Analysis on the cultivation strategies of the general teachers' core qualities based on cooperative data fusion recommendation

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Abstract. An analysis method for general teachers' core qualities based on the user satisfaction and cooperative data fusion recommendation with approximate feature is proposed in this paper to improve the effective analysis on the cooperative cultivation strategies of the general teachers' core qualities. Firstly, the evaluation model of the general teachers' core qualities is constructed and analyzed to realize the quantitative evaluation of the general teachers' core qualities. Secondly, according to the resolution limitation in the traditional definition of similarity, improvement is made on the basis of user evaluation confidence level, preference and feature similarity evaluation; it is made to be more suitable to the users' real experience by combining the use attribute to replace the similarities among users. Thirdly, the time-variant weight method is adopted to perfect the standard TOPSIS fusion, improve the time-variant attribute of TOPSIS decision fusion and realize the effective attribute fusion of the user similarity data. Finally, it could effectively improve the evaluation accuracy of the general teachers' core qualities through the algorithm proposed in the experiment simulation and has certain application values.

Key words. General teachers, Teachers' core qualities, Cooperative method, Cultivation strategies.

1. Introduction

Ministry of Education's suggestions about comprehensively deepening the curriculum revolution and implementing the fundamental task of establishing moralities and educating people (hereinafter referred to as *Suggestions*) were officially issued on March 30, 2014. There is a noticeable expression in this file: teachers' core quality system. The research proposes the students' development and teachers' core quality

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system at all learning stages, specifies the necessary qualities and key competencies that each student should get to suit the life-time development and social development; it highlights the personal cultivation, social care, homeland feelings and lies more emphasis on independent development, cooperation participation and innovative practice. However, a more realist problem has to enter people's field of vision, students' development cannot be separated from teachers' instruction, so that the cultivation of teachers' core qualities becomes another increasingly concerned social issue.

Teachers' core qualities are not only the essential components to improve quality education, but also the key points to cultivate the students' values and the re-production of the students and teachers' core qualities proposed by Ministry of Education. The 21st century has newer and higher requirements for talent cultivation; as the teaching staff, we should improve our individual qualities to keep up with the pace of times. An increasingly outstanding issue comes in front of us: how can the cultivation of teachers' core qualities be combined with the requirements of times; how to cultivate them in a more effective and active way; how to catalyze the generation of students and teachers' core qualities with the development of teachers' core qualities in order to seek a reasonable approach for the development of education, students' development and social progress. This project attempts to make effective exploration, investigation and analysis on ways and approaches to the cultivation of teachers' core qualities, discover problems and propose the relative countermeasures to solve the problems.

As the curriculum revolution deepens, how to carry out trainings suitable to the development of teachers' core qualities, lead the rapid improvement of teachers' core qualities, promote development of teachers' self-connation with thoughts and cultivate teachers' cultural awareness of seeking personality excellence with scientific spirit——as the system revolution and educational culture ecology construction advance, a more and more key problem is highlighted, namely how to realize the interaction between the development of students and teachers" core qualities and the cultivation fusion of teachers' core qualities, so that the improvement of teachers' core qualities can penetrate into the education and teaching of each teacher. "Cultivation of teachers' core qualities is a systematic revolution involving educational concept, content, method and system. To promote the development of basic feature education, the core is to cultivate a cultural awareness of seeking excellence in a persistent way with the scientific spirit."

2. Construction of teachers' core quality evaluation system

For a long time, the evaluation of teachers' core qualities in some elementary and secondary schools is rather extensive; on some aspects, there are only on-again off-again quantitative evaluations. Scientific and reliable evaluation system of teachers' core qualities is the foundation and premise to implement the teachers' core quality salary; also, the implementation of teachers' core quality salary has challenged the extensive teacher evaluation for a long time. Construction of evaluation system of teachers' core qualities can be started from the following aspects.

Situation 1: Establishment of evaluation indicators

Evidence of indicator selection

Education laws and regulations are the foundations for indicator selection. The related files of wage system reform in teachers' core qualities have the specific requirements in terms of evaluation orientation, content, mode and agent; they are taken as the evidence for indicator selection.

Schools' development strategies are the evidence for indicator selection; the indicator system will lead the teachers' work to manifest the schools' values and execute the schools' development strategies.

Principles of indicator selection

Comprehensiveness: the indicator selection shall completely reflect all aspects of education and teaching.

