Research on Evaluation of Classroom Teaching Quality in Vocational Colleges Based on Big Data Analysis

Ting Deng[1(✉)], Guanghua Li[2], and Jian Ye[2(✉)]

[1] School of Foreign Languages, Jiangxi Teachers College, Yingtan, Jiangxi, China
tingdeng2008@163.com
[2] Jiangxi Teachers College, Yingtan, Jiangxi, China

Abstract. With the development of China's digital economy, China's various undertakings are in an important stage of development and reform. In the aspect of education and teaching, the quality of classroom teaching plays an important role in evaluating the quality of teaching. Big data analysis is used to study the data of teachers' classroom teaching quality in vocational colleges with the help of K-means clustering algorithm and SPSS analysis. The indicators that play a key role in classroom teaching quality are found in order to further improve the teaching quality.

Keywords: K-Means Algorithm · Big Data Analysis · Evaluation of Classroom Teaching Quality

1 Introduction

With the rapid development of artificial intelligence and digital economy, people's life and work has been influenced greatly, and the concepts of innovation-driven development have penetrated into all fields at an alarming rate to form the profound change of social forms. At the same time the future intelligent education has injected new ideas to the education and teaching, provided new methods and tools, drive the fundamental transformation of the education teaching mode. Teaching quality in teaching activities as a whole is the organic unity of teaching process and teaching result quality. Teaching quality revolves around the teaching process, and teaching process is the main body of generating teaching quality. Classroom teaching not only imparts knowledge and ability cultivation, but also is the main way to shape the value view and cultivate the character. Therefore, the teacher's teaching and the quality of teaching directly affect the future development of students, which is related to the cultivation of moral education.

With the rapid development of big data technology and its continuous application in education and teaching, the auxiliary means of data analysis in the early stage have gradually become more and more relevant to the teaching activities of various disciplines.

With integrated development, traditional classroom teaching activities begin to develop towards information and intelligence. Improving the quality of the teaching,

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especially the quality of classroom teaching process, is the top priority of improving the quality of teaching and education. Therefore, it is very important for people to know how to make full use of these normalized data, analyze the potential rules through the statistics and mining technology, find out the key questions, and form the common teaching strategy and individual learning suggestions so as to let data serve teaching and improve the effectiveness of teaching by constructing the teaching model.

2 Research Background

Teaching quality is related to the quality of the students trained by the school. It is the primary task of the teaching work in vocational colleges and universities to do well the teaching quality. Teaching quality evaluation is an important part of higher education quality management system, is an important means to judge the teaching quality of schools, and is also the cornerstone of promoting the higher vocational teaching quality management. Classroom teaching is the core of higher education and the main channel for higher vocational colleges to impart knowledge and cultivate skills. Higher vocational colleges have realized that the improvement of classroom teaching quality is of great significance to the improvement of the overall teaching quality of higher vocational colleges, and various behaviors and data of teachers and students in three stages of pre-class, in-class and after-class are an important part of the evaluation of classroom teaching quality. Through the analysis of the classroom teaching of teachers, an effective information feedback mechanism is formed, and the evaluation and management methods of classroom teaching quality are optimized, so as to promote the development of students and teachers and improve the quality of classroom teaching [2].

The backwardness of the traditional teaching quality assessment makes the teaching quality superficial, the teachers and students are not active in participating, the evaluation results lack effectiveness and classification, the evaluation results lack analysis and feedback and so on, which have become the bottleneck of the quality assessment of the system of talent cultivation.

There are many useful explorations and practices on the diagnosis and improvement of quality management of vocational education in China, but there are still many problems. From the background of big data analysis of teaching quality assessment in higher vocational colleges, this paper collects data related to teaching quality evaluation, and studies the types of various data and their relationships. For the collected data, K-means algorithm and SPSS software are used to analyze, sort and screen the fragmented data, so as to obtain a variety of regular data and characteristics of teaching quality. The optimized k-means algorithm classifies the evaluation data of teachers' classroom teaching quality based on the grades, analyze the differences among different levels of teachers and then use SPSS data analysis software to analyze the differences of different titles in different indicators to assist colleges and universities to enhance teachers' targeted professional ability and ensures that the classroom teaching effect reaches the expectation.

3 Research Method

3.1 Big Data Analysis

Big data analysis is widely used in many fields. Different from the traditional analysis method of small scale and small amount of data, the big data segmentation method uses machine learning, pattern recognition and data mining to analyze the data, and gives more accurate and reliable analysis results. The characteristics of big data is that the data quantity is large and complex. If the traditional method for data processing is used, not only a lot of time will be cost, but the superficial statistic results will be obtained. And this is done by machine learning and data mining algorithm to analyze the deep correlation between data, and finally serve the application of big data. As the application of big data more and more widely, a lot of traditional industry with large data can achieve more accurate data analysis and decision making, and thus the growing college teaching quality evaluation and network integration must use the advantage of big data analysis and decision, in the better form and more accurate results to complete the teaching quality evaluation.

