Research on AHP-fuzzy comprehensive evaluation method and application

Kaiyou Yuan¹, Heng Li and Ming Jiang
Software Department, Chongqing Institute of Engineering, Chongqing, China
¹Email: 314104670@qq.com

Abstract. Considering the limitation of AHP-fuzzy comprehensive evaluation method on the isomorphism and mutual exclusion of comment sets, it is difficult to use this method to evaluate actual cases with different dimension comment sets or check comment grades. This paper propounded an improved AHP-fuzzy comprehensive evaluation method with heterogeneous and check comment set, and the proposed method was further applied to the comprehensive evaluation of the evaluation state of collegiate teaching quality. Results illustrated that the improved method excelled not only in analysing and comparing the membership degree of each evaluation grade of the ultimate evaluation factors, but also in examining and evaluating the expected compliance degree of each evaluation factor. The evaluation results were demonstrated to be more objective, accurate and applicable in a much wider scope.

1. Introduction

In human practical activities, there are a lot of comprehensive evaluation of complex problems which factors affecting the evaluation are often various and fuzzy, so it is difficult to give a very accurate evaluation. Therefore, T.L.Saaty proposed a qualitative and quantitative analytic hierarchy process (AHP) [1] and L.A.Zadeh proposed a fuzzy comprehensive evaluation method based on the fuzzy membership theory, which became a powerful tool to solve this kind of comprehensive evaluation problem.

AHP-fuzzy evaluation method decomposes the problem into several elements with different weights at different levels, and transforms fuzzy qualitative analysis into quantitative analysis by membership function to solve the comprehensive evaluation of some fuzzy indefinite problems [2], which is a quantitative and modeling scientific analysis method. The general model can be summed up as follows: the evaluation object is divided into m indexes \( u_1, u_2, \ldots, u_m \) according to the hierarchy, and the weight of the evaluation index is \( a_1, a_2, \ldots, a_m \), and the ultimate index has k evaluation categories \( v_1, v_2, \ldots, v_k \), so the comprehensive evaluation problem is to determine which category the object belongs to, whose input is the m index measurement value of the object, and output is a certain evaluation category [3]. However, there are some problems in this method, such as the subjectivity on determining the weight vector of the evaluation factors, the rigid cutting of the membership degree of the evaluation grade, and the limitation on the isomorphism and mutual exclusion of the evaluation set, so it is necessary to improve this method in order to adapt to the comprehensive evaluation of the problems with heterogeneous check comment set. Below, based on the research literature of AHP-fuzzy comprehensive evaluation method, this paper analyzes its limitations, proposes an improved
method, and applies it to the comprehensive evaluation of the evaluation state of collegiate teaching quality to verify its excellence and adaptability.

2. Review of current research

According to the retrieval results of hownet and other database systems, the present improvement and Application Research on AHP-fuzzy evaluation method are mainly focused on the scientific determination of evaluation factor weight vector and the improvement of accuracy of evaluation grade membership, such as Ning and Wang used the robustness design of Tiankou method to improve the determination of the weight vector of evaluation factors to build a model to evaluate the mine environment [4]; Liu et al. used the correlation degree and influence degree of each evaluation factor to improve the construction of judgment matrix which, after transformation and unification, was used to obtained the weight vector of evaluation factor to realize the evaluation selection of equipment test parameters [5]; Sharfuddin et al. proposed a knowledge-based system based on Fuzzy AHP, and established the relationship between decisions and supply chain performance standards, which realized accurate and comprehensive supply chain overall performance evaluation. It is an effective overall integration method [6]; Aydin and Rene combine fuzzy set theory, AHP and TOPSIS based order performance evaluation technology, and put forward a comprehensive evaluation method of production control strategy, which can comprehensively evaluate the control scheme of multi-layer and multi-stage manufacturing assembly system to meet JIT standard [7]; Anguibi et al. proposed a quantitative SWOT framework to quantify the integration of fuzzy language preference relations, which improved the difficulties of traditional AHP and Fuzzy AHP in data collection and judgment matrix consistency [8]; Deng and Lu propose a left-right fuzzy regression method, which is applicable to various forms of observed values. Four different numerical examples are used to illustrate the feasibility and wide applicability of the method [9]; Deng improved the weight coefficient calculation method of evaluation index based on the reasonable principle and transmission principle of evaluation index to be used in the evaluation of highway route selection [10]; Liu et al. used the improved 3-scale method to replace the 9-scale method recommended by AHP to determine the weight coefficient of each evaluation factor, and constructed a multi-level fuzzy evaluation model to evaluate and select the highway route [11]; Xia improved the evaluation factor weight assignment by using the analytic hierarchy process of improved triangular fuzzy number, and used the common matrix instead of the fuzzy matrix to carry out multiplication operation to improve the fuzzy comprehensive evaluation method to evaluate the sensory quality of tea [12]; By improving the algorithm of taking large and taking small and the irrationality of the principle of maximum membership degree, Xiong and Xian used the improved method to evaluate the membership degree of all factors at all levels [3]; Wang and Qiang changed the rigid cutting of the membership degree on a single evaluation grade to the flexible proportional distribution of the membership degree on two adjacent evaluation grades, so that the evaluation of a single membership degree is more accurate, and the deviation of the calculation result of the comprehensive membership degree is smaller [13].

