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A study on the weight allocation of multi-objective linear programming in the evaluation system of English education

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ABSTRACT

The problem of English education quality is worth exploring in depth, and quantifying the indicators of English education can help to understand the problems in teaching and improve the quality of teaching. The study firstly establishes the English education quality evaluation index system, including five first-level indexes of teaching resources, teaching content, teacher quality, teaching effect and teaching quality feedback and 15 second-level indexes, such as network resources, book resources and comprehensive teaching content. On this basis, the combination weights are determined by fusing the G2 method and the projection tracing method through the combination assignment method to eliminate the one-sidedness problem of adopting a single assignment method, and then the cloud model theory is introduced to establish the English education evaluation model based on the cloud model. Problems and shortcomings of multi-objective linear programming weight allocation in English education evaluation system are found through the evaluation results, which lead to low multi-objective linear programming weight allocation in English education evaluation system.

Keywords: projection tracing method, G2 method, cloud model, multi-objective linear programming, English education evaluation system

1. Introduction

With the development of society, new challenges to education have been ushered in. Educational evaluation system is a crucial component in the field of education, measuring the quality and effect of education and influencing the direction and development of education [1]. For students, teachers, schools and even the whole education system, a scientific and reasonable education evaluation system has an indispensable role. It covers a number of aspects, including students' academic performance, teachers' teaching quality, school management level and so on [2]. A scientific and reasonable education evaluation system can stimulate students' learning motivation and directly affect learning styles, improve teachers' teaching level, help schools to find out the problems and deficiencies in education and teaching, adjust the schooling strategy in time and optimize the allocation of resources

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[3].

In English education, the educational evaluation system mainly includes three levels, namely, student evaluation, teacher evaluation and school evaluation. Student evaluation requires focusing on the embodiment of the student's main position in the evaluation, and strives for the diversification of evaluation methods, which is not only limited to the evaluation of students' performance, but also includes classroom performance, comprehensive literacy, knowledge mastery, speaking level, etc., which is both concerned about the learning process and the results of the learning process, and at the same time advocates the joint participation of students, peers, teachers, parents, etc. in the evaluation [4-7]. Teachers' evaluation mainly involves teachers' teaching quality, teaching methods, professional development, teaching management, curriculum, students' feedback, etc. Teachers' teaching level should not be evaluated only by students' examination results, but also focus on teachers' efforts in cultivating students' comprehensive quality, providing teachers with more professional development opportunities, encouraging them to continuously innovate their teaching methods, and improving their teaching quality [8-11]. School evaluation is also gradually diversified, in addition to focusing on the rate of advancement and test scores, we should also examine the educational resources, teaching materials, teacher training, campus culture construction, educational innovation, etc., to encourage schools to run out of characteristics, to meet the developmental needs of different students, and to cultivate well-rounded talents for the society [12-13]. In the face of the various levels in the evaluation of English education, in order to obtain useful evaluation information from them to promote the development of students, teachers, and schools in a tripartite way, it is necessary to study between the various evaluation indicators.

Multi-objective linear programming (MOLP), as a mathematical planning method, aims to solve the problem of conflict or interconnection between multiple objectives [14]. In MOLP, multiple objective functions are considered simultaneously and these objectives are optimized by setting different weights or constraints. MOLP is usually solved using linear programming methods such as simplex method [15]. However, in multi-objective optimization, due to conflicts and interconnections between objectives, there may not be a single optimal solution, but rather a set of optimal solutions, called non-dominated or Pareto-optimal solutions, which form a curve or body called a Pareto frontier or Pareto set [16-17]. In solving the MOLP problem, we must explicitly specify the priority relationship between the objective functions, which can be achieved by setting different weights [18-19]. Therefore, the assignment setting of weights also becomes the focus.

The study first establishes an evaluation system for the quality of English teaching in a school. The system consists of three layers, namely the target layer, the criterion layer and the indicator layer, in which the criterion layer contains 5 indicators and the indicator layer contains 15 indicators. Subsequently, the process of combining and assigning weights to the indicator system by the improved G2 method and the projection tracing method optimized by accelerated genetic algorithm is introduced. The subjective and objective weights are calculated using the G2 method and projection tracing method, and then the combined weights are determined by multi-objective linear programming. Subsequently, the cloud model theory is introduced to establish the evaluation model of English education based on the cloud model. Finally, taking English education in a school as an example, the combination assignment assessment method is utilized to calculate the index weights and carry out the assessment of multi-objective linear planning weight allocation in the English education evaluation system.