The college teaching quality evaluation system based on big data analysis technology is mainly composed of classroom, service and client end. Starting from multiple subjects such as teachers, different administrators and students, the college teaching quality evaluation system based on big data analysis technology combines with the characteristics of higher vocational education and aims at different courses, improves the pertinence of the evaluation, constructs a multiple evaluation system, and comprehensively evaluates the teaching quality of teachers [3].

3.2 K-Means Algorithm

K-means algorithm is an unsupervised clustering algorithm based on partitioning, which is widely used due to its simple principle, fast running speed and easy implementation. Based on the idea of "similar things cluster together", the algorithm classifies the data with high similarity into one class, and the data with low similarity into different classes. Algorithm implementation process is that the first K data are randomly selected as the initial clustering centers, and other data in accordance with the principle of similarity with the highest similarity clustering center is divided into a class to choose the classification of clustering center again and calculate the sum of the squares of the clustering error of the data set. If the sum of the squares of the clustering error meet the conditions, the clustering is over. Otherwise, the partition is repeated until the closing condition is met [6].

The defects of the traditional k-means algorithm are optimized. When selecting the initial clustering center, the sum of the distances between the data and other data is taken as the reference value of the selection of the clustering center, and the distance and the smallest K samples are taken as the initial clustering center. Some concepts are as follows.

Set for the analysis of the data set

$$\mathrm{X}, \mathrm{X} = \{x_i \,|x_i \in R^p, i = 1, 2, \cdots, n\} \tag{1}$$

Definition 1: the similarity of data is defined as $\mathrm{d}(\mathrm{x}_i, \mathrm{x}_j)\mathrm{d}(\mathrm{x}_i, \mathrm{x}_j)$

$$\mathrm{d}(x_i, x_j) = \sum_{j=1}^{n} \sqrt[2]{(x_i - x_j)^t (x_i - x_j)} \tag{2}$$

The smaller the value of d (x_i, x_j), the greater the similarity of x_i and x_j. Thus, the larger the value, the smaller the similarity.

Definition 2: The mean distance of data x_i in data set X is VD (x_i).

Calculate the mean value of the sum of the distances between each sample and the rest of the samples. The smaller the data set, the more it is in the dense or intermediate region of the data set. The larger the value is, the data is in the sparse region of the data set.

Definition 3: The distance mean of the data set is VD.

$$\mathrm{VD} = \frac{1}{n^2} \sum_{i=1}^{n} \sum_{j=1}^{n} \sqrt[2]{(x_i - x_j)^t (x_i - x_j)} \tag{3}$$

Definition 4: Clustering center Ci of class I.

$$c_i = \frac{1}{n_i} \sum_{x_j \in c(i)} x_j \tag{4}$$

Definition 5: The sum of the squares of the clustering error is E

$$\mathrm{E} = \sum_{i=1}^{k} \sum_{j=c_i} |x_j - c_i|^2 \tag{5}$$

Among them, c_i is the clustering center of Class I, and Ni represents the numbers of the data in Class I. The formula $x_j \in c(i)$ means that the data x_i belongs to class I [5].

When the optimized k-means algorithm selects the initial clustering center, according to the formula (1) the mean distance Vd (x_i) of each data x_i will be calculated, and put the order from small to large. Calculate the similarity between all samples and clustering center according to formula (1). All data and the clustering center with the greatest similarity is divided into a class, and then the new cluster center is calculated according to formula 4. And according to formula 5, the sum of the squares of the clustering error of the data set is calculated. If the sum of the squares of the clustering error satisfies the condition, the clustering ends. Otherwise, the classification is carried out again according to the similarity principle. The optimized k-means algorithm is applied to the data of teachers' classroom evaluation results. By the clustering results to the differences among different levels of teachers, we can identify the key factors that determine the quality of teachers' classroom teaching and help schools make better decisions. The evaluation form of classroom teaching quality can improve the teachers' teaching ability.

4 Evaluation of Teachers' Class Teaching Quality

Based on the commonly used evaluation index by experts, teachers and students, the class teaching quality evaluation will be divided into four teaching indicators (the first level, including teaching method, classroom atmosphere, teaching attitude, and teaching administration) and fourteen secondary teaching indicators as shown in Table 1 [1].

To study whether there is a strong connection between the quality of classroom teaching and the title of teachers, attention is paid to analyze the differences of teachers with different titles in the classroom teaching quality. The teachers' titles are divided into three categories: assistant, lecturer and professor. The result of classroom teaching quality of teachers was divided into 5 according to the final total scores as shown in Table 2.

