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Xiaoping Feng

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The comprehensive evaluation of innovative education quality from the perspective of balanced and stable development

Xiaoping Feng

College of Humanities,
Hunan City University,
Yiyang, 413000, Hunan, China
Email: fxiaoping@mls.sinanet.com

Abstract: In order to overcome the problems of long data collection time, high error rate of index weight calculation and low accuracy of traditional evaluation methods, a comprehensive evaluation method of innovative education quality from the perspective of balanced and stable development is proposed. Firstly, the comprehensive evaluation index of innovative education quality under the background of balanced and stable development is preliminarily determined. The K-means clustering algorithm is used to collect education data, and the data are fused and reduced. Then, the comprehensive evaluation system of innovative education quality is established. Finally, the weight of evaluation index is calculated by AHP, and the comprehensive evaluation of education quality is realised by three-level fuzzy comprehensive evaluation model. The experimental results show that the average data acquisition time of this method is 0.63 s, the maximum error rate of evaluation index weight calculation is 2%, and the evaluation accuracy is above 94%.

Keywords: balanced and stable development; innovative education; comprehensive quality evaluation; K-means clustering algorithm; reduction processing; three-level fuzzy comprehensive evaluation.

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Biographical notes: XiaoPing Feng received her Master of Arts in Chinese Language and Literature from Hunan Normal University in 2008. She is currently an Assistant Professor at the College of Humanities at Hunan City University. She research interests include pedagogy education, scientific research management.

1 Introduction

Since the implementation of the compulsory education system, my country's education field has achieved rapid development and achieved a series of excellent results. However, while these achievements have been made, some drawbacks have gradually been exposed

in the field of education in my country, such as unbalanced social education resources, significant gaps in economic development levels, and differences in the level of school running. Significant differences (Cervero et al., 2020; Nojavan et al., 2021). Therefore, in order to promote the balanced and stable development of education, innovative education has become one of the important directions of education reform (Joniec, 2021). In order to clarify the application effect of the innovative education model, it is necessary to comprehensively evaluate the quality of innovative education, timely adjust the problems existing in the process of innovative education, adjust the innovative education program, and optimise the effect of innovative education (Ramirez-Sanchez et al., 2022), so the quality of innovative education comprehensive evaluation has become a social hotspot and an urgent problem for families, society and governments at all levels.

Aiming at the important subject of comprehensive evaluation of innovative education quality, Lu and Zhou (2021) proposes a comprehensive evaluation method of innovative education quality based on CIPP model. Collect innovative educational data, build a comprehensive evaluation system for innovative educational quality from the perspectives of resource allocation, educational actions, educational environment construction, educational achievements, etc. The comprehensive evaluation model of innovative education quality, input the collected data into the model, and obtain the comprehensive evaluation results of innovative education quality. However, this method has the problem that the collection of innovative educational data takes too long, and the practical application effect is poor. Ma (2021) proposed an innovative comprehensive evaluation method of educational quality based on deep learning network. Using web crawler technology to collect innovative education-related data, and normalising the collected data, starting from various aspects such as educational environment creation and student development, a comprehensive evaluation system for innovative education quality is built. Combined with the calculation results of the index weights, an innovative comprehensive evaluation model of education quality based on the deep learning network is constructed, the model is trained by the unsupervised learning method, and the evaluation index data is input into the model to realise the education quality evaluation. However, in practical application, it is found that this method has the problem of high error rate in the calculation of innovative comprehensive evaluation indicators of educational quality. Xu (2020) proposed an innovative comprehensive evaluation method of educational quality based on fuzzy mathematics. Using the expert interview method to design comprehensive evaluation indicators of innovative education quality, collect relevant index data, and integrate and normalise the collected data. On this basis, build a comprehensive evaluation index system for innovative education quality from the aspects of teaching base construction, teacher team construction, and educational effect tracking, etc., calculate the index weight, and build a related evaluation model to obtain innovative education through matrix operations. Quality comprehensive evaluation results. However, this method has the problem of low accuracy of comprehensive evaluation of innovative education quality.