To sum up, there is little research on the limitation of comment set isomorphism and mutual exclusion of AHP fuzzy comprehensive evaluation method, and the relevant theories, technologies, methods and applications need further exploration and research. At present, the main limitations of AHP-fuzzy comprehensive evaluation method are as follows:

1) The dimension of comment set is the same, that is to say, all factors must have the same comment grades, which is called isomorphic comment set in this paper, otherwise, fuzzy matrix cannot be constructed. To some extent, this restricts the evaluation demand of the coexistence of multi-dimensional evaluation grades (heterogeneous evaluation sets). For example, when the actual questionnaire is used to investigate the evaluation state of collegiate teaching quality, the evaluation factor of teaching improvement has two grades {improved, no improved}, while the evaluation factor of expected achievement has four grades {achieved, partially achieved, not achieved, not clear}.

2) Each element of the comment set is mutually exclusive, that is, when evaluating a certain evaluation factor, its evaluation value is unique, and only one item can be selected at a time, not
checked. To a certain extent, this limits the evaluation demand of coexistence of radio and check comment grades. For example, when the actual questionnaire is used to investigate the evaluation state of collegiate teaching quality, the evaluation factor of understanding degree of evaluation purpose has three grades {very clear, relatively clear, unclear} which are mutually exclusive, while the evaluation factor of evaluation standard maker has five grades {education experts, teaching researchers, school leaders, teachers, education administrative departments} which can be checked.

3) Each element of the comment set has no or equal weight. For example, for the evaluation of classroom teaching quality, there is no set weight or equal weight among the four elements of the comment set {excellent, good, general, qualified}, while experts actually choose the evaluation grade in terms of its importance. It can be considered to rank according to the importance of the evaluation grade, and its corresponding weight will decrease or increase in turn.

3. Improvement of evaluating method
In view of the above limitations, this paper proposes an improved method for comprehensive evaluation of the problems with heterogeneous check comment set. Based on AHP-fuzzy evaluation method, this method allows heterogeneous comment sets to be checked in the questionnaire evaluation. The specific steps are as follows:

1) Determine the factor set \( U \) of the evaluation object. The so-called factor set refers to the set of various factors that can affect the evaluated object. \( U = \{u_1, u_2, ..., u_m\} \) is the \( m \) evaluation factors (evaluation indexes) that describe the evaluated object, which is called the first level evaluation factor set. It divides factor set \( U \) into finite disjoint subsets \( U_i = \{u_{i1}, u_{i2}, ..., u_{in}\} \) \( (i = 1, 2, ..., m) \), which is called the second level factor set. It is obtained from the \( n \) elements contained in the \( m \) elements in the first level factor set, and the third level factor set can be set in the second level factor set, and so on.

2) Determine the weight set \( A \) of evaluation factors. The so-called weight set is a set of quantitative values that compares and weighs the relative importance of various factors in the total of the evaluated object in a certain quantitative form. It is represented by \( A = \{a_1, a_2, ..., a_m\} \), where \( a_i \) represents the weight of the \( i^{th} \) factor, requiring \( a_i \gg 0 \), and the sum of all element values of \( a_i \) is equal to 1.

3) Determine the comment grade set \( V \) and grade weight set \( X \) of the evaluation object. According to the actual situation, we can set different comment grade set \( V = \{v_1, v_2, ..., v_n\} \), and set the corresponding weight set \( X = \{n, n-1, ..., 1\} \) after ranking by grade importance.

