teaching management methods of universities in the era of big data based on entropy weight method. It can be seen that in traditional teaching models, teachers are the dominant force, and students are only passive listeners. In the era of big data, students as the main part can provide personalized and precise teaching. We should establish a new student-centered subject relationship, making the teaching process monitorable, promoting teaching precision and personalized learning. By using the entropy weight method to understand the characteristics of various courses, and precise teaching based on big data, information technology can be integrated into various links, effectively providing data support for teachers to grasp students' learning situation and decision-making.

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