People-orientation: the indicator selection shall focus on the features of teaching profession and reflect the ideal of people-orientation.

Motivation: the indicator selection shall be propitious to motivate the employees' initiatives and satisfy the teachers' highest demand for self-fulfillment.

Guidance: the indicator selection shall guide the teachers' professional development, lead the teachers to focus on the students' comprehensive development and specialty development and promote the schools' development.

Content of indicator system

In this research it constructed a general incentive evaluation indicator system for teachers' core qualities (A), the main body of which is composed of three parts as shown in Table 1. In which, B1 (evaluation of general teachers' core qualities) is the basic item involving each teacher, B2 (evaluation of post teachers' core qualities) is post item undertaken by some teachers, B 3 (evaluation of special teachers' core qualities) is the high-end teachers' core quality item involving some teachers.

Identification of indicator system

This step is mainly according to the regulations and schools' development strategies; the principles and requirements for indication selection are proposed by the schools' evaluation committee of teachers' core qualities; the indicators are selected by the researchers on the basis of consultation and interview before being approved by the teachers' congress after several rounds of interactions and improvements.

Situation 2: Establishment of indicator weight

Method of determining weight

Teachers' core quality evaluation system is a system with various variants and complicated structure; its factors need to be estimated about the relative materiality, which means to determine the index weight to control the nature of system. Teachers' core quality evaluation is based on people's subjective value judgment and applicable to the subjective weighting method; however, the subjective random weighting will reduce the reliability of the evaluation system while the reliability of evaluation can be improved by adopting the subjective weighting method that is relatively objective. Analytic hierarchy process (AHP) was proposed by the American operational research expert Saaty in 1970; it is a subjective weighting method that is widely applied at present. This method is user-friendly by adopting the fewer quantitative information to make scientific quantitative analysis on the problems that are difficult to accurately measure in a direct way.

Table 1. Awarding teachers' core quality evaluation indicators and their weights

A	B	C	D
Core quality indicators	General qualities	C1 Professional ethics (0.1192)	D1 Comprehensive evaluation on teachers' code of morality (0.1192)
		C2 Performance of duties (0.0913)	D2 Legal responsibilities (0.0318) D3 Safety responsibilities (0.0408) D4 Teaching responsibilities (0.0101) D5 Educational responsibilities
		C3 Basic conditions (0.0448)	D6 Mandarin level (0.0211) D7 Educational technology level (0.0095) D8 Other skill evaluations (0.0142)
		C4 Amount of work (0.1778)	D9 Workload index(0.0512) D10 Class hour (0.1065) D11 Temporary work(0.0201)
		C5 Attendance (0.1699)	D12 Coming to work late and leaving early D 13 Absent from work (0.0749) D14 Sick leave (0.0372) D15 Private affair leave(0.0411)
	General qualities	C6 Teaching process (0.1302)	D16 Each link of teaching specifications (0.0651) D17 Class teaching evaluation (0.0651)
		C7 Teaching result (0.1246)	
		C8 Multi-agent comprehensive evaluation	D23 Teachers' self-evaluation (0.0120) D24 Students' evaluation (0.0413) D25 Teachers' mutual evaluation (o.o18s} D26 Department evaluation (0.026) D27 Parents' evaluation (0.0142) D28 Other agents' evaluation (0.0064)
		C9 Others (0.0230)	D29 Others (0.0230)
	B2	C10 Duties	D30 Head teacher D31 Full-time duties D32 Part-time duties
Core quality indicators		C11 Educational and teaching honors	D33 Educational honorary titles within period (0.0631) D34 Teaching honorary titles within period (0.0484) D35 Other honorary titles within period (0.0229)
	B3 Special qualities	C12 Educational and teaching research	D36 Approving and initiating a project within period (0.0471) D37 Educational research achievement being awarded (0.0967)
		C13 Educational and teaching achievements	D38 Public class (0.0761) D39 Lecture (0.0721) D40 Thesis publication (0.1230) D41 Thesis award (0.04s8) D42 Work publication (0.0497) D43 Skill competition award (0.0803) D44 Guiding the student achievement to publish (0.0847) D45 Guiding the student achievement to win award (0.0333)
		Outstanding contributions	D46 Outstanding contributions (0.1368)
		C15 Others	D47 Others (0.0201)

Steps to determine the weight

Establish the hierarchical structure model. In the model of teachers' core quality evaluation system, A-level indicators are the highest while B, C and D-level indicators have constituted the indicators of different criterion layers.