4) Carry out the ultimate single factor fuzzy evaluation. After constructing heterogeneous fuzzy grade subsets, we need to quantify each element of each ultimate factor set \( U_i \) (assumed to be a secondary factor set) of the evaluated objects, that is, to determine the membership degree of the evaluated objects to the fuzzy grade subsets from a single factor perspective, and then get the fuzzy vector \( R_i \). For the evaluation value of the ultimate single factor with mutual exclusion comment grades, it is obtained by vector dot product, which is called the expected close value \( C_i = X_i \cdot R_i \). For the evaluation value of the ultimate single factor with non mutual exclusion comment grades, its expected close value \( C_i = X_i \cdot R_i / K_i \), where \( K_i \) is the average value of grade weights, \( C_i \) is the close degree of investigation evaluation to the evaluation expectation, between 0 and the highest grade weight \( n \). Then the ratio of the close value to the maximum value of the corresponding grade weight is used to express the expected compliance degree set \( D_i = C_i / n \), where \( D_i \) is the evaluation result vector of the ultimate factor set \( U_i \), between 0 and 1.

5) Carry out multi index comprehensive evaluation. Suppose that the weight of the secondary factor set \( U_i \) is \( A_i = \{a_{i1}, a_{i2}, ..., a_{in}\} \), the comprehensive evaluation set of the secondary factor set is \( D = A_i \cdot D_i \). Assuming that the weight of the first level factor set \( U = \{u_1, u_2, ..., u_m\} \) is \( A = \{a_1, a_2, ..., a_m\} \), the final comprehensive evaluation result is \( rst = A \cdot D \), between 0 and 1.
4. Application case

Table 1. Index system and weight of the evaluation state of collegiate teaching quality.

| Primary factors       | Weight | Secondary factors       | Weight | Comment grades     | Weight |
|-----------------------|--------|-------------------------|--------|--------------------|--------|
| Evaluation standard   | 0.3    | Standard setter (check) | 0.2    | Educational experts| 5      |
|                       |        |                         |        | Teaching and research staff | 4     |
|                       |        | Standard focus (check)  | 0.5    | School leaders     | 3      |
|                       |        |                         |        | Teacher             | 2      |
|                       |        |                         |        | Education Administration | 1    |
|                       |        | Teaching attitude       |        | 5                  |        |
|                       |        | Content of courses      |        | 4                  |        |
|                       |        | Teaching method         |        | 3                  |        |
|                       |        | Teaching effectiveness  |        | 2                  |        |
|                       |        | Teaching atmosphere     |        | 1                  |        |
|                       |        | Standard pertinence     | 0.3    | Yes                | 3      |
|                       |        | (radio)                 |        | Somewhat           | 2      |
|                       |        |                         |        | No                 | 1      |
| Purpose understanding | 0.3    |                         |        | Very clear         | 3      |
| (radio)               |        |                         |        | Clear              | 2      |
|                       |        |                         |        | Unclear            | 1      |
| Evaluation purpose    | 0.2    | Specific purpose        | 0.7    | To improve teacher teaching | 4    |
|                       |        | (check)                 |        | To understand the current situation of teaching | 3    |
|                       |        |                         |        | Selection and assessment of Teachers | 2    |
|                       |        |                         |        | Check payable      | 1      |
|                       |        | Principal object        | 0.65   | Students           | 4      |
|                       |        | (check)                 |        | Experts            | 3      |
|                       |        |                          |        | Colleagues         | 2      |
|                       |        |                          |        | Leaders            | 1      |
| Evaluation subject    | 0.15   | Teacher student emotion | 0.35   | Teachers and students' emotion is conducive to the evaluation results | 2    |
|                       |        | (radio)                 |        | Teachers and students' emotion is not conducive to the evaluation results | 1    |
|                       |        | Method satisfaction     | 0.3    | Satisfied          | 3      |
|                       |        | (radio)                 |        | More satisfied     | 2      |
|                       |        |                          |        | Dissatisfied       | 1      |
|                       |        | Specific method         | 0.7    | questionnaire      | 4      |
|                       |        | (check)                 |        | Online evaluation of teaching | 3    |
|                       |        |                          |        | Student discussion  | 2      |
|                       |        |                          |        | Others             | 1      |
| Evaluation function   | 0.25   | Expected achievement    | 0.2    | Reached            | 4      |
|                       |        | (radio)                 |        | Partially reached  | 3      |
|                       |        |                          |        | Not reached        | 2      |
|                       |        |                          |        | Unclear            | 1      |
|                       |        | Teaching improvement    | 0.3    | Yes                | 2      |
|                       |        | (radio)                 |        | No                 | 1      |
|                       |        | Specific functions      | 0.5    | Clear teaching objectives | 5    |
|                       |        | (check)                 |        | To organize teaching content | 4    |
|                       |        |                          |        | To choose teaching methods | 3    |
|                       |        |                          |        | Using teaching strategies | 2    |
|                       |        |                          |        | To create an interactive atmosphere | 1    |
This paper takes the evaluation state of classroom teaching quality in Chongqing A college as the research object, and AHP model construction and Delphi method are applied to develop the evaluation index system of the evaluation state of collegiate teaching quality. First of all, on the basis of referring to the evaluation scale of the evaluation state of collegiate teaching quality, a comprehensive analysis is carried out to form a draft of investigation and evaluation index system. Then according to the draft index system, a questionnaire was designed to solicit the opinions of seven experts (two teaching supervisors, two teaching managers, three front-line teachers) and three student representatives. After that, according to the results of the survey, the experts who put forward their opinions were interviewed to find out the reasons for the revision of the indexes. Finally, according to the reasons of revision, the evaluation indexes are selected and revised to form the final evaluation index system of the evaluation state of classroom teaching quality in Chongqing A college [14]. See Table 1.