2. Establishment of an evaluation system for English language education

2.1. *Construction of English Teaching Quality Evaluation System*

The establishment of education quality evaluation system is a complex systematic project, science, comprehensiveness and operability are the three major principles of teaching quality evaluation system. Because the teaching quality system not only contains the setting of indicators, the follow-up also involves data collection and analysis, so the realization of operability under the premise of science ahead. Combining the experience of domestic and foreign education evaluation index system and the current situation of teaching English subject in a school, the teaching evaluation quality system was established, and the English teaching quality evaluation index system is shown in Table 1. From the evaluation system of teaching indicators in advanced countries as well as regions of education, most of the indicator system is in the form of pyramid hierarchy, i.e., an evaluation goal, multiple evaluation guidelines, and a number of evaluation indicators under the guideline layer. Therefore, this paper continues this hierarchical system, and this hierarchical form is also consistent with the scoring method of hierarchical analysis. This paper adopts the "Input Dimension" and "Outcome Dimension" in the "Comprehensive Teaching Global Testing Report". "Learning outcomes" and "school organization and policy" in the Dutch teaching evaluation system. "Teacher level", "school level" and "student level" in the teaching quality evaluation system in Yuta State. "Curriculum and Teaching", "Teacher Quality" and "Teaching Quality Monitoring" in the Shanghai Teaching Quality Evaluation System. These guideline indicators are not named intuitively enough, and some of them are more macro and need to be improved. Therefore, the input dimension is changed to teaching resources, the curriculum and teaching is changed to teaching content, the teacher dimension and teacher quality are merged to teacher quality, the outcome dimension, learning outcomes as well as the student dimension are changed to teaching effectiveness, and the monitoring of teaching quality is retained, which is renamed as teaching quality feedback. Among them, teaching resources mainly refer to the various resources provided by the school for English teaching. Due to the application of network technology in modern teaching, classroom teaching has become more vivid and popular among students. In educationally developed areas, the application of the Internet in teaching has been very common, and there is no need to take it as a separate indicator, however, the Internet resources in our school, especially for students, are limited, so the Internet resources are set as a subordinate indicator of teaching resources. The teaching content retains the two indicators of whether the teaching content is comprehensive and whether the teaching objectives are clear, and a new indicator of the practicality of the teaching content is added. In the final analysis, English is only a communication tool, and how to use English is the ultimate goal of learning English. It is undeniable that the English knowledge learned in the classroom cannot be applied in daily life, especially in daily communication with foreigners, which is still lacking. Therefore, the practicality of the teaching content is taken as a subordinate indicator of the teaching content. Teachers' quality mainly refers to teachers' professional quality, teaching methods and professional ethics. Teaching effectiveness mainly refers to the results of students' English learning. In daily communication, listening, speaking, reading and writing cannot be neglected, so all four aspects of English learning are included in the examination.

Table 1. English teaching quality evaluation index system

Target layer	Criterion layer	Index layer
English teaching quality evaluation index system A	Teaching resources B1	Network resources C11
		Book resources C12
		Class capacity and other hardware facilities C13
	Teaching content B2	Comprehensive teaching C21
		Clear teaching goals C22
		practicability C23
	Teacher quality B3	Professional ability C31
		Teaching method C32
		Occupational ethics C33
	Teaching effect B4	Students' ability to hear English C41
		Students' ability to read English C42
		Students' ability to write English C43
	Teaching quality feedback B5	District education bureau C51
		School leadership C52
		English teacher level C53

2.2. Combinatorial assignment based on multi-objective linear programming

2.2.1. Improvement of the G2 method for determining subjective weights. First of all, the set of evaluation indicators is defined as $X=\{X_l,X_2,\ldots,X_n\}$, where n indicates the number of indicators, the expert selects an unimportant indicator from the indicators and takes it as a reference, which is recorded as X_a, calculates the ratio of the Gini coefficient of the rest of the indicators to X_a, determines the degree of importance of each indicator, and finally obtains the value of the weight of the indicators [20]. The specific calculation steps are as follows:

1) Calculate the value of the Gini coefficient of the indicators. All evaluation indicators are rearranged, and the Gini coefficient value of each evaluation indicator is calculated according to the formula G_i:

$$G_i=\frac{1}{mY_i}\sum_{p=1}^{m-1}\sum_{q=p+1}^{m}\left|y_{ip}-y_{iq}\right| \tag{1}$$

Where: m denotes the number of samples, y_{ip} and y_{iq} denote the value of the indicator X_i corresponding to the p th and q th samples respectively, and Y_i denotes the sum of the values of the m samples of X_i.

2) Calculate the importance of indicators. Based on the least important indicator selected by the experts from the indicators, which is recorded as X_a, the relative importance r_i of the other indicators is calculated:

$$r_i=\frac{G_i}{G_a} \tag{2}$$

Where: G_a represents the Gini coefficient value for indicator X_a.

3) Calculate the subjective weight of the indicator:

$$w_i=\frac{r_i}{\sum_{i=1}^{n} r_i} \tag{3}$$

2.2.2. Projective tracing method for determining objective weights for accelerated genetic algorithm optimization. Accelerated genetic algorithm (GA) is realized on the basis of biological evolution theory, population evolution theory and other theories, the algorithm is a kind of search algorithm that simulates the process of biological genetic evolution, in nature, in the process of genetic iteration again and again, through the individual selection, crossover and mutation and other operations, to select the highest degree of fitness of individuals, and constantly repeat this operation, to pick out the optimal individual, genetic algorithm will be used for the biological evolution of nature to solve practical decision-making problems, through the precise search of a large-scale population to evolve to the optimal solution, the method has the characteristics of fast computing rate and high accuracy. Genetic algorithm uses the biological evolution in nature to solve the actual decision-making problems, through the precise search of a large range of populations, and constantly evolve to the optimal solution, which is characterized by a fast computing rate and high degree of accuracy. The algorithm can fully extract the sample data, which is suitable for the analysis and research of complex systems, and the evaluation process is not affected by the subjectivity of experts, and has the characteristics of objectivity. Evaluation indicators are not independent, and interact with each other and influence each other, so it is impossible to accurately carry out a single evaluation, therefore, this paper combines the accelerated genetic algorithm and the projection tracing method, and uses the genetic algorithm to solve the optimal solution in the projection tracing model, to find the optimal projection direction, and to get the weighting value.