Construct the judgment matrix. The influence of the indicators at the same level on the indicators at the upper level shall be quantized according to "importance" by comparing each two of them. The importance ratio of x_i and x_j is expressed by positive number b_{ij}; the value of b_{ij} cites number 1~9 and the inverses as the scale. For instance, among the educational and teaching research indicators, if the educational research achievement being awarded is believed "strongly more important" than the approval of research subject, b_{ij} is valued as 7; the research subject approval at the opposite angle to the educational and teaching research achievement being awarded b_{ji} shall be 1/7. Matrix $A = (b_{ij})_{n \times n}$ obtained by all comparison results is called the comparative judgment matrix.

Consistency check and determination of weight. The feature vector ω corresponding to the maximum characteristic root $\lambda_{\max}$ of each comparative matrix is calculated. After passing the randomness-consistency ratio $CR\,(< 0.1)$ check, ω can be taken as the weight of each indicator; otherwise the judgment matrix shall be adjusted.

Guarantee of the weight reliability

Hierarchical structure model is completed after the indicator system has been identified by the confirmation procedure; however, the weight reliability will not be increased naturally due to the reasonable indicators and the AHP method; the weight reliability is influenced by the accuracy and consistency of matrix, so that the following procedures can be adopted to guarantee the weight reliability.

Establish the office and committee of the teachers' core quality evaluation to be responsible for the teachers' core quality evaluation as well as the payroll distribution and work organization and implementation.

Discuss the guidance direction of the teachers' core qualities required by the schools' development strategies and seek recognition.

Discuss the cognition of each indicator and seek recognition.

Make prediction for the importance of indicators and state the reasons in public, guide all parties to discuss to make the concepts of teaching and administrative staff unified.

Establish the authoritative and recognized expert group for judgment of indicator importance, the members of which shall include teacher representative, educational experts, school leaders etc.

The expert group shall judge the relative importance among the indicators, discuss the projects with large judgment difference, seek the average of all items and calculate as $1, 2, \cdots, 9$ according to half adjust upon the consistency of all judgments and take the inverses of the items at opposite angles to establish the judgment matrix.

Carry out the consistency check and determination of weight on the judgment matrix.

Make public the indicator weight, if there is obvious deviation, make new judg-

ments upon full discussion; the indicator system even can be adjusted and the weight can be re-calculated until accepted.

Propose them to the teachers' congress for approval through voting after the indicator system and weight scheme has been commonly recognized especially by the teachers' congress.

Scheme implementation. To maintain its stability and seriousness, it mustn't be adjusted randomly unless being revised according to the evaluations and revision procedures after implementation with the approval of the teachers' congress.

3.   Similarity decision fusion of teachers' core qualities

3.1.   Multi-criteria decision

There are quite a lot of research achievements in the fusion recommendation of teachers' core qualities [7, 8]; however, most of them stop at taking the simple average process for features at the time of processing the recommendation features of teachers' core qualities. On the other hand, during the actual recommendation of teachers' core qualities, users' evaluation feature attributes change frequently under the influence of various factors such as environment and emotions; therefore, the simplified mean value processing method will influence the recommendation accuracy and reasonability of teachers' core qualities. The time-variant weight decision fusion mode is constructed as shown in Figure 2.
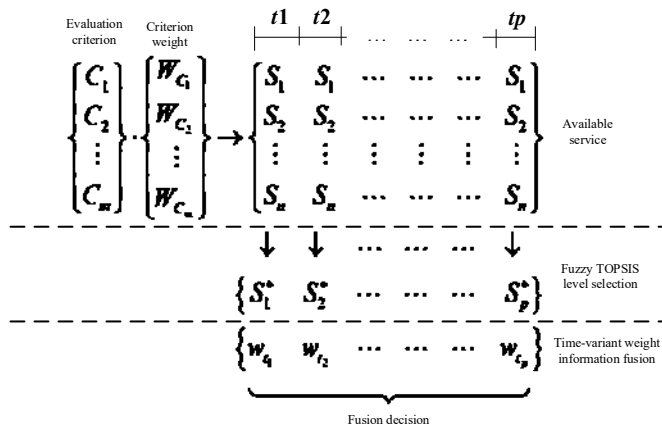

