



Research on the evaluation of learning quality of higher vocational students based on fuzzy comprehensive evaluation method

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Abstract. In view of the lack of evaluation methods for the learning quality of higher vocational students in the teaching process of our school, this paper constructs an evaluation model for the learning quality of higher vocational students based on the fuzzy comprehensive evaluation method, and quantifies the qualitative indicators into quantitative indicators, which helps to Measure the learning quality of higher vocational students at the overall level, and improve the theoretical and practical research on the evaluation of learning quality of higher vocational students from a quantitative perspective.

Keywords: fuzzy synthesis; learning quality of higher vocational students; evaluation.

1 Introduction

Under a teaching model that is compatible with on-the-job education, effectively improving learning ability has very important theoretical and practical significance for accelerating the pace of cultivating high-quality new vocational students. Our school is the cradle of delivering outstanding vocational students to the society. Strengthening the education of vocational students and improving the overall quality of students have become the top priority of our school. Therefore, establishing a set of evaluation standards that can effectively measure the learning quality of higher vocational students has very important theoretical and guiding significance for improving the learning quality of higher vocational students. Based on the current status of the learning process of higher vocational students, this article builds a learning quality evaluation system for higher vocational students based on fuzzy comprehensive evaluation method based on fuzzy mathematics theory and analytic hierarchy process, and quantifies the qualitative indicators of the learning quality of higher vocational students. In order to more reasonably and comprehensively analyze the learning outcomes of higher vocational students, thereby effectively improving their learning quality^[1].

2 Analysis on the Current Situation of Learning Quality Evaluation of Higher Vocational Students

This research group conducted questionnaire surveys, teacher discussions and expert consultations on the current situation of the learning quality evaluation of higher vocational students in our school. By summarizing, organizing and analyzing the feedback information, in general, the current learning quality evaluation of higher vocational students in our school is There are mainly the following problems^[2].

2.1 The Evaluation System is not Sound Enough

The current evaluation method is still based on the students' learning and examination results, and evaluates the students' learning quality in a one-sided way by scoring, without giving full play to the role of college teams and teaching and research departments in the evaluation process, the management system of evaluation is not perfect enough; the evaluation subject lacks the inspection, guidance and supervision to the evaluation process, so it is difficult to guarantee the quality of evaluation; the responsibility of the evaluation subject is unclear, so the evaluation is reduced to a formality, the evaluation result is not objective and fair enough.

2.2 The Purpose of the Evaluation is not Clear Enough

The aim of the current evaluation of higher vocational students' curriculum learning quality is to identify the learning effect, which has little effect on stimulating and promoting students' learning initiative. Generally speaking, the evaluation of higher vocational students' learning quality has three purposes: one is to stimulate and urge students to study, that is, to stimulate the function, and the other is to improve and develop the cooperation between teachers' teaching and students' study, the third is to identify or prove some problems, that is, summary function. However, the current curriculum learning quality evaluation of higher vocational students mainly plays its due role.

2.3 The Evaluation Content is not Comprehensive Enough

At present, the educational concept of taking skill training as the core and taking post as the aim has been widely accepted, and the proportion of practical teaching links accounts for more than 50% of the teaching plan class hours, but this kind of educational idea and the structural change did not reflect in the appraisal, to the practical ability and the practical ability appraisal pay insufficient attention. At present, in the evaluation of the content, the evaluation of higher vocational students learning quality mainly from the theory of evaluation, evaluation of the content of the book-based, and Skills Operation Evaluation is too general, in the aspect of teachers, teachers only evaluate students' learning quality from their homework and classroom performance, and the content is one-sided, neglecting students' military political thought, learning method, learning attitude and cooperative spirit, the evaluation result loses its objectivity.

2.4 The Evaluation Method is not Scientific Enough

At present, the evaluation of curriculum learning quality of higher vocational students is mainly manifested in the following ways: the evaluation of theoretical knowledge is mainly based on written examination, and less on other forms; The evaluation process of students' ideological and political attitudes and values is not standard, standard is not clear, and the data processing is not scientific.