1) Indicator data standardization. Standardize the indicator data to facilitate uniform calculation. Mark the j nd indicator data of the i st sample as $x(i,j)$, then there is a data set of all indicators as $\{x(i,j) \mid i=1,2,\ldots,n; j=1,2,\ldots,m\}$, where n represents the number of samples to be evaluated and m represents the number of evaluation indicators, and the decision matrix A is obtained according to the results of the standardized processing of sample data.

For the standardization of positive indicators:

$$x_{ij} = \frac{x_{ij} - \min\left(x_j\right)}{\max\left(x_j\right) - \min\left(x_j\right)} \tag{4}$$

For normalization of negative indicators:

$$x_{ij} = \frac{\max\left(x_j\right) - x_{ij}}{\max\left(x_j\right) - \min\left(x_j\right)} \tag{5}$$

$$A = \begin{pmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{pmatrix}_{n*m} \tag{6}$$

2) Construct the projection indicator function. Construct the projection indicator function $Q(a)$, the projection tracing method is to synthesize the n -dimensional data $\{x_{ij} \mid j=1,\ldots,m\}$ into a one-dimensional projection value z_i with $a=\{a_1,a_2 \ldots a_m\}$ as the projection direction, the formula is:

$$z_i = \sum_{j=1}^{m} a_j x_{ij}, i=1,2,\ldots,n \tag{7}$$

Where a is the unit length vector and z_i is the projection value, the synthesis requires z_i to have the characteristics of local projection points as dense as possible, and the overall projection points are scattered as much as possible between them. Therefore, the available classification index is the objective function, and the formula is as follows:

$$Q_a = S_z \times D_z \tag{8}$$

where S_z is the standard deviation of z_i and D_z is the local density of z_i, which is given by:

$$S_z = \sqrt{\frac{\sum_{i=1}^{m}(z_i - \bar{z})^2}{n-1}} \tag{9}$$

$$D_z = \sum_{i}^{m}\sum_{j}^{n}\left(R - r_{ij}\right) \times u\left(R - r_{ij}\right) \tag{10}$$

$$r_{ij} = \left|z_i - z_j\right| (i = 1, \ldots, m; j = 1, \ldots, n) \tag{11}$$

where $\bar{z}$ is the average value of z_i. R is the window radius of the local density, whose threshold can be taken as $0.1S_z$, $0.01S_z$, etc. r_{ij} is the distance between samples. $u(p)$ is a unit step function, when $p = \left(R - r_{ij}\right) \geq 0$, the value is 1, otherwise 0.
3) Determine the optimal projection indicator function. Because the sample data of each indicator is given, so the projection indicator function is only one variable of the projection direction vector, and the projection function is optimal when a is the maximum. Therefore, its maximization objective function and constraints expression is:

$$Max\left(Q_a\right) = S_z \times D_z \tag{12}$$

$$\sum_{j=1}^{m} a_j^2 = 1, a_j \geq 0 \tag{13}$$

The above formula is more complicated to calculate the projection index function, and it is easier and more effective to use accelerated genetic algorithm (AGA) to solve the above problem.
4) Solve the optimization result. By obtaining the optimal projection direction vector a, the objective weight value can be calculated. In view of the complexity of the calculation process of the above objective function, this paper calculates the optimal projection direction with the help of the programming software MATLAB, and obtains the objective weights of the indicators W_2.

$$w_j = a_j^2 \tag{14}$$

Where w_j is the weight value of the j nd indicator. a_j is the value of the best projection direction for the j th indicator.

2.3. Subjective and objective weight allocation based on multi-objective linear programming

Combined weights are applied to integrate the advantages of various subjective and objective weighting methods, with the objective weighting method using principal component analysis and entropy weighting, and the subjective weights determined by hierarchical analysis. Meanwhile, in order to reflect the actual information of the indicators more objectively, the objective weights are further supplemented by the improved projection tracing method.

According to the concept of Shannon's information entropy and the measure of relative difference of weights, the first type of uncertainty objective function and the second type of weight consistency objective function are established respectively. Combined with the constraints, the multi-objective optimization model of indicator weights can be established. The weighting model is solved using the non-dominated sorting genetic algorithm-II to determine the optimal combination coefficients, and the final weights are obtained accordingly.

$$f_1(\alpha) = -\sum_{k=1}^{l} \alpha_k \ln \alpha_k \tag{15}$$

$$f_2(\alpha) = \sum_{j=1}^{m} \sum_{k=1}^{l} \sum_{k=1}^{l} \left(W_j - w_{kj}\right)^2$$
$$F(\alpha) = \left(\max f_1(\alpha), \min f_2(\alpha)\right) \tag{16}$$

$$s.t. \begin{cases} \sum_{k=1}^{l} \alpha_k = 1 \\ 0 < \alpha_k \leq 1 \end{cases} \tag{17}$$

$$W = \sum_{k=1}^{l} \alpha_k w_k \tag{18}$$

Where: α is the vector of combination coefficients. k is the serial number of the assignment method. l is the total number of assignment methods. α_k is the combination coefficient of the weights determined by the assignment method of category k. j is the evaluation indicator serial number. W_j is the final weight of the j th evaluation indicator. w_{kj} is the weight of the j th evaluation indicator determined by the k th type of assignment method. $F(\alpha)$ is the overall objective function. W is the combined weight vector. w_k is the vector of weights calculated by the k th type of assignment method.