Fig. 1. Decision process

During the decision process in Figure 1, $C = \{C_1, C_2, \cdots, C_m\}$ refers to the evaluation criterion of m dimensions, $W_C = \{W_{C_1}, W_{C_2}, \cdots, W_{C_m}\}$ refers to the corresponding criterion weight vector that plays a role in enhancing the identification degree of decision criterion; $w_t = \{w_{t_1}, w_{t_2}, \cdots, w_{t_m}\}$ is corresponding to the time-variant fusion weight, it plays a role in improving the resolution ratio of corresponding periods of time. Figure 1 shows the fuzzy TOPSIS decision fusion process: (1) extraction of recommendation feature attributes of available teachers'

core qualities; (2) feature similarity evaluation of teachers' core qualities based on fuzzy TOPSIS; (3) feature attribute fusion based on time-variant weight

3.2. Decision fusion

In the current modes, the TOPSIS decision weight W_C always needs to consider the user preference for setting, while in the actual application, due to the multi-source features of the decision data, the weight is difficult to obtain; what's more, it's impossible to make the unified value quantization, there might be information loss on a certain degree. As a result, the TOPSIS secondary decision fusion recommendation algorithm is proposed, the specific process is as follows:

Step 1: assume there are m available teachers' core qualities S_i $(i = 1, 2, \cdots, m)$, the criterion for deciding the teachers' core qualities is C_j $(j = 1, 2, \cdots, n)$, so that the decision matrix form of teachers' core qualities at all intervals is as below:

$$
X = \begin{array}{c} \\ S_1 \\ S_2 \\ \vdots \\ S_m \end{array} \begin{array}{cccc} C_1 & C_2 & \cdots & C_n \\ \left[\begin{array}{cccc} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{array} \right] \end{array}.
\tag{1}
$$

In which, x_{ij} refers to the scalar quantization of teachers' core quality option S_i to C_j criterion.

Step 2: the entropy evaluation method is adopted to calculate the criterion weight, obtain the normalized form of decision criterion C_j $(j = 1, 2, \cdots, n)$, its projection P_{ij} form is:

$$
P_{ij} = x_{ij} \bigg/ \sum_{i=1}^{m} x_{ij}.
\tag{2}
$$

The calculation form of entropy is:

$$
e_j = - (\ln m)^{-1} \cdot \sum_{j=1}^{n} p_{ij} \ln p_{ij}.
\tag{3}
$$

The calculation form of criterion weight is:

$$
W_{C_j} = (1 - e_j) \bigg/ \sum_{k=1}^{n} (1 - e_k).
\tag{4}
$$

Step 3: the form of TOPSIS secondary decision fusion recommendation is:

$$
\tilde{R} = [\tilde{r}_{ij}]_{m \times n}.
\tag{5}
$$

As time changes, the similarity evaluation value of teachers' core qualities will change greatly, during the decision fusion process, the teachers' core qualities can be divided into the constant teachers' core quality items (C) and time-variant teachers' core quality items (F). If the triangular fuzzy number is defined as (a_{ij}, b_{ij}, c_{ij}), the

fusion rule can be defined as:

$$
\begin{cases}
\tilde{r}_{ij} = \left(\dfrac{a_{ij}}{c_j^+}, \dfrac{b_{ij}}{c_j^+}, \dfrac{c_{ij}}{c_j^+} \right), & if \ j \in F \\[4mm]
\tilde{r}_{ij} = \left(\dfrac{a_j^-}{c_{ij}}, \dfrac{a_j^-}{b_{ij}}, \dfrac{a_j^-}{a_{ij}}, \right), & if \ j \in C
\end{cases}
\tag{6}
$$

The related parameters in the formula are defined as:

$$
\begin{cases}
c_j^+ = \max c_{ij}, & if \ j \in F \\[2mm]
a_j^- = \min a_{ij}, & if \ j \in C
\end{cases}
\tag{7}
$$