2.5 The Indicator System is not Reasonable Enough

The index system is not reasonable, which is mainly reflected in the low proportion of the process evaluation results in the total evaluation results, and it is difficult to play the role of evaluation in promoting students' learning and their all-round development, the main reason is that the concept of evaluation can not be changed and the status and function of process evaluation in the evaluation of curriculum learning quality are not understood enough. The evaluation standard is not clear enough, mainly in the teacher evaluation, homework evaluation, stage detection and so on, there is no clear standard, and the evaluation has lost objectivity and impartiality.

2.6 The Feedback is not Timely Enough

Before the evaluation, some students do not know how to evaluate the learning quality of the courses, so they can not play the role of guidance and motivation of evaluation, the teaching process has been completed, in time is the students want to improve their learning, has been too late, lost the opportunity to self-correction.

3 Construction of Learning Quality Evaluation System for Higher Vocational Students based on Fuzzy Comprehensive Evaluation Method

Based on the above-mentioned problems in the evaluation of higher vocational students' learning quality, this paper introduces the fuzzy comprehensive evaluation method into the evaluation of higher vocational students' learning quality, this paper constructs a learning quality evaluation model of higher vocational students based on fuzzy comprehensive evaluation method, and introduces the calculation process of the model in detail. The construction of learning quality evaluation system of higher vocational students based on fuzzy comprehensive evaluation method is completed^[3].

3.1 Fuzzy Comprehensive Evaluation Method

Fuzzy Comprehensive Evaluation Method is a comprehensive evaluation method based on fuzzy mathematics. According to the theory of membership degree of fuzzy mathematics, this comprehensive evaluation method transforms qualitative evaluation into quantitative evaluation, that is to say, fuzzy mathematics is used to make an overall

evaluation of the things or objects restricted by many factors. It has the characteristics of clear results and strong systematicness. It can solve fuzzy and difficult to quantify problems well. It is suitable for all kinds of non-deterministic problems^[4].

3.2 Construction of Learning Quality Evaluation Model for Higher Vocational Students

To evaluate the learning quality of higher vocational students, we should start from the actual needs of their posts^[5]. According to the actual demand of students in higher vocational colleges, we know that, an excellent higher vocational students should have solid basic knowledge of science and culture and professional operation skills, good physical and mental quality, excellent practical ability and training ability. Therefore, the content of learning quality assessment of higher vocational students usually involves the following aspects: Theoretical Level, Professional Operation Skills, Ideological and political attitudes, Social Quality, Practical and group training ability, Views from key members of the student teams and teachers, Students' self-assessment, Students evaluate each other. Therefore, we constructed the following hierarchical model, as show in Figure 1:

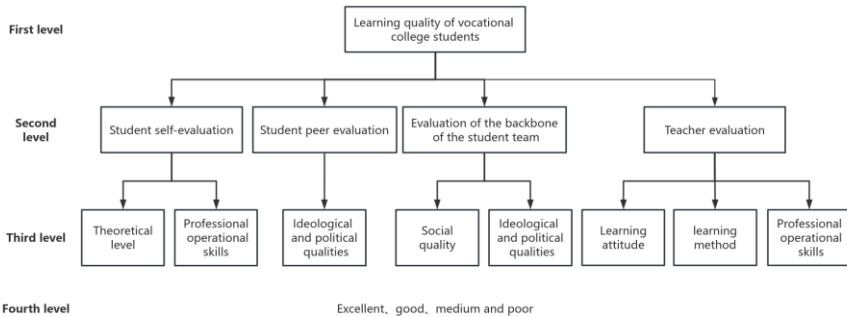


Fig. 1. the evaluation model of higher vocational students' learning quality.

3.3 Solving the Evaluation Model of Higher Vocational Students' Learning Quality

Based on the above hierarchical model, we define the following symbol system and related formulas related to the algorithm^[6], the meanings of each scale are show in Table 1:

(1)In the first-level evaluation index (corresponding to the second level), the factors of student self-evaluation, student mutual evaluation, student team backbone evaluation, teacher evaluation are respectively A_1, A_2, A_3, A_4 , The set of first-order index factors is obtained: $A = \{ A_1, A_2, A_3, A_4 \}$.