3. Calculation of evaluation indicator weights

3.1. Determination of subjective weights based on the G2 method

3.1.1. Data sources. To study and evaluate the weight assignment of multi-objective linear programming in the evaluation system of English education, the English education classes in a school are the object of the study, and the data come from the questionnaire surveys of the educators and relevant experts in the school, and two kinds of questionnaires are issued to carry out the research. The data obtained from the Questionnaire on the Importance of Evaluation Indicators was used as the data input for ranking the importance of evaluation indicators and assigning importance in the G1 method. The data obtained from the Evaluation Indicator Scoring Sheet was used as the calculation of the weights of the G1 method.

3.1.2. G1 method for determining subjective weights of indicators. According to the data in the "Questionnaire on the Importance of Evaluation Indicators" on the relationship of the evaluation indicators for the order and importance of the assignment of the data to start the calculation of weights, through the calculation of the weights of the first-level indicators as an example, in accordance with the formula to calculate and get the results of the calculation of the weights. The results of the calculation of the order relationship and importance of the first-level indicators are shown in Table 2. According to the table, it can be seen that the weight of teaching resources in the first-level indicators is 0.191, the weight of teaching content is 0.294, the weight of teacher quality is 0.1871, the weight of teaching effect is 0.1728, and the weight of teaching quality feedback is 0.1551.

Table 2. The order of the primary index and the importance of the calculation result

Experts	Order relation	r_2	r_3	r_4	B_1	B_2	B_3	B_4	B_5
1	C1>C4>C2>C3	1.1	1.4	1.4	0.3429	0.2095	0.1644	0.3004	0.2106
2	C1>C2>C4>C3	1.4	1.3	1.4	0.3339	0.2693	0.1596	0.2339	0.2342
3	C4>C1>C3>C2	1.1	1.5	1.2	0.2759	0.2103	0.1635	0.3269	0.2509
4	C4>C2>C1>C3	1.3	1.1	1.7	0.2157	0.2549	0.1466	0.3626	0.2049
5	C2>C1>C4>C3	1.2	1.2	1.3	0.2815	0.2944	0.1845	0.2352	0.2291
6	C2>C4>C1>C3	1.2	0.8	1.3	0.2467	0.2963	0.192	0.2515	0.2906
7	C3>C1>C4>C2	1.1	1.2	1.2	0.287	0.1678	0.3139	0.2148	0.2618
8	C1>C4>C3>C2	1	1.2	1.2	0.3157	0.1771	0.222	0.2742	0.218
9	C1>C4>C2>C3	1.2	1.2	1.1	0.3333	0.2271	0.198	0.2796	0.2233
10	C1>C4>C2>C3	1.4	1	1	0.2993	0.2078	0.2043	0.24	0.2593
11	C1>C2>C4>C3	1.3	1	1.4	0.342	0.2528	0.2419	0.1927	0.2297
12	C1>C4>C3>C2	1	1.3	1.2	0.3014	0.1951	0.231	0.2621	0.2677
13	C4>C1>C2>C3	1.3	1.2	1.1	0.2778	0.2202	0.1949	0.3094	0.2203
14	C2>C1>C4>C3	1.1	1.1	1.2	0.2787	0.2947	0.2095	0.2482	0.2441
15	C1>C2>C4>C3	1.1	1.2	1.2	0.3126	0.2669	0.1739	0.2448	0.2526
Evaluation result					0.191	0.294	0.1871	0.1728	0.1551

The calculation of the weights of the secondary indicators is carried out in accordance with the method of calculating the weights of the primary indicators, i.e., the G1 method is used to determine the subjective weighting results based on the results of the experts' ranking of the importance of the secondary evaluation indicators. The results of the second-level indicator weights are shown in Table 3. From the table, it can be seen that the weight of the secondary indicators in teaching resources is $B_1 = (0.1503, 0.1402, 0.1033)$, the weight of the secondary indicators in teaching content is $B_2 = (0.0924, 0.1527, 0.048)$, the weight of the secondary indicators in teacher quality is $B_3 = (0.0733, 0.1281, 0.0709)$, the weight of the secondary indicators in teaching effect is $B_4 = (0.2682, 0.2307, 0.2776)$, and the weight of the secondary indicators in teaching quality feedback is $B_5 = (0.2262, 0.2787, 0.2637)$.

Table 3. Secondary index weight results

Secondary indicator	Weighting
C11	0.1503
C12	0.1402
C13	0.1033
C21	0.0924
C22	0.1527
C23	0.048
C31	0.0733
C32	0.1281
C33	0.0709
C41	0.2682
C42	0.2307
C43	0.2776
C51	0.2262
C52	0.2787
C53	0.2637

By synthesizing the weights of the five first-level indicators and the weights among the 15 second-level indicators calculated by the G1 method, thus obtaining the table of subjective weight results of the evaluation indicators of multi-objective linear programming in the evaluation system of English education, the results of the subjective weights of the safety evaluation indicators are shown in Table 4. From the table, we can get that the subjective weights of evaluation level one indicators are ordered as teaching content, teaching resources, teacher quality, teaching effect, teaching quality feedback.