This paper takes the expert ranking method to construct the weight of the evaluation indexes of the evaluation state of classroom teaching quality in Chongqing A college. First, the primary and secondary indexes in Table 1 are designed into a questionnaire. Then seven experts and three student representatives are invited to rank the importance of indexes at all levels. Finally, we use the formula to make statistics. The formula applicable to weight calculation is

\[ W_i = \frac{2 \left[ n (1 + m) - R_i \right]}{mn (1 + m)} \]

where \( m \) is the number of indexes, \( n \) is the number of experts, \( R_i \) is the sum of the ranking of the \( i^{th} \) index by each expert, and \( W_i \) is the weight of the \( i^{th} \) index[15]. For example, Table 2 shows the ranking results on the importance of secondary indexes under "evaluation standard". \( R_1 = 28 \), \( R_2 = 11 \), \( R_3 = 21 \), \( m = 3 \), \( n = 10 \) are brought into the formula for calculation. The weight (one decimal place) is 0.2, 0.5, 0.3 respectively. In the same way, we can get the specific weight of other indexes. See Table 1.

| Index                                    | EXP1 | EXP2 | EXP3 | EXP4 | EXP5 | EXP6 | EXP7 | STU1 | STU2 | STU3 | \( R_i \) |
|------------------------------------------|------|------|------|------|------|------|------|------|------|------|---------|
| Standard setter (check)                  | 2    | 3    | 3    | 3    | 2    | 3    | 3    | 3    | 3    | 3    | 28      |
| Standard focus (check)                   | 1    | 1    | 2    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 11      |
| Standard pertinence (radio)              | 3    | 2    | 1    | 2    | 3    | 2    | 2    | 2    | 2    | 2    | 21      |

The expert ranking method is also used to construct the weight of the comment grade. According to the ranking statistical results of seven experts and three student representatives on the importance of each comment grade, we use Likert n-point scoring method to assign values, and get the specific weight of each comment grade, as shown in Table 1.

1) Determine evaluation factor set.

According to the evaluation index system in Table 1, there are five primary evaluation indexes for classroom teaching quality evaluation, which are \( U_1, U_2, U_3, U_4 \) and \( U_5 \) respectively. In this way, the primary evaluation factor set can be constructed as \( U = \{u_1, u_2, u_3, u_4, u_5\} \). Similarly, each secondary evaluation factor set can be constructed as \( U_1 = \{u_{11}, u_{12}, u_{13}\} \), \( U_2 = \{u_{21}, u_{22}\} \), \( U_3 = \{u_{31}, u_{32}\} \), \( U_4 = \{u_{41}, u_{42}\} \), \( U_5 = \{u_{51}, u_{52}, u_{53}\} \).

2) Determine evaluation weight set.