Step 4: according to the weight obtained from the above-mentioned Step 2 in combination with the fuzzy rule obtained from Step 3, the decision fusion matrix of teachers' core qualities can be calculated as below:

$$
\tilde{V} =
\begin{bmatrix}
\tilde{v}_{11} & \tilde{v}_{12} & \cdots & \tilde{v}_{1n} \\
\tilde{v}_{21} & \tilde{v}_{22} & \cdots & \tilde{v}_{2n} \\
\vdots & \vdots & \vdots & \vdots \\
\tilde{v}_{n1} & \tilde{v}_{n2} & \cdots & \tilde{v}_{nn}
\end{bmatrix}
=
\begin{bmatrix}
\tilde{r}_{11} & \tilde{r}_{12} & \cdots & \tilde{r}_{1n} \\
\tilde{r}_{21} & \tilde{r}_{22} & \cdots & \tilde{r}_{2n} \\
\vdots & \vdots & \vdots & \vdots \\
\tilde{r}_{m1} & \tilde{r}_{m2} & \cdots & \tilde{r}_{mn}
\end{bmatrix}
\tag{8}
$$
$$
\cdot diag \left\{ W_{C_1}, \cdots W_{C_n} \right\}.
$$

Step 5: the decision control evaluation value is sequenced according to the decision fusion matrix of teachers' core qualities mentioned earlier to obtain the corresponding ideal solutions (solutions in positive and negative forms) as below:

$$
\begin{cases}
A^+ = \left(\tilde{v}_1^+, \tilde{v}_2^+, \cdots, \tilde{v}_n^+ \right) \\[2mm]
A^- = \left(\tilde{v}_1^-, \tilde{v}_2^-, \cdots, \tilde{v}_n^- \right)
\end{cases}
\tag{9}
$$

Step 6: the distance between the triangle regular ideal solution $A_1 = (a_1, b_1, c_1)$ and $A_2 = (a_2, b_2, c_2)$ is calculated as:

$$
d(A_1, A_2) = \sqrt{ \frac{1}{3} \left[(a_1 - a_2)^2 + (b_1 - b_2)^2 + (c_1 - c_2)^2 \right] }.
$$

$$
\begin{cases}
d_i^+ = \displaystyle\sum_{j=1}^{k} d \left(\tilde{v}_{ij}, \tilde{v}_j^+ \right), i = 1, 2, \cdots m \\[4mm]
d_i^- = \displaystyle\sum_{j=1}^{k} d \left(\tilde{v}_{ij}, \tilde{v}_j^- \right), i = 1, 2, \cdots m
\end{cases}
\tag{10}
$$

Step 7: the similarity decision indicators of teachers' core qualities shall be sequenced to obtain the optimum recommendation option of teachers' core qualities:

$$CC_i = \frac{d_i^-}{d_i^+ + d_i^-} \, . \tag{11}$$

3.3. Secondary quantization

The criterion weights of teachers' core qualities at all intervals are calculated to distinguish the influences of feature attributes at different times. The calculation form of weight at time t_i for time $t_1, t_2, \cdots, t_n$ is:

$$\omega_i = A + \frac{K - A}{\left(1 + e^{-B(\Delta t_i - M)}\right)^{0.5}} \, . \tag{12}$$

In this formula, Δt_i is the interval, B is speed-up parameter, M is set as the allowable value of the maximum interval, A is its lower limit value and K is its upper limit value. Weight of the current interval is set as 1, as the recommendation process of teachers' core qualities advances, the value drops to the lower limit 0.4. to guarantee the independence of the decision recommendation of advanced teachers' core qualities, the Boole form of matrix is borrowed and defined as:

$$U = \begin{matrix} & \begin{matrix} t_1 & t_2 & \cdots & t_n \end{matrix} \\ \begin{matrix} S_1 \\ S_2 \\ \vdots \\ S_m \end{matrix} & \begin{bmatrix} u_{11} & u_{12} & \cdots & u_{1n} \\ u_{21} & u_{22} & \cdots & u_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ u_{m1} & u_{m2} & \cdots & u_{mn} \end{bmatrix} \end{matrix} \, . \tag{13}$$

