Research on ideological and political evaluation of computer courses based on AHP-fuzzy comprehensive evaluation

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Abstract. Ideological and political evaluation of computer curriculum is of great significance to the reform of computer curriculum. Use AHP-fuzzy comprehensive evaluation to establish the ideological and political evaluation model of university computer courses, and verify the effectiveness and scientificity of the evaluation method and evaluation model through empirical research.

Keywords: Computer courses; evaluation; AHP-fuzzy.

1 Introduction

Ideological and political education is a new requirement of college education in the new era, which theoretically solves the problems of single ideological and political education and separating it from professional education. The proposal of ideological and political concept innovates the educational concept of Chinese ideological and political work, breaks through the traditional ideological and political education paradigm, and provides new ideas, new perspectives and new models for the development of ideological and political education. After the ideological and political education is put forward, many scholars and experts have carried out theoretical research and educational reform practice. As a compulsory general education course in colleges and universities, university computer foundation is open for all non-computer major students. The courses are not only opened early, but also have a wide audience. First year students are in the important stage of the outlook on life, values, and many students of college life and curiosity and expectations, should seize this critical period, change the previous course teachers focus on the cultivation of computer theory of knowledge and skills, teaching pay little attention to students 'ideological and political education, rarely pay attention to improve students' moral quality and the formation of students' values teaching methods, in the effective implementation of ideological education, play a "pioneer" role.

Education of university computer basic courses education teaching evaluation research less, such as Jia Liping (2021) [1]using hierarchical analysis of computer course

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education teaching evaluation index weight and priority, but not the course education final teaching effect evaluation analysis, Li Xiaohong (2023)[2] explore university computer basic courses education teaching, but not the teaching quality evaluation research, Liu J (2022)[3] taking the basic course of computer as an example, this paper constructs a hierarchical structure to evaluate the learning effect of students by choosing appropriate indexes and combining with AHP method. The academic research of computer curriculum also includes course content, teaching effect, course system and so on. Martin(2007)[4] study the ideal computer literacy curriculum content and teaching strategies to meet the needs of students and technological progress. Lee (2023)[5], Kaila (2022)[6], Sitaridis (2021)[7] have studied the evaluation of computer courses from different perspectives.

Learn from other disciplines in the course education teaching evaluation research, from the results, the macro level has not yet put forward a set of accurate and comprehensive evaluation system, but to stimulate the principal responsibility of professional teachers, from the micro level of course teaching implementation process and results, the combination of quantitative qualitative course education teaching evaluation model and evaluation method has high feasibility and certain practical significance.

2 Evaluation Indicators

The quality of evaluation teaching effect mainly depends on the feelings of the participants in teaching activities. Students and teachers are the direct participants in the ideological and political construction of the curriculum. Because teaching and learning are not an inevitable unified process, the acceptance degree of students cannot correspond to the teaching level of teachers one to one. Therefore, students' evaluation should focus on the understanding and perception of the ideological and political knowledge points of the curriculum implemented by teachers, which is difficult to be intuitively reflected and quantified in reality. Therefore, when establishing the evaluation model, we choose to realize the evaluation purpose of combining qualitative and quantitative through fuzzy level analysis from the perspective of students.

Table 1. Evaluation Indicators

Level 1 indicators	Secondary indicators
Curriculum design	The teaching goal is clear, reflects the ideological and political education goal, can be evaluated and measured
	The course structure is reasonable and can help students master knowledge and skills systematically
	The teaching assessment method is reasonably designed and integrated into the assessment content of ideological and political education
Content of courses	Can effectively solve the teaching key and difficult points, the teaching content is correct
	Fully excavate the ideological and political elements in the field of computer

	Combine ideological and political elements with professional knowledge organically
Teacher quality	Teaching posture is dignified, full of spirit, clear and standard expression
	Teachers have high political literacy and ideological consciousness
	Fully prepared for teaching and can listen to students' teaching feedback carefully after class
Teaching efficiency	Master the basic knowledge and skills, and effectively achieve the teaching objectives
	Students can truly understand the meaning of ideological and political elements in the course
	Cultivate students' ability to be rigorous, meticulous and excellence
Learning process	Students are willing to accept the ideological and political related teaching activities designed by teachers
	Students can actively interact and participate in the ideological and political teaching activities in class
	Students can master the course content, whether they can understand and use what they have learned

According to the research results of other scholars, the initial index system for the evaluation of the effectiveness of ideological and political teaching was formulated, the first-level indicators were refined and the second-level indicators were improved in the form of expert discussion and interview. Five first-level indicators were revised according to the actual teaching process, and 15 second-level indicators were further divided. Table 1 shows the evaluation indicators.