Saaty put forward 9-scale method in AHP theory on how to set the weight of primary or secondary evaluation factors objectively and reasonably[16], but experts will determine the weight of each primary and secondary index according to the actual evaluation work of the college. If the college attaches importance to the diversity of the evaluation subject, it can be guided by improving the weight of the secondary evaluation factors "principle object". According to the evaluation index system in Table 1, the primary evaluation weight set \( A = \{a_1, a_2, a_3, a_4, a_5\} \), the secondary evaluation factor sets \( A_1 = \{a_{11}, a_{12}, a_{13}\} \), \( A_2 = \{a_{21}, a_{22}\} \), \( A_3 = \{a_{31}, a_{32}\} \), \( A_4 = \{a_{41}, a_{42}\} \), \( A_5 = \{a_{51}, a_{52}, a_{53}\} \).

For the weight of comment grades, the weight of each option is set in the reverse way after the experts select and sort by the importance degree. The first weight is \( n \) and the last weight is 1. For
example, the ranking of specific evaluation pattern is \{questionnaire, online evaluation of teaching, student discussion, others\}, which weight set is \(X_{42} = \{4, 3, 2, 1\}\).

3) Determine evaluation variable set.

After the evaluation factor set is determined, the evaluation variable set is formed by giving each ultimate evaluation factor a certain value. In this paper, the final percentage of each grade of secondary evaluation factors is defined as the evaluation variable value, and the evaluation variable set is as follows:

\[R_{11} = \{a_{11}, b_{11}, c_{11}, d_{11}, e_{11}\}, R_{12} = \{a_{12}, b_{12}, c_{12}, d_{12}, e_{12}\}, R_{13} = \{a_{13}, b_{13}, c_{13}\}, R_{21} = \{a_{21}, b_{21}, c_{21}\}, R_{22} = \{a_{22}, b_{22}, c_{22}, d_{22}\}, R_{31} = \{a_{31}, b_{31}, c_{31}, d_{31}\}, R_{32} = \{a_{32}, b_{32}\}, R_{41} = \{a_{41}, b_{41}, c_{41}\}, R_{42} = \{a_{42}, b_{42}, c_{42}, d_{42}, e_{42}\}, R_{51} = \{a_{51}, b_{51}, c_{51}, d_{51}, e_{51}\}, R_{52} = \{a_{52}, b_{52}\}, R_{53} = \{a_{53}, b_{53}, c_{53}, d_{53}, e_{53}\}\]

4) Construct comprehensive evaluation model.

According to the comprehensive evaluation algorithm of heterogeneous check comment set of AHP-fuzzy evaluation, the secondary index compliance set is equal to the vector dot product of the secondary index grade weight set and the evaluation variable set (radio) or the vector dot product of the secondary index grade weight set and the evaluation variable set divided by the grade weight mean value (check). The the primary index compliance set is equal to the vector dot product of the secondary index evaluation weight set and the secondary index compliance set. The comprehensive evaluation result is equal to the vector dot product of the primary index evaluation weight set and the primary index compliance set. Therefore, the comprehensive evaluation model is as follows:

\[
\text{rst} = A \cdot D
\]

\[= A \cdot (A_{11} \cdot D_{11}, A_{12} \cdot D_{12}, A_{13} \cdot D_{13}, A_{21} \cdot D_{21}, A_{22} \cdot D_{22}, A_{31} \cdot D_{31}, A_{32} \cdot D_{32}, A_{41} \cdot D_{41}, A_{42} \cdot D_{42}, A_{51} \cdot D_{51}, A_{52} \cdot D_{52})
\]

\[= A \cdot ((a_{11}, a_{12}, a_{13}) \cdot (d_{11}, d_{12}, d_{13}), (a_{21}, a_{22}) \cdot (d_{21}, d_{22}), (a_{31}, a_{32}) \cdot (d_{31}, d_{32}), (a_{41}, a_{42}) \cdot (d_{41}, d_{42}), (a_{51}, a_{52}, a_{53}) \cdot (d_{51}, d_{52}, d_{53}))
\]

\[= A \cdot ((a_{11}, a_{12}, a_{13}) \cdot (X_{11} \cdot R_{11}) / K_{11}, (X_{12} \cdot R_{12}) / K_{12}, X_{13} \cdot R_{13}), (a_{21}, a_{22}) \cdot (X_{21} \cdot R_{21}, (X_{22} \cdot R_{22}) / K_{22}), (a_{31}, a_{32}) \cdot (X_{31} \cdot R_{31}) / K_{31}, X_{32} \cdot R_{32}, (a_{41}, a_{42}) \cdot (X_{41} \cdot R_{41}, (X_{42} \cdot R_{42}) / K_{42}), (a_{51}, a_{52}, a_{53}) \cdot (X_{51} \cdot R_{51}, X_{52} \cdot R_{52}, (X_{53} \cdot R_{53}) / K_{53})\]

5) Evaluate the evaluation state of teaching quality.