In this formula, u_{ij} is the Boole weight of teachers' core quality S_i at the corresponding interval t_j, so the Boole weight of the highest teachers' core quality S_i is $u_{ij} = 1$. One array of this Boole weight matrix refers to the decision fusion recommendation of teachers' core qualities at a certain interval while the matrix row refers to the decision fusion recommendation of teachers' core qualities at all intervals. As a result, the calculation form of the decision fusion level R_i is as below:

$$R_i = \sum_{j=1}^{n} \omega_j u_{ij} \, . \tag{14}$$

In this formula, ω_j is the weight element changes along time. Repeat this process, the level recommendation of teachers' core qualities at all intervals can be obtained as:

$$\begin{bmatrix} R_1 \\ R_2 \\ \vdots \\ R_m \end{bmatrix} = \begin{bmatrix} u_{11} & u_{12} & \cdots & u_{1n} \\ u_{21} & u_{22} & \cdots & u_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ u_{m1} & u_{m2} & \cdots & u_{mn} \end{bmatrix} \cdot \begin{bmatrix} \omega_1 \\ \omega_2 \\ \vdots \\ \omega_n \end{bmatrix} \, . \tag{15}$$

According to formula (15), the fusion decision level R can be obtained, through

the numerical sequencing of it, the optimum teachers' core quality S_k can be obtained and it will be recommended to the requester as the final result.

It is the time-variant criterion weight form of teachers' core qualities but not the average evaluation method is adopted in the above process, so as to be more effective in avoiding the local optimum during the recommendation process of teachers' core qualities. Here are the calculation processes:

Step 1: (similarity computing) according to the users' feature attributes and their evaluation data on the teachers' core quality recommendation, the matrix similar to the user feature and the users' similar matrix to the evaluation of the teachers' core qualities can be obtained;

Step 2: (feature segmentation) the users' feature attributes are distinguished by time progress, the decision criterion vector $C_j \, (j = 1, 2, \cdots, n)$ is set according to the users' preference to make evaluation on the teachers' core quality feature attributes at all intervals, the evaluation information is fetched according to the decision process in Figure 1;

Step 3: (assessment criterion) based on the users' preference for the teachers' core qualities, the entropy is adopted to simplify the computing form of decision criterion and solve $C_j \, (j = 1, 2, \cdots, n)$, the specific process of which is as shown in Step 1$\sim$2 in Chapter 4.2;

Step 4: (level of teachers' core qualities) the decision matrix of teachers' core qualities at all time is structured, the initial scheme of the teachers' core quality recommendation is obtained according to the time-variant weight decision and TOPSIS decision. Due to the independent character of all intervals in this process, the TOPSIS teachers' core quality decision can be executed in parallel, the specific process is as shown in Step 3$\sim$7 in Chapter 4.2;

Step 5: (secondary decision) based on the time-variant weight, it recurs forward from the current time; the weight shall be assigned in the descending order from 1 to 0.4 to emphasize the teachers' core qualities at the current time. According to the selected time-variant weight, the secondary decision fusion shall be carried out on the decision result of the teachers' core qualities at all time obtained by the assessment criterion (Step 3), the optimum teachers' core quality recommendation result shall be selected as shown in Chapter 4.3 in detail.

4. Experiment analysis

4.1. Data acquisition

Despite the different strategic targets and evaluation points of colleges and universities, the contents of evaluation indicators are basically the same, i.e. teaching effect, teaching method, teaching content and so on. Upon referring to the related documents, the author has collected and arranged them to design the questionnaire and finally confirmed 14 indicators for core quality evaluation of teachers at colleges and universities: teaching content, teaching method, teaching attitude, teaching means, teaching effect, research project, work, thesis, scientific award, academic conference, professional construction, further study, educational background in ad-

dition to the experiment data as shown in Table 2.

Table 2. Original data

Object	Teacher 1	Teacher 2	Teacher 3	Teacher 4	Teacher 5	Teacher 6
Teaching method	93	87	95	78	70	78
Teaching content	92	89	96	85	69	65
Teaching attitude	90	92	90	87	75	80
Teaching effect	91	80	93	79	68	83
Teaching means	95	85	98	90	85	80
Research project	276	108	375	80	60	75
Work	100	90	105	65	60	65
Thesis	305	190	355	230	110	85
Scientific award	200	150	156	105	85	90
Academic conference	50	70	80	90	50	92
Professional construction	10	14	14	8	6	14
Further study	4	5	8	3	1	3
Educational background	90	90	90	80	80	80
Title	10	8	10	5	3	5

4.2. TOPSIS method is adopted to evaluate the teachers' core qualities

The normalized decision matrix is calculated according to formula (1).