3 Evaluation Model

3.1 Theoretical Basis

Hierarchical analysis (Analytic Hierarchy Process, AHP) is a multi-objective decision analysis method that organically combines qualitative and quantitative analysis. Fuzzy comprehensive evaluation method is to use the theoretical idea of fuzzy mathematics membership, transform the qualitative evaluation into quantitative evaluation, and solve how to reasonably and scientifically synthesize a single index, so as to realize the purpose of comprehensive evaluation. AHP can solve the complex problems which are difficult to be analyzed by quantitative indexes, and it is especially suitable for the system with many factors and layers Fuzzy comprehensive evaluation can deal with those decision-making problems which involve subjective judgment in a fuzzy way, so it expands the application range of comprehensive evaluation to a great extent.The combination of qualitative analysis and Quantitative analysis analysis provides a systematic analytical framework for complex decision-making problems.

3.2 The Evaluation Model

1)Hierarchical analysis determines the weights

Hierarchical analysis requires inviting multiple experts to score the importance of each evaluation criterion and integrating each expert score together as the basis for the final weight. To compare the importance between the index factors, the scaling method of 1-9 and its reciprocal is generally used. Set, the function represents the importance scale between the factors, and the convention f (x, y) =1 / f (y, x), as shown in Table 2.

Table 2. Compare SCALING

Degree of importance	f(x，y)	f(y, x)
x and y is equally important	1	1
x is slightly important	3	1/3
x is obviously important	5	1/5
x is strongly important	7	1/7
x is absolutely important	9	1/9
between the grades	2,4,6,8	1/2,1/4,1/6,1/8

Suppose that $X = \{X_1 \quad X_2 \quad \ldots \quad X_N\}$ is a set of all factors, make a pairwise comparison of each factor, and construct a judgment matrix, as shown in Equation (1). From the judgment matrix A, the maximum eigenvalue λmax is obtained, and the eigenvector of the judgment matrix about λmax is obtained, and the eigenvector is normalized.

$$A = \begin{bmatrix} a_{11} & a_{12} & \ldots & a_{1n} \\ a_{21} & a_{22} & \ldots & a_{2n} \\ \ldots & \ldots & \ldots & \ldots \\ a_{m1} & a_{m2} & \ldots & a_{mn} \end{bmatrix} \tag{1}$$

Determine to determine the index weight is scientific and reasonable, need to use consistency index to check the constructed judgment matrix has consistency, namely using the consistency of the judgment matrix index CI (Consistency Index) and the same order of the average random consistency index RI (Random Index) ratio, as shown in Equation (2). Where CR is the random consistency ratio of the judgment matrix, n is the order of the judgment matrix, and RI is the average random consistency index, when CR <0.10, indicating that the judgment matrix weight coefficient allocation is effective and reasonable, with satisfactory consistency, and can be used in real studies. Otherwise, the judgment matrix needs to be readjusted until the satisfactory consistency requirement is finally achieved. A smaller CR indicates a higher consistency of the judgment matrix.

$$CR = \frac{CI}{RI} = \frac{\lambda_{\max} - n}{RI\ (n-1)} \tag{2}$$

*2)*Fuzzy *comprehensive evaluation algorithm*

The factor set is a common set of elements composed of various factors affecting the evaluation object, usually expressed by U, $U = \{u_1 \quad u_2 \quad \ldots \quad u_n\}$,where the element ui represents the i the factor that affects the evaluation object. These factors, usually have different degrees of ambiguity. The evaluation set is a set of various results that the evaluator may make for the evaluation object. It is usually expressed by V, $V = \{v_1 \quad v_2 \quad \ldots \quad v_m\}$,where the element v j represents the j the kind of evaluation results.