Because the data collected by the traditional innovative education quality method is not complete enough, and there are many redundant data in the collected data, there are many problems in the evaluation process, such as long data collection time, high error rate of index weight calculation, and low accuracy. Therefore, this paper aims to solve these problems and designs a new comprehensive evaluation method of innovative

education quality from the perspective of balanced and stable development. The design scheme is as follows:

- 1 Preliminarily determine the comprehensive evaluation index of innovative education quality under the background of balanced and stable development through the expert survey method, and use K-means clustering algorithm to collect innovative education data, including school positioning and safeguard measures, training objectives, teaching site construction and Management, team building, teaching facilities, teaching resources, teaching management services, consulting services, teaching quality, student evaluation, employer evaluation, and integrate and simplify the collected data.
- 2 Select evaluation index data from the reduced data to build a comprehensive evaluation system for innovative education quality. The analytic hierarchy process is used to calculate the weight of the evaluation index, and the three-level fuzzy comprehensive evaluation model is used to realise the comprehensive evaluation of innovative education quality.
- 3 Compare the time-consuming of data collection, the calculation error rate of the evaluation index weight and the evaluation accuracy of different methods.

2 Design of comprehensive evaluation method for innovative education quality

2.1 Innovative educational data collection and processing

Balanced and stable development means that the problems of unbalanced social resources, large gaps in economic development levels, and uneven school-running levels have been basically resolved, ensuring social security and stable development. In this context, through continuous adjustment and allocation of educational resources. In order to further maintain a balanced and stable development trend, it is necessary to comprehensively evaluate the quality of innovative education, so as to timely solve the problems existing in the process of innovative education, adjust the innovative education program, ensure the maximisation of the effect of innovative education, and give full play to the maximum function of education. Therefore, this paper mainly determines the comprehensive evaluation index of innovative education quality under the background of balanced and stable development through the expert investigation method, uses K-means clustering algorithm to collect innovative education data, and fuses and reduces the collected data.

In order to ensure the accuracy of the comprehensive evaluation of innovative education quality, this paper preliminarily determines the comprehensive evaluation of innovative education quality through the expert survey method, and then uses the K-means clustering algorithm to collect innovative education data. The purpose of this algorithm is to cluster similar sample data together. In this paper, Euclidean distance is used to achieve similarity measurement.

Assuming that there are two points on the two-dimensional plane, which are described by $a(x_1, y_1)$ and $b(x_2, y_2)$ respectively, the formula for calculating the distance between them (Wang et al., 2022; Fan et al., 2021) is as follows:

$$d_{12} = \sqrt{(x_1 - x_2)^2 (y_1 - y_2)^2} \quad (1)$$

Assuming that there are two points in the three-dimensional space, which are described by $a(x_1, y_1, z_1)$ and $b(x_2, y_2, z_2)$ respectively, the formula for calculating the distance between them is as follows:

$$d_{12} = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2} \quad (2)$$

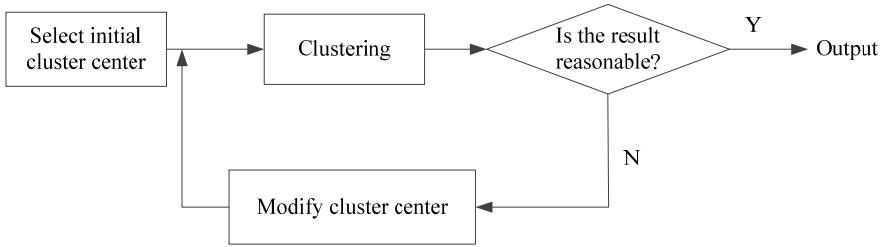
Assuming that there are two dimension vectors, represented by x_{1k} and x_{2k} respectively, the formula for calculating the distance between them is as follows:

$$d_{12} = \sqrt{\sum_{k=1}^n (x_{1k} - x_{2k})^2} \quad (3)$$

In the formula, n represents the number of dimensions.

The specific process of collecting innovative education data using K-means clustering algorithm is shown in Figure 1.

Figure 1 Innovative education data collection process



Assuming a total of n samples, the algorithm steps are as follows:

- 1 Arbitrarily select K initial cluster center points $Z_1(1), Z_2(1), Z_3(1), \dots, Z_K(1), K \leq N$ (Li et al., 2021).
- 2 Allocate the remaining sample points to one of the K cluster centers according to the shortest distance principle, namely

$$\text{Min}\{X - Z_i(k), i = 1, 2, \dots\} = X - Z_j(k) = D_j(k) \quad (4)$$

In the formula, k represents the number of iterations of the K-means clustering algorithm, $Z_i(k)$ and $Z_j(k)$ represent different cluster center vectors, and $D_j(k)$ represents the selected cluster center vector in,

$$X \in S_j(k) \quad (5)$$

In the formula, $S_j(k)$ represents the best cluster center vector.