(2)In the two-level evaluation index (corresponding to the third level), the factors of theoretical level, professional operation skills, ideological and political quality, social

quality, learning attitude, learning methods are respectively $B_1, B_2, B_3, B_4, B_5, B_6$, the set of secondary index factors is obtained $B=\{B_1, B_2, B_3, B_4, B_5, B_6\}$.

(3)In the three-level evaluation indexes (corresponding to the fourth level), let the three-level indexes subordinate to the two-level indexes $B_i(i=1, 2, 3, 4, 5, 6)$ be combined $C_{i1}, C_{i2}, C_{i3}, C_{i4}$, which are denoted as $C_i\{C_{i1}, C_{i2}, C_{i3}, C_{i4}, C_{i5}\}$.

(4)For the rating scale we define it as four: Excellent (90-100), good (80-90), Pass (60-80), fail (0-60). Be recorded as V_1, V_2, V_3, V_4 , We build evaluation sets $V\{V_1, V_2, V_3, V_4\}$.

(5)Define the weight of the evaluation index system. In our model, the weight is very important and directly affects the result of the Comprehensive Evaluation. Here, the solution of the weight is constructed to determine the comparison matrix. Suppose we have a set $A=\{A_1, A_2, A_3, A_4, A_5, A_6\}$ as an example, we establish the following fuzzy consistent judgment matrix:

$$A = \begin{bmatrix} a_{11} & \cdots & a_{16} \\ \vdots & \ddots & \vdots \\ a_{61} & \cdots & a_{66} \end{bmatrix} \tag{1}$$

a_{ij} denotes the membership degree of fuzzy relation between factor A_i and factor A_j that " A_i is more important than A_j ".

Table 1. meanings of each scale.

Scale a_{ij}	Meaning
1	The two elements are of equal importance
3	The former element is slightly more important than the latter
5	The former element is obviously more important than the latter
7	The former element is more important than the latter
9	The former element is more important than the latter
2, 4, 6, 8	Represents an intermediate value for the above judgment

After the comparison judgment matrix is established, the weights are calculated by the characteristic root method, the sum method, the method root, the logarithmic least squares and the least squares method. The weight can be obtained by solving the matrix with the method of square root. According to the above explanation, we can get the weight vector of the first-order factor index vector set as $WA=[W_{A1}, W_{A2}, W_{A3}, W_{A4}]$

The weight vector of the index set of the second-order factors is $WB=[w_1, w_2, w_3, w_4, w_5, w_6]$. Similarly, we can get the weight vector of the index set of the third-order factors, $WB1=[w_{11}, w_{12}]$;

$$WB2=[w_{21}, w_{22}, w_{23}, w_{24}];$$

$$WB3=[w_{31}, w_{32}, w_{33}, w_{34}, w_{35}];$$

$$WB4=[w_{31}, w_{32}, w_{33}, w_{34}];$$

$$W_{B5}=[w_{51},w_{52},w_{53},w_{54},w_{55}];$$

$$W_{B6}=[w_{61},w_{62}].$$

(1) The comprehensive judgment matrix R_{jk} at the fourth level was defined R_{jk} ($j=1, 2, 3, 4$, representing the comprehensive judgment matrix constructed from the questionnaires of student self-evaluation, student mutual evaluation, student team backbone evaluation and teacher evaluation respectively). According to the original information collected from the questionnaire survey, we obtained the excellent rate, good rate, pass rate and fail rate of each factor of the six three-level index sets of classroom evaluation through the processing of Excel software. As follows $R_k(k=1, 2, 3, 4, 5, 6)$:

$$R_k = \begin{bmatrix} r_{k11} & \cdots & r_{k14} \\ \vdots & \ddots & \vdots \\ r_{k51} & \cdots & r_{k54} \end{bmatrix} \tag{2}$$

Among them, $r_{k11}, r_{k12}, r_{k13}, r_{k14}$ respectively represent the excellent rate, good rate, pass rate and fail rate of the tertiary factor C_{k1} , which belongs to the secondary index factor B_K .