Membership is a mathematical method to transform language expression into numerical expression, and to quantify the concept of subjectivity and ambiguity. Each rating level is associated with a membership degree. The degree of membership of the evaluation object to the evaluation set is determined from a factor ui, as shown in Equation (3). In the row j element rij indicates the membership to the vj level fuzzy subset when a evaluated object is a factor ui. The matrix R composed of n one-factor evaluation sets is a fuzzy comprehensive evaluation matrix.

$$R_i = \begin{bmatrix} r_{11} & r_{12} & \ldots & r_{1m} \\ r_{21} & r_{22} & \ldots & r_{2m} \\ \ldots & \ldots & \ldots & \ldots \\ r_{n1} & r_{n2} & \ldots & r_{nm} \end{bmatrix} \tag{3}$$

Due to the different importance of each factor, that is, the weight of the factors is different, and the weight of each factor ui is ci, then the fuzzy set of the weight set of each factor is different, as shown in Equation (4). Combine C and the fuzzy relation matrix R with the appropriate fuzzy operator, and obtain the vector P of the fuzzy comprehensive evaluation results. In the formula, pi indicates the degree of the evaluation result vi corresponding to the evaluated object. According to the principle of maximum affiliability, the evaluation result v_j corresponding to the largest p_j.

$$C = (c_1 \quad c_2 \quad \ldots \quad c_n) \tag{4}$$

$$\begin{aligned} P = C.R &= (c1 \quad c2 \quad \ldots \quad cn). \begin{bmatrix} r_{11} & r_{12} & \ldots & r_{1m} \\ r_{12} & r_{22} & \ldots & r_{2m} \\ \ldots & \ldots & \ldots & \ldots \\ r_{n1} & r_{n2} & \ldots & r_{mn} \end{bmatrix} \\ &= (p_1 \quad p_2 \quad \ldots \quad p_m) \end{aligned} \tag{5}$$

4 Example

In this study, ideological and political courses of a basic computer university were selected for evaluation, and evaluation information was obtained by collecting student questionnaires. A total of 100 questionnaires and 96 valid questionnaires were issued in this evaluation. According to the evaluation model described above, u1 represents the curriculum design, u2 the teaching content, u3 the teacher quality, u4 the teaching effect, and u5 the learning process.

4.1 Build a judgment matrix and determine the index weights at all levels

When determining the weight of indicators, the expert scoring method is adopted to invite 10 teachers to compare and score the relative importance of each index of the same level and affiliation, and the judgment matrix is constructed as shown in Equation (6).

$$A = (a_{ij})_{5X5} = \begin{bmatrix} 1 & 6/5 & 4/3 & 3/2 & 2 \\ 5/6 & 1 & 1 & 4/3 & 1/2 \\ 3/4 & 1 & 1 & 6/5 & 3/2 \\ 2/3 & 3/4 & 5/6 & 1 & 3 \\ 1/2 & 2 & 2/3 & 1/3 & 1 \end{bmatrix} \tag{6}$$

The maximum eigenvalue of A matrix was 5.37 by python, and the eigenvector corresponding to the maximum eigenvalue was calculated and normalized to obtain Equation (7). Computing the judgment matrix CR=0.08, satisfying CR <0.10 indicates that the weight coefficient assignment is valid and reasonable.

$$\mathrm{b} = (b_1 \quad b_2 \quad b_3 \quad b_4 \quad b_5) = (0.25 \quad 0.18 \quad 0.2 \quad 0.21 \quad 0.16) \tag{7}$$

4.2 Establish a fuzzy evaluation matrix

The evaluation set of the second-level indicators in table 1 is V ={excellent,good, qualified, unqualified} = {90,75,60,50}. 100 students were selected to score teacher A, counted the original evaluation data, and eliminated invalid data such as incomplete filling, and the valid data accounted for 96%. The questionnaire survey score is shown in Figure 1.

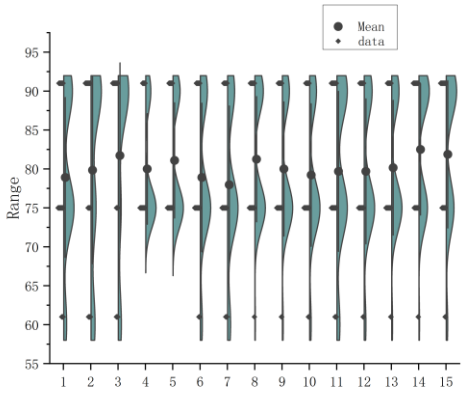

Fig. 1. A half-violin diagram of the questionnaire

Reliability refers to the consistency and reliability of the measured results, and the measurement parameter is usually the Cronbach's α value. According to the view of most scholars, if the Cronbach's α coefficient is above 0.9, the reliability of the test or scale is very good, between 0.8 and 0.9 is good, between 0.7 and 0.8 is acceptable, between 0.6 and 0.7 is average, and between 0.5 and 0.6 is not ideal. Table 3 shows the results of the reliability analysis of both tables in this study, which indicates the high internal consistency and good reliability of the study scale. Table 4 shows the validity test passed KMO and Blartlett spherical test, KMO value was 0.72 and Bartlett test: P <0.05, significant. In conclusion, the scales in this study have good reliability and validity.