Table 4. The results of the subjective weight of the safety evaluation index

Target layer	Criterion layer	Weighting	Index layer	Weighting
A	B1	0.191	C11	0.0619
			C12	0.0698
			C13	0.0593
	B2	0.294	C21	0.1378
			C22	0.0199
			C23	0.1363
	B3	0.1871	C31	0.0535
			C32	0.0647
			C33	0.0689
	B4	0.1728	C41	0.0535
			C42	0.0277
			C43	0.0916
	B5	0.1551	C51	0.0391
			C52	0.0293
			C53	0.0867

3.2. *Determination of objective weights based on the projection tracing method*

3.2.1. Determination of weights for tier-1 indicators. According to the data in the Evaluation Indicator Scoring Table, the data of each indicator in the first-level indicator scoring table are standardized according to the formula to obtain standardized first-level indicator data, and the scoring and standardized data of each first-level indicator are shown in Table 5.

Table 5. Each grade index and standardized data

	Scoring					Standardized data				
Expert/indicator	B_1	B_2	B_3	B_4	B_5	B_1	B_2	B_3	B_4	B_5
1	86	88	88	74	72	0.907	0.81	0.91	0.1732	0.1718
2	72	70	87	86	90	0.0947	0.04	0.66	0.7854	0.7858
3	73	91	73	87	86	0.2849	0.79	0.01	0.654	0.6466
4	90	84	87	95	92	0.8569	0.66	0.75	0.958	0.9553
5	69	92	88	89	85	0.0046	0.91	0.87	0.7821	0.7745
6	88	84	78	89	95	0.7155	0.55	0.37	1.0004	1.0018
7	82	85	71	72	73	0.4722	0.65	0.1	0.0881	0.0821
8	72	72	84	90	92	0.1921	0.03	0.71	0.826	0.8311
9	89	88	89	72	68	0.9056	0.7	0.85	0	0.0038
10	91	77	70	72	76	0.9541	0.39	0.05	0.1781	0.1703
11	77	77	91	92	91	0.4295	0.08	0.79	0.8295	0.8257
12	89	93	89	79	74	1.002	0.95	0.71	0.3449	0.3469
13	89	88	89	90	96	0.8542	0.85	0.95	0.8662	0.87
14	72	69	91	82	75	0.1409	0.01	0.73	0.4345	0.4297
15	83	90	94	73	68	0.6708	0.85	1	0.1291	0.1334

The correlation coefficients between the indicators at each level were calculated according to the formula, and the correlation coefficients between the indicators at each level are shown in Table 6.

Table 6. Correlation coefficient of each level

Index	B_1	B_2	B_3	B_4	B_5
B_1	1	0.3655	0.1826	-0.01225	-0.1837
B_2	0.3953	1	-0.2545	0.2152	-0.2297
B_3	-0.0305	0.2351	1	0.3295	-0.0227
B_4	0.2284	0.0212	0.3211	1	1.1755
B_5	0.2641	0.2661	0.1255	0.2895	1

According to the formula, the information and weight of the first-level indicators can be calculated, and the results of the information and weight of each first-level indicator are shown in Table 7. From the table, it can be seen that the objective weight of the first-level indicators is $B=(0.2459, 0.2498, 0.2318, 0.3008, 0.3261)$.

Table 7. The amount of information and weight of each level index

Primary indicator	B_1	B_2	B_3	B_4	B_5
G_i	1.0793	0.9683	1.17	1.1676	1.1520
Weighting	0.2266	0.2144	0.1635	0.1258	0.2697

3.2.2. Determination of weights for secondary indicators. According to the above calculation process, the information and weight results of each secondary indicator are calculated, and the results of secondary indicator weights and information are shown in Table 8. From the table, it can be seen that the weight of the secondary indicators in teaching resources is $B_1=(0.1054, 0.0778, 0.0587)$, the weight of the secondary indicators in teaching content is $B_2=(0.1017, 0.1224, 0.1117)$, the weight of the secondary indicators in teacher quality is $B_3=(0.0618, 0.1369, 0.1053)$, the weight of the secondary indicators in teaching effect is $B_4=(0.2596, 0.2646, 0.1797)$, and the weight of the secondary indicators in feedback on teaching quality is $B_5=(0.3068, 0.2233, 0.2757)$.

Table 8. Secondary index weights and information results

Secondary indicator	Weighting	Information content
C11	0.1054	2.6272
C12	0.0778	2.1976
C13	0.0587	2.0861
C21	0.1017	2.409
C22	0.1224	2.4717
C23	0.1117	2.5258
C31	0.0618	2.3113
C32	0.1369	2.3562
C33	0.1053	2.2735
C41	0.2596	0.9906
C42	0.2646	1.0324
C43	0.1797	0.8495
C51	0.3068	1.1194
C52	0.2233	1.0281
C53	0.2757	1.0717

According to the calculation steps of the projection tracing method, the weights of 5 first-level indicators and 15 second-level indicators are obtained, and the result table of objective weights of evaluation indicators is obtained through the comprehensive calculation of the two. The objective weight statistics of evaluation indicators are shown in Table 9. From the table, it can be obtained that the weights of the first-level indexes are sorted into teaching quality feedback, teaching resources, teaching content, teacher quality and teaching effect.