The ideal solution vector A^+ and negative ideal solution vector A^- are determined:

$$A^+ = \left\{d_1^+, d_2^+, \cdots, d_{14}^+\right\} = \{1.0, 1.0, \cdots, 1.0\} \ .$$

$$A^- = \left\{d_1^-, d_2^-, \cdots, d_{14}^-\right\} = \{0.1, 0.1, \cdots, 0.1\} \ .$$

In this formula, d_j^+ and d_j^- are respectively corresponding to the maximum and minimum values to evaluate the indicators of the objective.

Calculate the comprehensive index pf each evaluation objective and make the comprehensive ranking. According to formula (6), the relative distance from the indicator evaluation value vector of the samples to the ideal solution and negative ideal solution can be calculated for the comprehensive evaluation calculation to get the comprehensive ranking result. Compare it with the comprehensive ranking result obtained in document [6] by adopting the combined method of principal component analysis and entropy as shown in Table 3.

Table 3. Comprehensive ranking result

Object	Proposed method	Comprehensive ranking	Document [6] method	Comprehensive ranking
Teacher 1	0.6342	2	0.0705	2
Teacher 2	0.6038	3	0.0683	3
Teacher 3	0.8776	1	0.0724	1
Teacher 4	0.4023	4	0.0657	4
Teacher 5	0.0821	6	0.0648	6
Teacher 6	0.3586	5	0.0652	5

It can be seen from Table 2 that the evaluation results between the proposed algorithm and the combined method of principal component analysis and entropy in document [6] are exactly identical and in line with the actual situations of teachers. However, the calculation process of this proposed algorithm is simpler and easier to carry out than the latter, which has saved a large amount of time resource; in addition, no data information is lost during the calculation, so that the evaluation result will be easier, more scientific, accurate and better to reflect the comprehensive teachers' core qualities.

4.3. Contrast of algorithm

To strengthen the sufficiency of this experiment, contrasting the recommendation algorithms of teachers' core qualities, the two versions of collaborative filtering mentioned in document [15, 16] are adopted to improve the recommendation methods of teachers' core qualities. The recommendation indicators of teachers' core qualities adopt the absolute error mean (MAE) and the calculation form is as below:

$$MAE = \frac{\sum_{i=1}^{N} |p_i - q_i|}{N} . \quad (16)$$

In this formula, N is the recommendation test set scale of teachers' core qualities, q_i is the user's evaluation of teachers' core qualities, p_i is the forecast evaluation of teachers' core quality decision process.

Decision accuracy of teachers' core qualities: first of all, set the number of inquiries of neighbor inquiry algorithm as $K = 35$, then the comparison of the filtering recommendations of cooperative teachers' core qualities with the three different improvement modes is as shown in Figure 2. It can be known from the data comparison curve in Figure that compared with the filtering decision experiment data of cooperative teachers' core qualities mentioned in document [15, 16], the MAE value obtained during the decision process of SFSTOPSIS teachers' core qualities mentioned in this paper is the minimum, which indicates that compared with the decision recommendation accuracy of teachers' core qualities in the teachers' core quality decision algorithm proposed in document [5–16], the decision algorithm of SFSTOPSIS teachers' core quality algorithm proposed in this paper is higher; the

obtained teachers' core quality option of decision recommendation is more ideal, which has reflected the effectiveness of the SFSTOPSIS teachers' core quality decision process.
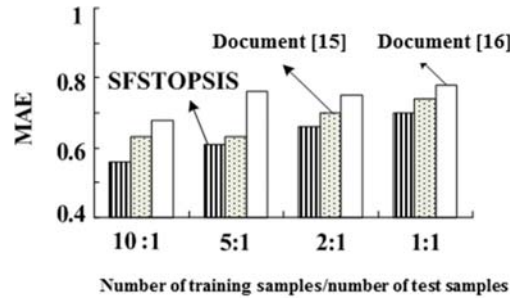

Fig. 2. Decision accuracy comparison of teachers' core qualities

5.   Conclusion

An analysis method for general teachers' core qualities based on the user satisfaction and cooperative data fusion recommendation with approximate feature is proposed in this paper to construct and analyze the evaluation model of general teachers' core qualities, realize the quantitative evaluation of the general teachers' core qualities; also, the time-variant weight method is adopted to perfect the standard TOPSIS fusion, realize the improvement of quantitative evaluation accuracy of the general teachers' core qualities; the experiment result has verified the effectiveness of the algorithm.

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