The membership value of the collected data is obtained, as shown in Table 5, and the fuzzy evaluation moment between the first-level evaluation index factors and the evaluation set is established, as shown in Equation (8).

Table 3. Reliability ANALYSIS

Cronbach's α	**Normalized Cronbach's α**	**Terms**	**sample number**
0.896	0.896	15	96

Table 4. Validity ANALYSIS

KMO test and Bartlett		
KMO		0.72
Bartlett Sphelicity test	Approximate chi square	1221.855
	df	105
	P	0.000

Table 5. Evaluation of statistical values

Level 1 indicators	Secondary indicators	Judgment set			
		excellent	good	qualified	unqualified
U_1	U_{11}	0.4	0.47	0.13	0
	U_{12}	0.53	0.26	0.21	0
	U_{13}	0.63	0.18	0.19	0
U_2	U_{21}	0.33	0.67	0	0
	U_{22}	0.41	0.59	0	0
	U_{23}	0.36	0.53	0.11	0
U_3	U_{31}	0.34	0.51	0.15	0
	U_{32}	0.44	0.54	0.02	0
	U_{33}	0.39	0.56	0.05	0
U_4	U_{41}	0.37	0.55	0.08	0
	U_{42}	0.44	0.44	0.12	0
	U_{43}	0.4	0.52	0.08	0
U_5	U_{51}	0.4	0.55	0.05	0
	U_{52}	0.53	0.44	0.03	0
	U_{53}	0.53	0.4	0.07	0

The 3D percentage stacked wall graph is used to display the fuzzy evaluation matrix data to make the data more intuitive and visualized. As shown in Figure 2.

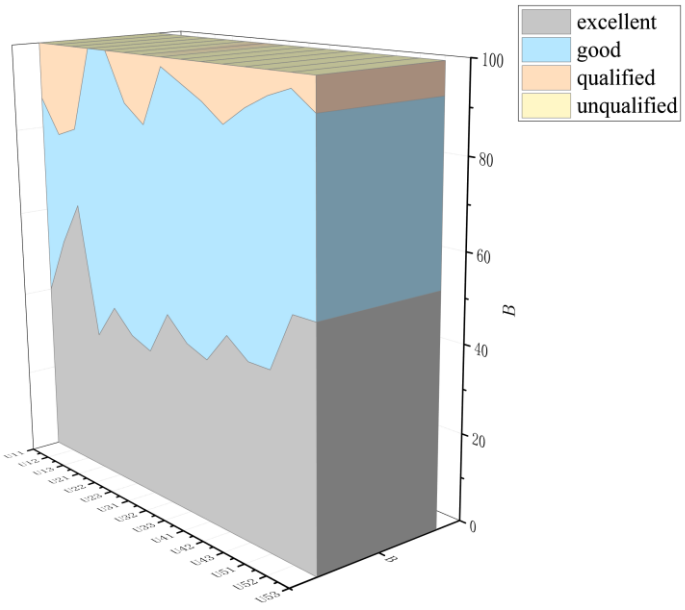

Fig. 2. D percentage stacked wall graph

$$R_1 = \begin{bmatrix} 0.4 & 0.47 & 0.13 & 0 \\ 0.53 & 0.26 & 0.21 & 0 \\ 0.63 & 0.18 & 0.19 & 0 \end{bmatrix}$$

$$R_2 = \begin{bmatrix} 0.33 & 0.67 & 0 & 0 \\ 0.41 & 0.59 & 0 & 0 \\ 0.36 & 0.53 & 0.11 & 0 \end{bmatrix} \quad R_3 = \begin{bmatrix} 0.34 & 0.51 & 0.15 & 0 \\ 0.44 & 0.54 & 0.02 & 0 \\ 0.39 & 0.56 & 0.05 & 0 \end{bmatrix} \quad R_4 = \begin{bmatrix} 0.37 & 0.55 & 0.08 & 0 \\ 0.44 & 0.44 & 0.12 & 0 \\ 0.4 & 0.52 & 0.08 & 0 \end{bmatrix}$$

$$R_5 = \begin{bmatrix} 0.4 & 0.55 & 0.05 & 0 \\ 0.53 & 0.44 & 0.03 & 0 \\ 0.53 & 0.4 & 0.07 & 0 \end{bmatrix} \tag{8}$$