Table 9. Evaluation index objective weight statistics

Target layer	Criterion layer	Weighting	Index layer	Weighting
A	B1	0.2266	C11	0.0802
			C12	0.0651
			C13	0.0813
	B2	0.2144	C21	0.0726
			C22	0.0568
			C23	0.085
	B3	0.1635	C31	0.0579
			C32	0.0651
			C33	0.0405
	B4	0.1258	C41	0.0268
			C42	0.0553
			C43	0.0437
	B5	0.2697	C51	0.0869
			C52	0.0772
			C53	0.1056

3.2.3. Determining combination weights based on multi-objective linear programming. According to the calculation steps of the combination assignment method, the subjective and objective weights determined by the G1 method and the projection tracing method are combined and calculated to derive the combination coefficient, according to which the combination weights of the evaluation indexes are calculated. The distribution of subjective, objective and combined weights is shown in Figure 1. From the figure, it can be seen that the distribution trend of the evaluation index weight calculation results of the G1 method, projection tracing method and the combination of three methods, from the figure can be visualized that the combination of weights is better coordinated and integrated subjective and objective weights, so that the results of the evaluation index weights are more scientific and reliable.

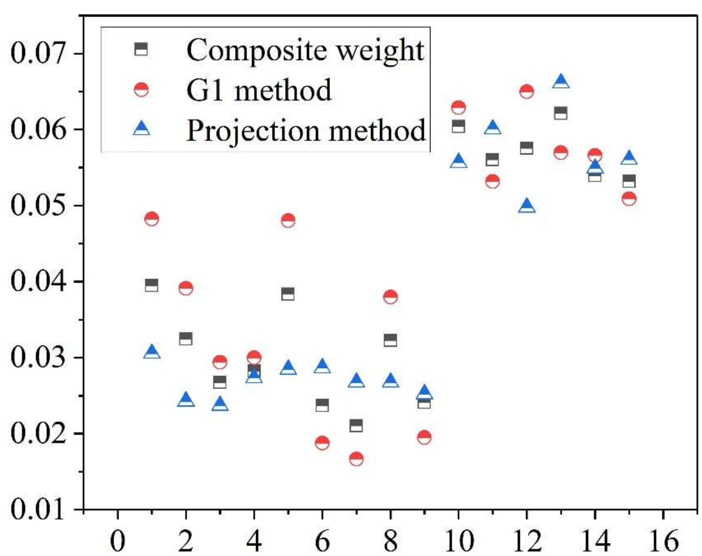

Fig. 1. Evaluation index weight distribution

The weights of the indicators of the English education evaluation system are shown in Table 10. From the table, we can analyze the weight distribution of multi-objective linear planning in the English education evaluation system is mainly affected by the teaching resources and teaching effect in the first-level indicators, followed by the teaching content, teaching quality and teaching quality feedback.

Table 10. English education evaluation system index weight

Index	G1 method	Projection method	Composite weight
B_1	0.191	0.2266	0.2433
B_2	0.294	0.2144	0.2336
B_3	0.1871	0.1635	0.1804
B_4	0.1728	0.1258	0.2616
B_5	0.1551	0.2697	0.0811
C11	0.0619	0.0802	0.0563
C12	0.0698	0.0651	0.0487
C13	0.0593	0.0813	0.0456
C21	0.1378	0.0726	0.0303
C22	0.0199	0.0568	0.0312
C23	0.1363	0.085	0.0411
C31	0.0535	0.0579	0.038
C32	0.0647	0.0651	0.0388
C33	0.0689	0.0405	0.0726
C41	0.0535	0.0268	0.0601
C42	0.0277	0.0553	0.0883
C43	0.0916	0.0437	0.1272
C51	0.0391	0.0869	0.0565
C52	0.0293	0.0772	0.2653
C53	0.0867	0.1056	0.1441

4. Cloud model evaluation methods

The cloud model evaluation method can complete the direct conversion of qualitative concepts and quantitative information, taking into account the arbitrariness and ambiguity of the evaluation process. On the basis of the determined evaluation index system, the thesis quantifies each index, determines the subjective and objective weights respectively, and carries out the combination of weights. The cloud model theory is introduced to establish the evaluation model based on the cloud model. Finally, with the help of MATLAB software, through the inverse cloud generator, input the comprehensive cloud of indicators, output the comprehensive cloud diagram, and compare it with the standard cloud diagram, in order to make the evaluation results more accurate, calculate the similarity between the indicator cloud and the standard grade, and select the maximum value of the similarity as the comprehensive evaluation grade, and finally arrive at the evaluation grade of the quality of English education. The evaluation process is shown in Figure 2.