According to the evaluation index system of classroom teaching quality (Table 1), 59 front-line teachers and managers are invited to evaluate the evaluation state of classroom teaching quality in Chongqing A college by questionaire. By calculating the proportion of 59 evaluators in different comment grades, we get \(X_{11} = (5, 4, 3, 2, 1), R_{11} = (0.97, 0.93, 0.85, 0.90, 0.78), K_{11} = 3; X_{12} = (5, 4, 3, 2, 1), R_{12} = (0.98, 0.95, 0.97, 0.93, 0.85), K_{12} = 3; X_{13} = (3, 2, 1), R_{13} = (0.47, 0.31, 0.22), K_{13} = (3, 2, 1), R_{13} = (0.17, 0.22, 0.61); X_{21} = (4, 3, 2, 1), R_{21} = (0.76, 0.85, 0.20, 0.34), K_{21} = 2.5; X_{22} = (4, 3, 2, 1), R_{22} = (0.97, 0.93, 0.85, 0.39), K_{22} = 2.5; X_{23} = (2, 1), R_{23} = (0.95, 0.05), K_{23} = (3, 2, 1), R_{23} = (0.47, 0.27, 0.25); X_{31} = (4, 3, 2, 1), R_{31} = (0.93, 0.85, 0.90, 0.00), K_{31} = 2.5; X_{32} = (4, 3, 2, 1), R_{32} = (0.15, 0.39, 0.20, 0.25); X_{33} = (2, 1), R_{33} = (0.76, 0.24); X_{34} = (5, 4, 3, 2, 1), R_{34} = (0.98, 0.95, 0.97, 0.93, 0.85), K_{34} = 3.\) Combined with the weight of the primary and secondary index, the above data are brought into the AHP-fuzzy comprehensive evaluation model with heterogeneous check comment set in 4), and the \(\text{rst} = 0.82\) between 0 and 1 can be obtained, which indicates that the overall evaluation state of classroom teaching quality in Chongqing A college is in good condition.

5. Discussion and prospect

1) The improved AHP-fuzzy comprehensive evaluation method can not only analyze and compare the membership degree of each comment grade of the ultimate evaluation index, but also analyze and evaluate the expected compliance degree of each evaluation index, and finally get the overall situation of the evaluation object. But it can't analyze and compare the membership degree of each evaluation grade of each evaluation index like the traditional AHP fuzzy evaluation method.

2) The improved AHP-fuzzy comprehensive evaluation method expands the comprehensive evaluation of the problems with heterogeneous check comment set, and it is more widely applied than the traditional AHP-fuzzy evaluation method. No matter in what kind of evaluation, the key is to set up a scientific evaluation index system and weight according to the actual situation of the evaluation object.
3) The improved AHP-fuzzy comprehensive evaluation method can use the existing methods to construct the evaluation index system and weight, such as AHP model method, Delphi method, expert ranking method, key feature survey method, 9-scale method, triangle fuzzy number scale method, matrix dual method, etc.[17], however, it is suggested to use Likert n-point method to assign the weight of the comment grade to ensure the calculation uniformity between the radio comment set and the check comment set index. The objective accuracy of the evaluation is directly related to the scientificity of evaluation index and weight setting, as well as the quality and level of the evaluators themselves.

4) The improved AHP-fuzzy comprehensive evaluation method is mainly limited to the disunity of the lower limit of the evaluation results between check and radio comment indexes. For the evaluation of check comment indexes, when all evaluators do not select any option, the result is 0, when all evaluators select all options, the result is 1, so the result range is between 0 and 1. For the evaluation of radio comment indexes, when all evaluators select the highest weight option, the result is 1, when all evaluators select the lowest weight option, the result is \( \frac{1}{n} \), where \( n \) is the highest weight, so the result range is between \( \frac{1}{n} \) and 1. In the future, we will focus on the calculation method of evaluation expected compliance, so as to unify the lower limit of evaluation results between check and radio comment indexes.

Acknowledgments
Fund project. 2019 Chongqing higher education teaching reform research project "Research and Practice of Application-oriented Undergraduate Theoretical Classroom Teaching Quality Evaluation System in New Secondary College" (No.: 193298)

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