Combined with the expert scoring method to determine the weight of the second-level indicators, the comprehensive evaluation model of the weighted average type is used to obtain the evaluation result vector of the Curriculum design U1, as shown in Equation (9). Similarly, the evaluation result vector of U2, U3, and U4 is obtained, as shown in Equation (10).

$$\begin{aligned} P_1 = C_1.R_1 &= \begin{pmatrix} 0.4 & 0.3 & 0.3 \end{pmatrix} \begin{bmatrix} 0.4 & 0.47 & 0.13 & 0 \\ 0.53 & 0.26 & 0.21 & 0 \\ 0.63 & 0.18 & 0.19 & 0 \end{bmatrix} \\ &= \begin{pmatrix} 0.51 & 0.32 & 0.17 & 0 \end{pmatrix} \end{aligned} \tag{9}$$

$$\begin{aligned} P_2 &= \begin{pmatrix} 0.38 & 0.58 & 0.04 & 0 \end{pmatrix} \\ P_3 &= \begin{pmatrix} 0.39 & 0.54 & 0.07 & 0 \end{pmatrix} \\ P_4 &= \begin{pmatrix} 0.41 & 0.49 & 0.1 & 0 \end{pmatrix} \\ P_5 &= \begin{pmatrix} 0.49 & 0.46 & 0.05 & 0 \end{pmatrix} \end{aligned} \tag{10}$$

A comprehensive evaluation matrix is thus obtained, as shown in Equation (11). The evaluation results are shown in Figure 3.

$$R = \begin{bmatrix} 0.51 & 0.32 & 0.17 & 0 \\ 0.38 & 0.58 & 0.04 & 0 \\ 0.39 & 0.54 & 0.07 & 0 \\ 0.41 & 0.49 & 0.1 & 0 \\ 0.49 & 0.46 & 0.05 & 0 \end{bmatrix} \tag{11}$$

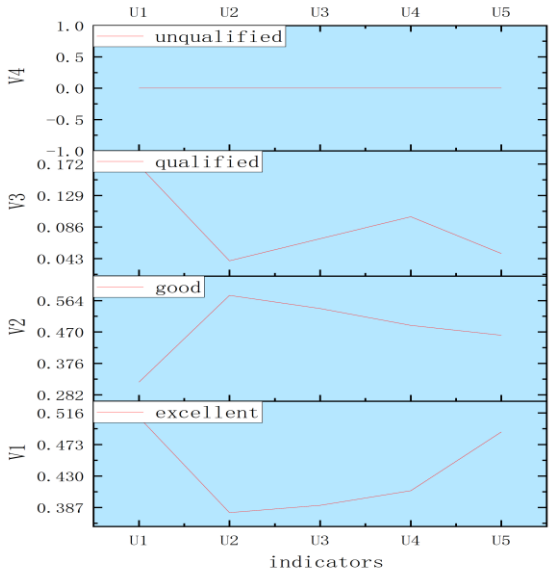

Fig. 3. Evaluation results

According to the primary index weight, a comprehensive evaluation is conducted, as shown in equation (12).

$$P = (0.25 \quad 0.18 \quad 0.2 \quad 0.21 \quad 0.16)\begin{bmatrix} 0.51 & 0.32 & 0.17 & 0 \\ 0.38 & 0.58 & 0.04 & 0 \\ 0.39 & 0.54 & 0.07 & 0 \\ 0.41 & 0.49 & 0.1 & 0 \\ 0.49 & 0.46 & 0.05 & 0 \end{bmatrix} \tag{12}$$

$$= (0.44 \quad 0.47 \quad 0.09 \quad 0)$$

According to the evaluation set V ={excellent, good, qualified, unqualified} = {90,75,60,50}, the comprehensive score of students can be rated S as 80.25. This calculation is somewhere between excellent and good.

5 Conclusions

In the implementation of the basic ideological and political courses of university computer, the ideological and political content contained in the teaching content is explored, and the ideas of patriotism, love and dedication, network security and positive life attitude are conveyed to students in the discussion, but both the ideological and political resources and the evaluation system need to be further improved. The combination of AHP and fuzzy comprehensive evaluation method provides a system-

atic and scientific method for the ideological and political evaluation of computer courses. Through this method, students' ideological and political quality can be comprehensively and accurately evaluated, to provide strong support for the in-depth ideological and political development of the course. Through AHP-fuzzy design and application of comprehensive evaluation method, to improve the university computer basic course education teaching effect, teachers must improve the course education overall teaching design ability, improve course professional knowledge and course ideological elements fit, optimization of teaching methods, attention to students accept course ideological teaching willingness, etc.

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