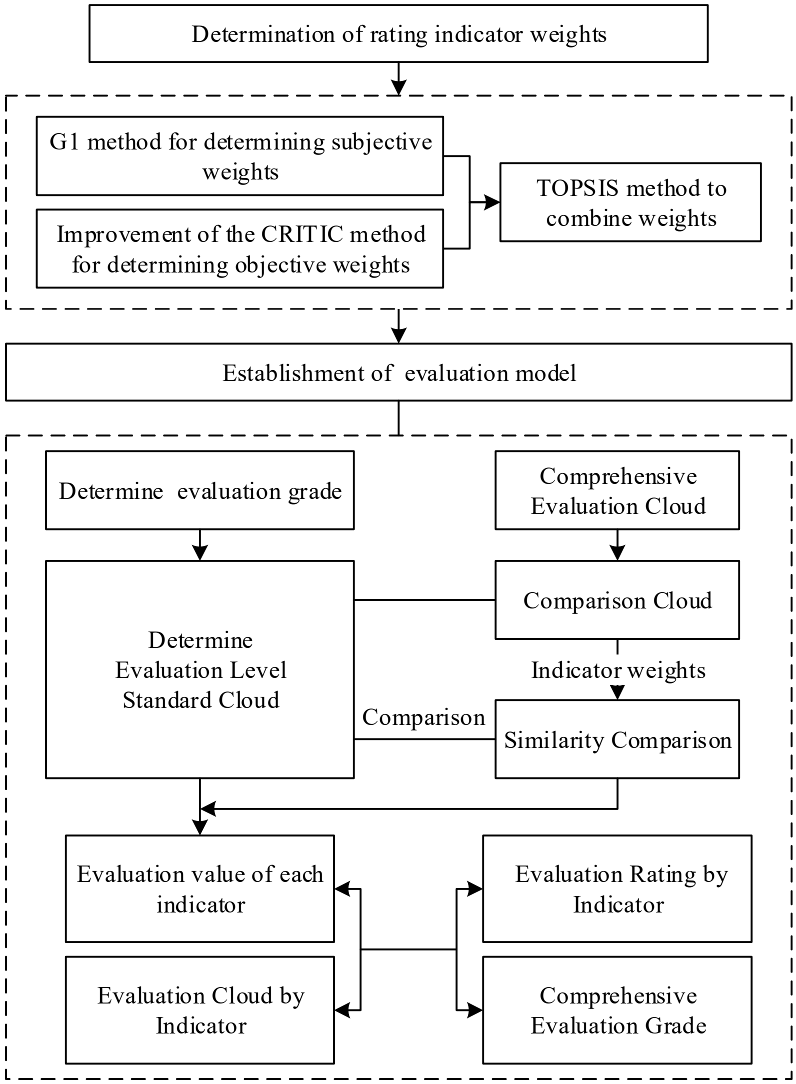

Fig. 2. Evaluation process

4.1. Basic cloud algorithms

The basic cloud algorithm is composed of a forward cloud generator and an inverse cloud generator. Forward cloud generator is the process of changing three cloud digital features into cloud droplets, i.e., completing the conversion from qualitative concepts to qualitative data. The inverse cloud generator is the inverse of the forward cloud generator, i.e., it is the process of transforming the cloud droplets into cloud digital features, i.e., it realizes the conversion from quantitative data to qualitative concepts.

4.2. Cloud Model Calculation Steps

4.2.1. Forward cloud generator. The main computational steps of the forward cloud generator are as follows:

a) Input and program the cloud digital features (E_x, E_n, H_e) and the number of cloud drops into the MATLAB software.

b) Generate normal random numbers $E_n \sim N(E_n, H_e)$ and $X \sim N(E_x, E_n')$.

c) Calculate:

$$y_i = \exp\left[-\frac{(x_i - E_x)^2}{2(E_x)^2}\right] \tag{19}$$

d) Let (x_i, y_i) be a cloud droplet, X denote the quantitative value from which the qualitative concept is transformed by the forward generator, and Y denote the measure.
e) Repeat the above steps, to be repeated until the number of cloud droplets that meet the conditions of the study can be generated [21].

4.2.2. Reverse cloud generator. The reverse cloud generator refers to the conversion of a sample from a quantitative to a qualitative process.
Input: cloud droplet X and its quantitative value u, i.e. (x_i, y_i).
Output: features reflecting the qualitative concept of cloud droplet (E_x, E_n, H_e) [22].
a) Calculate the sample mean:

$$\overline{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \tag{20}$$

The center distance of the sample:

$$A = \frac{1}{n}\sum_{i=1}^{n} |x_i - \overline{x}| \tag{21}$$

Variance:

$$S^2 = \frac{1}{n-1}\sum_{i=1}^{n} (x_i - \overline{x})^2 \tag{22}$$

b) Calculate expectations:

$$E_x = \overline{x} \tag{23}$$

c) Calculate the entropy:

$$E_n = \sqrt{\frac{\pi}{2}} \times \frac{1}{n}\sum_{i=1}^{n} |x_i - \overline{x}| \tag{24}$$

d) Calculate the superentropy:

$$H_e = \sqrt{(S^2 - E_n^2)} \tag{25}$$

5. Empirical analysis of English language education assessment

5.1. *Assessment of results*

The cloud parameters of each index are calculated according to the theory of cloud model calculation for the combined assignment score table, and the cloud model parameters of each index are shown in Table 11. As can be seen from the table, B_1 (teaching resources) has the lowest expectation value of 66.5 points, and B_4 (teaching effect) has the highest expectation value of 85.6 points, which indicates that English education resources in schools are still relatively scarce. In addition, the cloud superentropy of the first-level indicators is less than 0.5, which indicates that the scorers have the same judgment standard in the scoring process, and it provides a more realistic basic data for the understanding of the current situation of English education. In the second-level indicator cloud superentropy, there are three indicators greater than 1, which indicates that there is some information asymmetry in the process of determining the ability of the indicators, but from the first-level indicator, their scores are high, indicating that the overall situation is good.