- 3 The specific calculation formula of the cluster center vector $Z_j(k+1), j = 1, 2, \dots, K$ is as follows:

$$Z_j(k+1) = \frac{1}{N_j} \sum_{x \in S_j(k)} X, j=1,2,\dots,K \quad (6)$$

- 4 If $Z_j(k+1) \neq Z_j(k), j=1,2,\dots,K$, return to step (1), modify the cluster center point, and reclassify; if $Z_j(k+1) = Z_j(k), j=1,2,\dots,K$, the algorithm converges and the calculation is completed (Gong et al., 2021; Chen et al., 2021).

Assuming that the innovative education data collected by the K-means clustering algorithm is $x_1 \sim x_n$ and $[x_1, x_2, \dots, x_n]$, respectively, each value has a weight of w and $[w_1, w_2, \dots, w_n]$, respectively. The weighted average of these values is:

$$\bar{x} = \frac{w_1x_1 + w_2x_2 + \dots + w_nx_n}{w_1 + w_2 + \dots + w_n} \sum_{x \in S_j(k)} X, j=1,2,\dots,K \quad (7)$$

The execution process of the innovative educational data reduction algorithm is as follows:

Input: a decision table $S = \{U, A \cup \{d\}, V, f\}$,

Output: A reduction of $S = \{U, A \cup \{d\}, V, f\}$.

- 1 Partition the data of condition attribute set A and decision attribute set d (Ona and Mr, 2021);
- 2 Make U/A and U/d for the data of the divided condition attribute set A and decision attribute set d , where $U/A = \{[x]_A; x \in U\}$ $U/d = \{[x]_d; x \in U\}$.
- 3 Calculate the A -positive domain
 $pos_A(d) = \bigcup_{X \in U/d} A(X) = \bigcup \{[x]_A; \exists Y \in U/d, [x]_A \subseteq Y\} = \bigcup \{[x]_A; [x]_A \subseteq [x]_d\}$ of d .
- 4 Find the discrimination matrix $\alpha^*(x, y)$, there is a single attribute element in the matrix, take this element as the attribute core, and set all values containing this element as $\emptyset$ (Zheng et al., 2021; Martin et al., 2021);
- 5 According to all elements α_{ij} in the matrix that are not empty sets, construct disjunctive logical expression $L_{ij} = \bigvee_{a_r \in \alpha_{ij}} a_r$, perform conjunctive operation on L_{ij} , and obtain discriminative function $\Delta^* = \bigwedge L_{ij}$.
- 6 Obtain attribute reduction results of innovative education data.

2.2 Weight calculation of comprehensive evaluation index of innovative education quality

This paper constructs a comprehensive evaluation system of innovative education quality based on the principles of directionality, subjectivity, diversification, scientificity, feasibility and development, so as to lay a solid foundation for the subsequent

comprehensive evaluation of innovative education quality. The comprehensive evaluation system of innovative education quality is shown in Table 1.

Table 1 Comprehensive evaluation system of innovative education quality

<i>Level indicators</i>	<i>Secondary indicators</i>
Guiding ideology of running a school	School-running orientation and safeguard measures Training goal
Teaching process management	Teaching point construction and management The recruitment of students management Professional settings The exam management Educational administration and degree management of student status Practical teaching management Process monitoring and file management
Teaching conditions	Team construction Construction of teaching facilities Teaching resources Teaching guarantee
Learning support service system	Support services during the learning process Teaching management service Consulting services
Effect of education	The quality of teaching Student assessment Evaluation of employer

Fully consider the rationality and fairness of subsection interval setting and its corresponding score interval setting, and combine the actual situation and characteristics of innovative education quality, use subsection assignment quantification method to quantify the comprehensive evaluation index of innovative education quality, so as to ensure the reliability of quantification results.

This paper uses AHP method to determine the weight of comprehensive evaluation index of innovative education quality. The specific steps are as follows:

- 1 The 1–9 scale theory was used to determine the importance of preliminary comparison of different indicators.
- 2 Determine the pairwise comparison judgement matrix

Assuming that each factor in factor set $V = \{V_1, V_2, \dots, V_m\}$ is relative to the overall comprehensive evaluation objective of innovative education quality, the relevant judgement matrix is described by the following formula:

$$A = \begin{matrix} M \\ V_1 \\ V_2 \\ \vdots \\ V_m \end{matrix} \left\{ \begin{matrix} 1 & V_{21} & \cdots & V_{1m} \\ V_{21} & 1 & \cdots & V_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ V_{m1} & V_{m2} & \cdots & 1 \end{matrix} \right\} = (V_{ij})_{m \times m} \quad (8)$$

where V_{ij} represents the judgement value of the relative importance of elements V_i to V_j for the overall evaluation target of M . The characteristic of this matrix is that the diagonal elements are 1, that is, the importance of each element relative to itself is 1. For each element in the sub factor set $V_i = \{V_{i1}, V_{i2}, \dots, V_{ik}\}$ with respect to the factor V_i , the judgement matrix for comparing the importance of each element is as follows:

$$B_i = \begin{matrix} M \\ V_{i1} \\ V_{i2} \\ \vdots \\ V_{ik} \end{matrix} \left\{ \begin{matrix} 1 & B_{12}^i & \cdots & B_{1k}^i \\ B_{21}^i & 1 & \cdots & B_{2k}^i \\ \vdots & \vdots & \ddots & \vdots \\ B_{k1}^i & B_{k2}^i & \cdots & 1 \end{matrix} \right\} = B_{k \times k} \quad (9)$$

where B_{ij}^i indicates that relative to each evaluation criterion (i.e., first level evaluation index) of V_i , element V_{kj} is relative to V_{ij} judgement value of importance.

Each element in the matrix A is normalised by column:

$$\overline{V}_{ij} = \frac{V_{ij}}{\sum_{k=1}^m V_{kj}} \quad (i, j = 1, 2, \dots, m) \quad (10)$$

The matrix obtained after processing is added by rows, and the result is:

$$\overline{W}_{ij} = \sum_{j=1}^m \overline{V}_{ij} \quad (i, j = 1, 2, \dots, m) \quad (11)$$

where $\overline{V}_{ij}$ represents the processed matrix.

Normalise the obtained vectors $\overline{W} = (\overline{W}_1, \overline{W}_2, \dots, \overline{W}_m)^T$:

$$W_i = \frac{\overline{W}_i}{\sum_{j=1}^m \overline{W}_j} \quad (i, j = 1, 2, \dots, m) \quad (12)$$

where $\overline{W}_i$ and $\overline{W}_j$ represent the normalised eigenvector and normalisation coefficient respectively.

The feature vector $W = (w_1, w_2, \dots, w_m)^T$ is thus obtained.

3 Calculate $\lambda_{\max}$ of the maximum features of the judgement matrix:

$$\lambda_{\max} = \frac{1}{m} \sum_{i=1}^m \frac{(AW)_i}{\omega_i} \quad (13)$$

where $(AW)_i$ represents the i th element in vector AW , and ω_i represents the weight coefficient.

4 Calculation consistency index CI

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (14)$$

where n is the order of the judgement matrix.

5 Calculate the consistency ratio CR , where

$$CR = \frac{CI}{RI} \quad (15)$$

Wherein, the average random consistency index is RI .

When $CI < 0.1$, it is generally considered that the consistency of the judgement matrix is acceptable. The smaller the value of CI , the smaller the value of the judgement matrix deviates from the actual situation, and the lower the calculation error rate of the comprehensive evaluation index of innovative education quality, which can lay a solid foundation for the subsequent comprehensive evaluation of innovative education quality.

2.3 Comprehensive evaluation of innovative education quality

In the comprehensive evaluation of innovative education quality, there are many factors to be considered, and there are always levels between them. In this complex situation, it is difficult to compare the good and bad order of indicators in the comprehensive evaluation system of innovative education quality, and no meaningful comprehensive evaluation results of innovative education quality can be obtained. The reduced data selects the evaluation index data to build an innovative education quality comprehensive evaluation system. The weight of evaluation index is calculated by analytic hierarchy process, and the comprehensive evaluation of innovative education quality is realised by combining the three-level fuzzy comprehensive evaluation model. The three-level fuzzy comprehensive evaluation model deals with fuzzy evaluation objects through accurate digital means, and can make a more scientific, reasonable and practical quantitative evaluation of the data containing fuzzy information. The evaluation result is a vector, not a point value, and contains rich information, which can not only accurately depict the evaluated object, but also further process and obtain reference information.

1 Dividing judgement factor set U

The evaluation factor set $\bar{U}$ is divided, i.e., $U = \{U_1, U_2, \dots, U_n\}$, in which $U_i = \{u_{i1}, u_{i2}, \dots, u_{im}\}$, i.e., U_i contains k_i factors, $\sum_{i=1}^n k_i = n$, $\bigcup_{i=1}^n U_i = U$ and $U_i \cap U_j = \emptyset, i \neq j$.

2 Primary evaluation

The k_i factors of each $U_i = \{u_{i1}, u_{i2}, \dots, u_{ikt}\}$ are comprehensively evaluated according to the original model. Assuming that the total evaluation matrix of k_i factors of fuzzy subset A_i and A_i of factor importance of alum is R_i , we can obtain:

$$A_i \circ R_i = b_i = (b_{i1}, b_{i2}, \dots, b_{in}), i = 1, 2, \dots, N \quad (16)$$

where B_i is the single factor evaluation of U_i .