Table 1. Evaluation of classroom teaching quality

Factors	Main point	score
Teaching attitude	Care for students	10
	Work hard, no arbitrary class adjustment	10
	Kind and natural teaching manner, standard language	10
	Enough preparation for teaching	10
Teaching methods	Highlight the difficulties, combine theory with practice	10
	Flexible teaching methods. Promote the students' learning interest	10
	Apply the modern information technology properly	10
	Good Blackboard design	10
Teaching administration	Evaluate students properly	10
	Teaching different students with characteristic methods	10
	Assign and correct the homework strictly	10
	Give full play to the leading role of teachers and the main role of students to reflect the teaching design	10
Classroom atmosphere	Actively participate in the classroom activities	10
	Students have high concentration	10

Table 2. Class quality evaluation grade table

level	optimal	Good	medium	qualified	poor
Sores range	100–90	89–80	79–70	69–60	59–0

4.1 Data Source

A questionnaire survey was carried out in Jiangxi's colleges. 200 questionnaires were distributed and 153 valid questionnaire were collected. In total, 44 professors, 78 lectures and 34 assistants were analyzed. The data are analyzed from two aspects, first according to the classroom quality evaluation table to analyze the teachers' grade and the proportion of teachers in each grade and then to get the teaching quality evaluation table. The school can be targeted to build the teacher team. From the scores of 14-second-level indicators, the dispersion of evaluation indicators is analyzed. If a large degree of dispersion of an evaluation index appears, the index has a great influence on teachers' classroom teaching. If the dispersion of an index is small and the index score is relatively high, it means that the index needs to be optimized or targeted at training teachers.

4.2 Test Analysis

The software spss is used to analyze the data set of classroom quality evaluation. Lenovo notebook is used to operated with the memory of 4G. The evaluation grade of classroom teaching quality is divided into 5 grades, and the clustering results are divided into 5 categories. In the case that k value is equal to 5, the optimized k-means is used to perform the clustering analysis of the data set of quality evaluation results. After that, the number of teachers in different levels is shown in Table 3.

As can be seen from the clustering results in Table 3, 20% of the teachers are excellent in classroom teaching, 35% of the teachers performed well, 29% of the teachers performed moderately, 16% of the teachers basically met the minimum requirements, and 0% of the teachers is unsatisfied, which reflects that the teachers in colleges has carried out strict practice and assessment before their entering the classroom, and reached the standard classroom teaching requirements.

Table 4 analyzes the mean and standard deviation of 153 teachers on 14 different indicators. By analyzing the figures, teachers will be targeted to train and improve [4].

From the Table 4, it is indicated that the four indicators of the teaching attitude have higher score but the indicators of the teaching methods have the lowest sore and classroom atmosphere and teaching administration are between the two levels. Among them, the standard deviation of teaching methods, teaching administration and classroom atmosphere are relative large. These scores reflect that teachers have more rigorous teaching attitude. In the teaching methods and teaching administration, more time and energy will be spent by teachers. To improve teachers' teaching quality, teachers should be adapted to the current learning habits of students. The large standard deviation in teaching administration and teaching methods reflect the teachers' lack of the innovative

Table 3. Clustering results of K-means algorithm

level	optimal	Good	medium	qualified	poor
Sores range	100–90	89–80	79–70	69–60	59–0
Level change	30	53	45	25	0

Table 4. Mean and standard deviation of different evaluation index of classroom teaching quality

Factors	Main point	Mean	Standard deviation
Teaching attitude	Care for students	9.0	0.3
	Work hard, no arbitrary class adjustment	9.02	0.5
	Kind and natural teaching manner, standard language	9.05	0.3
	Enough preparation for teaching	9.0	0.6
Teaching methods	Highlight the difficulties, combine theory with practice	7.3	1.23
	Flexible teaching methods. Promote the students' learning interest	7.2	1.28
	Apply the modern information technology properly	7.4	1.26
	Teaching different students with characteristic methods	7.5	1.0
Teaching administration	Evaluate students properly	7.8	1.0
	Good blackboard design	7.8	1.3
	Assign and correct the homework strictly	8.2	1.0
	Give full play to the leading role of teachers and the main role of students to reflect the teaching design	7.5	1.2
Classroom atmosphere	Actively participate in the classroom activities	8.0	1.1
	Students have high concentration	8.2	1.2

thinking. In the teachers' training, the teachers with the low sore will be required to get enough train to improve the teaching ability. Based on the classroom teaching quality evaluation of different teachers with different professional titles, different teachers will be targeted to get different train to improve teaching ability and promote the teachers' team. The proportion of different titles in different classroom teaching quality evaluation grades is different.

Table 5. Proportion of different titles in different classroom teaching quality evaluation grades

level	professors	instructors	assistants
excellent	17	16	2
good	20	40	7
moderate	7	15	10
qualification	0	7	15

As can be seen from Table 5, the proportion of professors in excellent and good grades is higher than the proportion of instructors and assistants without the professor in the qualified level. Further analysis of the professors in the classroom teaching fall in the application of teaching methods, the reasonable teaching administration, and professional preface knowledge. At the same time, it reflects the depth of the professor's professional knowledge.

5 Conclusion

With the K-Means Algorithm in big data analysis and the software spss, teachers' classroom teaching quality is analyzed and studied. It is found that teaching ethics, teaching attitude are approved by students. However, there are great deficiencies in teaching methods and teaching administration. Therefore, it is necessary to refine them, and at the same time different teachers with different titles will be targeted to learn. With the digital economy, teacher classroom teaching evaluation will be improved and effective.

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