(2) The third level comprehensive judgment matrix is defined P . The third level is a comprehensive judgment matrix for each factor $P_{ji}=R_{ji} * W_{Bi}(i=1, 2, 3, 4, 5, 6)$, Can finally get $P_j=[p_{j1}, p_{j2}, p_{j3}, p_{j4}, p_{j5}, p_{j6}]^T$. ($j=1, 2, 3, 4$, respectively, represents the third-level comprehensive judgment matrix obtained from the fourth-level comprehensive judgment matrix of student self-evaluation, student mutual evaluation, student team backbone evaluation and teacher evaluation).

(3) Our second level of synthetic judgment matrix S_1, S_2, S_3, S_4 . For the second level of student self-assessment, student mutual assessment, student team backbone evaluation, teacher evaluation, we can calculate its comprehensive judgment matrix S_1, S_2, S_3, S_4 . Its calculation method is $S_j=W_B * P_j=[w_1, w_2, w_3, w_4, w_5, w_6] \times [p_1, p_2, p_3, p_4, p_5, p_6]^T$.

Table 2. Evaluation grades and corresponding scores.

Level	excellent	good	pass	fail
Score range	90-100	80-90	60-80	45-60
Representative score	95	85	70	53

As show in Table 2,the fraction vector is $Q=[95, 85, 70, 53]^T$.

(1)The second level is calculated from the scores of student self-evaluation, student mutual evaluation, student team backbone evaluation and teacher evaluation $Q_1, Q_2, Q_3, Q_4, Q_i=S_i * Q(i=1, 2, 3, 4)$.

(2)Final Result= $[Q_1, Q_2, Q_3, Q_4] * W_A=[Q_1, Q_2, Q_3, Q_4] \times [W_{A1}, W_{A2}, W_{A3}, W_{A4}]$.

4 Conclusion

In this paper, a model of learning quality evaluation of higher vocational college students based on fuzzy comprehensive evaluation method is constructed, and the weight of each index is given through consistency test of comparison matrix, which avoids the subjective decision. In general, this model can evaluate the learning quality of higher

vocational students scientifically and objectively. However, the process of establishing a perfect evaluation method for the learning quality of higher vocational students is relatively complicated, and the evaluation criteria, evaluation indicators, weight determination, etc., all require rigorous demonstration work. Therefore, the proposed method can be used as a reference method for the evaluation of the learning quality of higher vocational students. In order to improve the theory and practice of teaching quality evaluation of mechanical engineering majors from a quantitative point of view.

The following are some problems with our model, which we look forward to improving in the future:

First, the amount of actual application data is too little, and the lack of scientific. Long-term investigation is needed to improve the accuracy of each evaluation coefficient.

Second, the solution process of the whole model is well realized without computer software, and the calculation is large and complex.

Thirdly, more evaluation indexes can be added to improve the scientificity of the model.

References

1. Construction and application of the student satisfaction evaluation system for the extracurricular education services in colleges [J]. Xue Lin, Cho Yuh-Jen, He Wei, Computer applications in engineering education . 2021(2).
2. Construction of the Quality Evaluation System for Healthy Urbanization from the Angle of Economics [J]. Huiying Wang International Journal of Business and Management. 2009(1).
3. Research on construction and correlation analysis of whole process teaching quality evaluation system under the blended learning mode [C]. Xia Zhaomin, Wang Jingmin, Yan Xiao International Conference on Education, Knowledge and Information Management . 2021.
4. Risk Assessment Method of Drainage Network Operation Based on Fuzzy Comprehensive Evaluation Combined with Analytic Network Process [J]. Ba Zhenning, Fu Jisai, Liang Jianwen, Journal of Pipeline Systems Engineering and Practice. 2021(2).
5. Research on the Construction of Evaluation Index System for Master of Engineering Learning Achievement [J]. Yijia Gao. Operations Research and Fuzziology.2024(4).
6. Developing Mentors: Adult participation, practices, and learning in an out-of-school time STEM program [D]. Scipio, Deana Aeolani.2015.

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