3 Secondary evaluation

Let the fuzzy self set of factor importance of $U = \{U_1, U_2, \dots, U_N\}$ be A and $A = \{A_1, A_2, \dots, A_N\}$, then the total evaluation matrix U of U is:

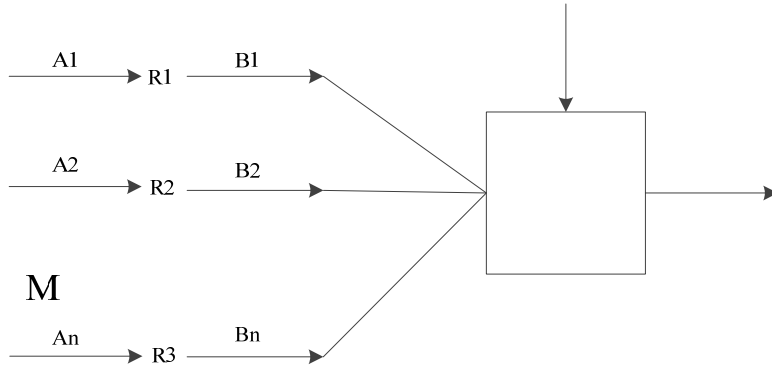
$$R = \begin{bmatrix} B_1 \\ B_2 \\ \dots \\ B_N \end{bmatrix} = \begin{bmatrix} A_1 \circ R_1 \\ A_2 \circ R_2 \\ \vdots \\ A_N \circ R_N \end{bmatrix} \quad (17)$$

The overall (secondary) comprehensive evaluation result is obtained, i.e.,

$$B = A \circ R \quad (18)$$

This is also the comprehensive evaluation result of evaluation factor U . The critical process is shown in Figure 2.

Figure 2 Evaluation process chart



In the research in this paper, because there are many factors involved in the comprehensive evaluation of innovative education, in order to ensure the accuracy and efficiency of the comprehensive evaluation of innovative education quality, a three-level fuzzy comprehensive evaluation model is adopted. The specific steps are shown in Figure 3:

- 1 The factor set $U = \{u_1, u_2, \dots, u_n\}$ of the evaluation object is established.
- 2 The evaluation set $V = \{v_1, v_2, \dots, v_n\}$ is established. Such as the evaluation of the quality of innovative education, the evaluation set is a set of grades; Generally, it can be roughly determined by “excellent, good, qualified and unqualified”, and of course, it can also be expressed by “good, good, general, poor and poor”.
- 3 Establish single factor evaluation, i.e., establish a fuzzy map from U to $F(V)$.

$$f: U \rightarrow F(V), \forall u_i \in U \quad (19)$$

$$u_i \mapsto f(u_i) = \frac{r_{ij}}{v_1} + \frac{r_{i2}}{v_2} + \dots + \frac{r_{im}}{v_m} \quad (20)$$

$$0 \leq r_{ij} \leq 1, 1 \leq i \leq n, 1 \leq j \leq m \quad (21)$$

The fuzzy relation can be induced from f and the fuzzy matrix can be obtained.

$$R = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1m} \\ r_{21} & r_{22} & \dots & r_{2m} \\ \dots & \dots & \dots & \dots \\ r_{n1} & r_{n1} & \dots & r_{nm} \end{bmatrix} \quad (22)$$

- 4 *Comprehensive evaluation.* Due to the different emphasis on each factor in U , it is necessary to give different weights to each factor. It can be expressed as a fuzzy subset $A = (a_1, a_2, \dots, a_n)$ on U , and it is specified that $\sum_{i=1}^n a_i = 1$. After A and R are obtained, the comprehensive evaluation model for comprehensive evaluation of innovative education quality is:

$$B = A \circ R \quad (23)$$

3 Experimental design

3.1 Simulation experiment design

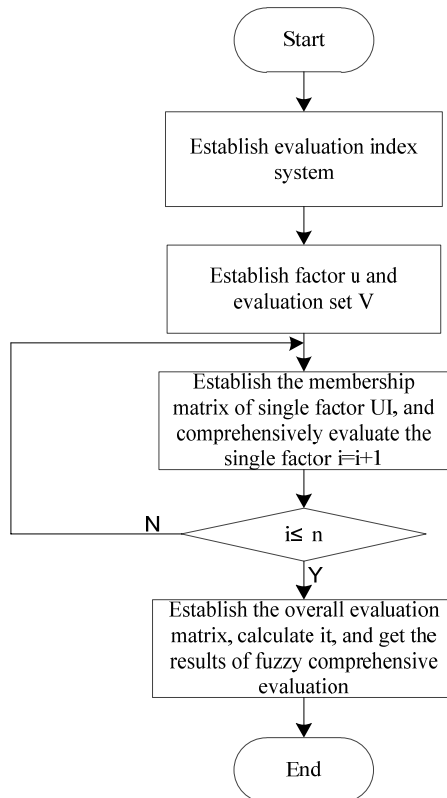
In order to verify the effectiveness of the comprehensive evaluation method of innovative education quality from the perspective of balanced and stable development is designed in this paper, an experimental test was conducted. The overall test scheme is as follows:

- 1 *Experimental environment parameters:* The hardware device is a 64G solid-state hard disk, 16G cache, 8-core high-speed processor, and the system is a Windows 10 computer. SQL 2019 database and MATLAB 7.0 software are set inside to improve the experimental operation speed and ensure the scientific reliability of the experiment.
- 2 *Experimental data:* The experimental data are from 5 universities. Collect the campus environment, faculty and student performance of these 3 universities, and

integrate and normalise the collected data to ensure that the length of the experimental data can be less than the length allowed by the simulation software. On this basis, all data are divided into experimental sets and test sets. The data in the test sets are input into the simulation software to obtain the optimal operating parameters of the platform. The parameters are used as the parameters in the subsequent experiment process. The data in the experimental sets are input into the simulation software for testing, so as to obtain the relevant experimental results.

- 3 *Experimental evaluation index*: Lu and Zhou (2021) method, Ma (2021) method and method in this paper are tested experimentally, and the application effects of different methods are verified by comparing the data collection time of different methods, the error rate of evaluation index weight calculation and the evaluation accuracy. Among them, the shorter the time-consuming of innovative education data collection, the higher the efficiency of data collection; The lower the calculation error rate of the comprehensive evaluation index weight of innovative education quality, the higher the calculation accuracy; The higher the accuracy of the comprehensive evaluation of innovative education quality, the higher the accuracy of the evaluation results.

Figure 3 Comprehensive evaluation steps of innovative education



3.2 Analysis of experimental results

In order to verify the efficiency of innovative education data collection by different methods, the data collection time of the three methods is compared, and the results are shown in Table 2.

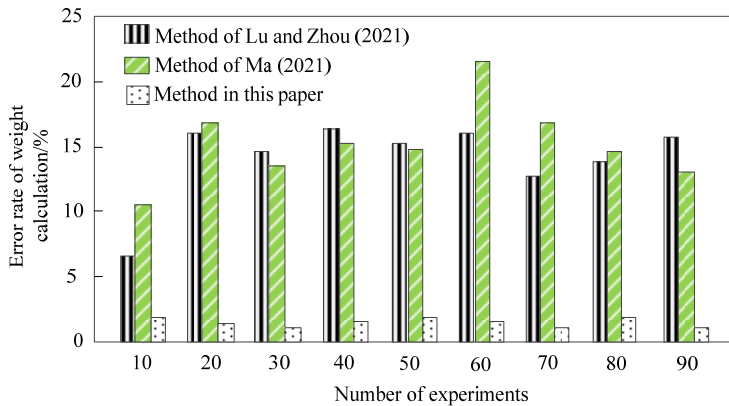
Table 2 Comparison results of data acquisition time

Number of experiments	Acquisition time/s		
	<i>Lu and Zhou (2021) method</i>	<i>Ma (2021) method</i>	<i>Methods in this paper</i>
10	1.35	5.63	0.68
20	1.48	5.47	0.56
30	1.56	5.63	0.67
40	1.21	5.14	0.68
50	1.69	5.78	0.57
60	1.57	4.86	0.67
70	1.93	4.13	0.63
80	1.51	4.55	0.58
90	1.66	4.84	0.61
Average value	1.55	5.11	0.63

By analysing the data in Table 2, it can be seen that the maximum time-consuming for innovative education data collection of Lu and Zhou (2021) method is 1.93 s, the maximum time-consuming for innovative education data collection of Ma (2021) method is 5.78 s, and the maximum time-consuming for innovative education data collection of the method in this paper is 0.68s. The method in this paper is lower than Lu and Zhou (2021) method and Ma (2021) method by 1.25 s and 5.1 s respectively; The minimum value of innovative education data collection time of Lu and Zhou (2021) method is 1.21 s, the minimum value of innovative education data collection time of Ma (2021) method is 4.13 s, and the minimum value of innovative education data collection time of this method is 0.56s. This method is lower than Lu and Zhou (2021) method and Ma (2021) method by 0.65 s and 3.57 s respectively; The average time-consuming for innovative education data collection of Lu and Zhou (2021) method is 1.55 s, the average time-consuming for innovative education data collection of Ma (2021) method is 5.11 s, and the average time-consuming for innovative education data collection of the method in this paper is 0.63s. The method in this paper is lower than Lu and Zhou (2021) method and the method Ma (2021) method by 0.92s and 4.48s respectively; The above data show that the data acquisition time of this method is shorter and the efficiency is higher. The reason is that this method uses K-means clustering algorithm to collect innovative education data, and conducts data fusion and reduction processing to ensure the quality and efficiency of data collection.