Table 11. The parameters of the cloud model

Primary indicator	Index parameters (First class)	Secondary indicator	Index parameters (secondary)
B_1	(66.5,1.764,0.266)	C11	(66.5, 1.942, 0.71)
		C12	(74.9, 0.97, 0.348)
		C13	(73.5, 1.809, 0.486)
B_2	(76.2,1.562,0.336)	C21	(76.6, 2.723, 0.442)
		C22	(64.2, 1.259, 0.6)
		C23	(64.2, 0.845, 0.329)
B_3	(82.3,2.066,0.428)	C31	(67.3, 1.39, 0.338)
		C32	(63.7, 2.012, 0.429)
		C33	(79.8, 3.169, 0.377)
B_4	(85.6,1.236,0.362)	C41	(77.3, 3.418, 0.798)
		C42	(66.5, 1.268, 0.458)
		C43	(78.5, 2.682, 0.624)
B_5	(79.6,0.231,0.361)	C51	(79.5, 2.558, 1.301)
		C52	(64.4, 1.339, 0.254)
		C53	(67.6, 1.658, 0.18)

Based on the five first-level indicators and the comprehensive weight coefficients to calculate the comprehensive cloud indicator parameters, after obtaining the comprehensive cloud indicator parameters in the evaluation system of English education as (77.283,1.524,0.362), a cloud diagram of multi-objective linear planning weight distribution in the evaluation system of English education is generated. The comprehensive evaluation value is shown in Figure 3. From the figure, it can be seen that: first, the discrete degree, cloud thickness and span range of the comprehensive assessment cloud are smaller than the standard cloud, indicating that there is a greater consistency in the understanding of different scorers of the status quo of multi-objective linear planning in the evaluation system of English education, which is in line with the authenticity of the data, and combines strong objectivity on the basis of evaluating the fuzzy and random nature. Second, the weight distribution of multi-objective linear programming in the English education evaluation system is between Level III and Level IV, indicating that the overall situation is good and there is still some room for improvement.

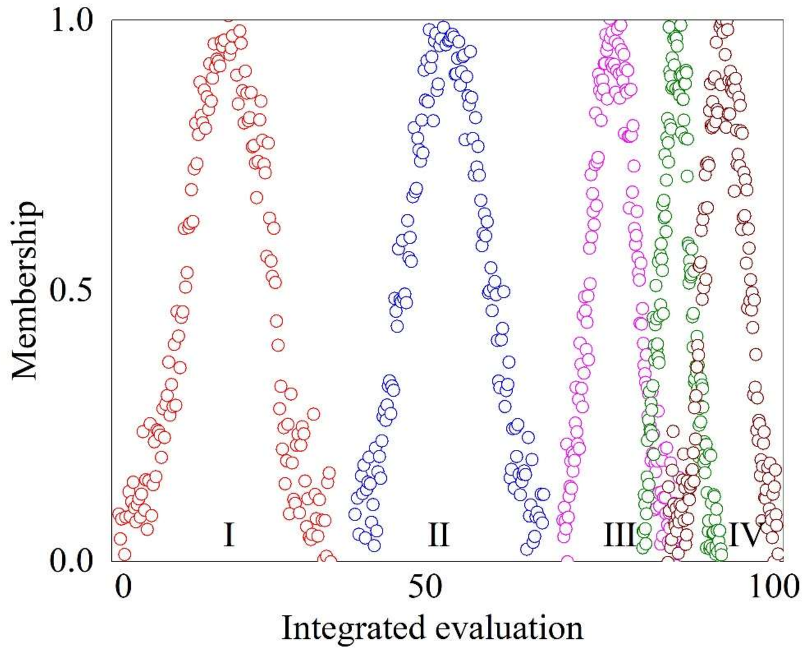

Fig. 3. Integrated evaluation

5.2. Analysis of elements

The scores of the first-level indicators and the comprehensive weight allocation are shown in Table 12. The shortcomings of the multi-objective linear planning weight allocation in the English education evaluation system can be seen. For the teaching resources level one indicator, it has the largest weight, but the overall score is the lowest, which is an important reason for the low multi-objective linear planning weight allocation in the English education evaluation system.

Table 12. Grade one index score and integrated weight distribution

	B_1	B_2	B_3	B_4	B_5
Score	66.8	76.9	82.5	85.9	88.6
Composite weight	0.2433	0.2336	0.1804	0.2616	0.0811

6. Conclusion

The article takes English education in a school as an example application object of the evaluation model constructed in the paper, conducts multi-objective linear planning for the weight allocation in the evaluation system of this English education, and carries out empirical analysis. The results are as follows:

After weight calculation by applying the G1 method and entropy weight method to the data scored by the experts, the comprehensive weights of five first-level indicators are obtained, and the weight order is teacher quality (0.262)>teaching quality feedback (0.254)>teaching resources (0.226)>teaching content (0.152)>teaching effect (0.106), respectively.

Using the combined assignment-cloud model for the English education evaluation system, it was found that there were problems and deficiencies in the lack of educational resources in the multi-objective linear planning weight allocation in the English education evaluation system of a school.

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