The error rate of weight calculation of the comprehensive evaluation index of innovative education quality of the three methods is compared, and the comparison results are shown in Figure 4.

Figure 4 Comparison results of error rate of index weight calculation (see online version for colours)



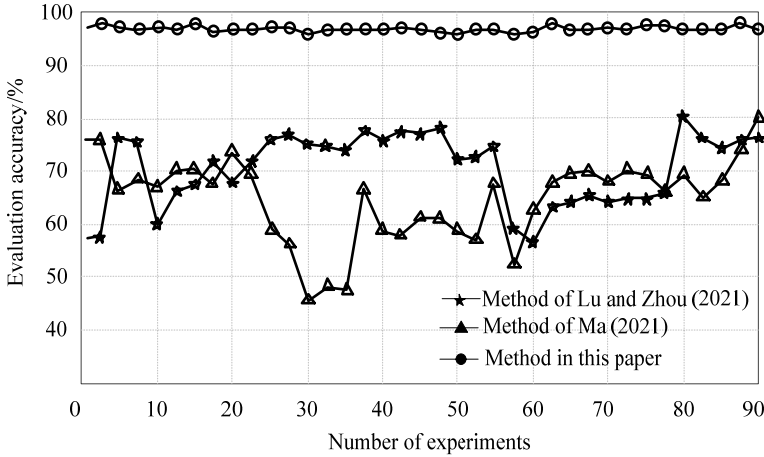
According to the data in Figure 4, the maximum error rate of the weight calculation of the comprehensive evaluation index of innovative education quality in Lu and Zhou (2021) method is 17%, the maximum error rate of the weight calculation of the comprehensive evaluation index of innovative education quality in Ma (2021) method is 22%, and the maximum error rate of the weight calculation of the comprehensive evaluation index of innovative education quality in this method is 2%, which is 15% and 20% lower than Lu and Zhou (2021) method and Ma (2021) method, respectively; The minimum error rate of the weight calculation of the comprehensive evaluation index of innovative education quality in Lu and Zhou (2021) method is 7%, the minimum error rate of the weight calculation of the comprehensive evaluation index of innovative education quality in Ma (2021) method is 11%, and the minimum error rate of the weight calculation of the comprehensive evaluation index of innovative education quality in the method of this paper is 1%, which is 6% and 10% lower than Lu and Zhou (2021) method and Ma (2021) method, respectively; The above data show that compared with the experimental comparison method, the index weight calculation error rate of this method is lower and the calculation accuracy is higher. The reason is that this method builds a comprehensive evaluation system of innovative education quality by selecting evaluation index data, calculates the weight of evaluation index by using the analytic hierarchy process, and realises the comprehensive evaluation of innovative education quality by combining the three-level fuzzy comprehensive evaluation model.

The comprehensive evaluation accuracy of innovative education quality of the three methods is compared, and the comparison results are shown in Figure 5.

By analysing the data in Figure 5, we can see that with the increase of the number of experiments, the accuracy of comprehensive evaluation of innovative education quality of different methods presents an irregular change trend. The comprehensive evaluation accuracy of the innovative education quality of the method Lu and Zhou (2021) method varies from 57% to 80%, and the comprehensive evaluation accuracy of the innovative education quality of Ma (2021) method varies from 44% to 77%, while the comprehensive evaluation accuracy of the innovative education quality of the method in this paper always remains above 94%, indicating that the evaluation accuracy of the method in this paper is higher and the comprehensive evaluation results of the innovative education quality are more accurate. The reason is that this method builds a

comprehensive evaluation system of innovative education quality by selecting evaluation index data, calculates the weight of evaluation index by using the analytic hierarchy process, and realises the comprehensive evaluation of innovative education quality by combining the three-level fuzzy comprehensive evaluation model. Therefore, this method has a high evaluation accuracy.

Figure 5 Comparison results of comprehensive evaluation accuracy of innovative education quality



4 Conclusion

- 1 Along with the social economic development level gradually improve, information technology has been widely applied in the field of education, education reform has been steadily push, in the field of innovative education models, in order to guarantee the stability of education balanced development view and accurate evaluation of innovative education, improve the existing problems of innovative education. It is urgent and necessary to study the comprehensive evaluation method of innovative education quality, so this paper proposes a new comprehensive evaluation method of innovative education quality from the perspective of balanced and stable development.
- 2 The experimental results show that the method of innovative education data acquisition time average of 0.63 s, innovative education quality comprehensive evaluation index weight calculation of maximum error is 2%, innovative education quality comprehensive evaluation precision always stay above 94%, data acquisition of high efficiency, and evaluation index weight calculation precision are high precision. It can be widely used in the field of education, so as to achieve the ultimate goal of promoting the transformation and development of modern education mode.

References

- Cervero, A., Castro-Lopez, A., Lvarez-Blanco, L., Wang, Z. and Guan, J. (2020) 'Evaluation of educational quality performance on virtual campuses using fuzzy inference systems', *PLoS ONE*, Vol. 15, No. 5, pp.e0232802–e0232813.
- Chen, L., Luo, Y., Liu, X., Ni, L. and Ding, R. (2021) 'Improved collaborative filtering recommendation algorithm based on user attributes and K-means clustering algorithm', *Journal of Physics: Conference Series*, Vol. 1903, No. 1, pp.012036–012047.
- Fan, Y., Liu, Y., Qi, H., Liu, Y. and Hu, D. (2021) 'Anti-interference technology of surface acoustic wave sensor based on K-means clustering algorithm', *IEEE Sensors Journal*, Vol. 21, No. 7, pp.8998–9007.
- Gong, W., Pang, L., Wang, J., Xu, Z. and Song, X. (2021) 'A social-aware K means clustering algorithm for D2D multicast communication under SDN architecture', *AEU – International Journal of Electronics and Communications*, Vol. 132, No. 2, p.153610.
- Joniec, E.Z. (2021) 'Concerns of quality and reliability of educational videos focused on frailty syndrome on YouTube platform', *Geriatrics*, Vol. 7, No. 1, pp.3–11.
- Li, X., Zhu, J., Shi, H., Li, Z. and Liu, H. (2021) 'Surface defect detection of seals based on K-means clustering algorithm and particle swarm optimization', *Scientific Programming*, Vol. 37, No. 2, pp.109–118.
- Lu, M. and Zhou, Y.W. (2021) 'Research on the quality evaluation of innovation and entrepreneurship education in universities based on CIPP model', *Trade and Exhibition Economics*, Vol. 10, No. 1, pp.90–92.
- Ma, R.B. (2021) 'Research on quality evaluation of preschool education based on deep learning network', *Modern Electronic Technology*, Vol. 44, No. 9, pp.69–73.
- Martin, T., Drissen, L. and Prunet, S. (2021) 'Data reduction and calibration accuracy of the imaging fourier transform spectrometer SITELLE', *Monthly Notices of the Royal Astronomical Society*, Vol. 16, No. 4, pp.4–18.
- Nojavan, M., Heidari, A. and Mohammaditabar, D. (2021) 'A fuzzy service quality based approach for performance evaluation of educational units', *Socio-Economic Planning Sciences*, Vol. 73, No. C, pp.1–11.
- Ona, A. and Mr, B. (2021) 'A geometric-based data reduction approach for large low dimensional datasets: delaunay triangulation in SVM algorithms – ScienceDirect', *Machine Learning with Applications*, Vol. 15, No. 4, pp.100025–100036.
- Ramirez-Sanchez, M.Y., Gutierrez-Pallares, E., Pereira, V.A., Zhang, K. and Shu, L. (2022) 'Evaluation of the main components for learning with materials in educational platforms', *International Journal of Education and Practice*, Vol. 10, No. 2, pp.96–106.
- Wang, X., Shen, A., Hou, X., Ni, L. and Jiang, T. (2022) 'Research on cluster system distribution of traditional fort-type settlements in Shaanxi based on K-means clustering algorithm', *PLOS ONE*, Vol. 17, No. 3, pp.1–25.
- Xu, J. (2020) 'Research on quality evaluation method of college innovation and entrepreneurship education based on fuzzy mathematics', *Chinese Journal of Business*, Vol. 18, No. 2, pp.196–198.
- Zheng, X., Zhang, L. and Xu, Z. (2021) 'L1-norm Laplacian support vector machine for data reduction in semi-supervised learning', *Neural Computing and Applications*, Vol. 15, No. 1, pp.1–18.