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Fuzzy Theory on Internet P.E. Courses Evaluation

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Abstract: Combined with research findings from previous studies, this study elaborated overall evaluative method of indicator system and performed in-depth research on indicator dimension in indicator system, indicator weightiness and evaluative standards to construct a comprehensive indicator system of network course evaluation so as to be used in evaluative system. And then, towards the features of fuzziness and indeterminacy of evaluative objects during education evaluation, fuzzy theory was introduced and evaluation mode based on fuzzy comprehensive evaluation was determined with features of network course evaluation. Finally, with database technology and interconnection technology between WEB and database, a design project is put forward and key functional modules of system is also discussed.

Key words: Fuzzy theory, P.E courses evaluation, module

INTRODUCTION

P.E network courses are the generalization of teaching content on physical education and implemented teaching activities through network performance which contains two parts that is, on the basis of P.E teaching target, one of these two parts is teaching content of P.E organized by teaching strategies while the other one is supporting environment of P.E network education. Network technological development provides technological support for networked course exploration on P.E. As important bases cultivating P.E talents, some problems have been faced by educators of P.E on how universities adapt to the requirement of distance education in networked time on cultivating sports talents and how universities can construct a kind of efficient development mode of P.E networked courses to overcome problems faced by current P.E networked courses development and to guarantee smooth conduction of P.E network teaching (Tao *et al*., 2006).

With extensive development of educational normalization, most of researchers make use of scientific theory of education information to direct systematic design and perform comprehensive reference to some basic educational theories like teaching and learning principles rather than impurely understand evaluative system of networked courses with the theory of technology and machine application. Therefore, this method can promote evaluative system to better satisfy users' requirement. However, due to its uncertainty, educational information system is far complex than common engineering system with its main features of high degree fuzziness and subjectivity. Traditionally emphasizing accurate mathematical method cannot be totally appropriate for describing and handling various kinds of interior information in this system. But, fuzzy mathematics is a newly developed emerging mathematical branch for introducing mathematics in each field which has fuzzy phenomenon and fuzzy definition. The appearance of fuzzy mathematics greatly broadens mathematical application scope. Therefore, it is necessary and feasible to introduce fuzzy mathematics during handling educational information. Recently, domestic and overseas scholars have performed important research on networked courses evaluation and provided a group of scales, gauges and indicator set with referential values which offers a reliable research foundation (Unal and Unal, 2011).

This study firstly, analyzed domestic and overseas networked courses evaluation method and offered a networked course evaluation mode based on fuzzy synthetic evaluation. This kind of evaluation mode is brought forward towards the features of fuzziness and indeterminacy of networked course evaluation information and improved evaluative science and objectivity (Zhao *et al*., 1997). Besides, in the evaluative indicator system, evaluation indicator is divided into level-1 indicator and level-2 indicator according to the standards of networked course evaluation. The combination principle between whole and part is realized after each evaluative result is synthesized to perform comprehensive evaluation on networked courses and determine evaluation ratings of networked courses. Fuzzy comprehensive evaluation system of networked courses in objective reality is coincided through designing and realizing one result and the key module which is the handling project of sub modules of fuzzy comprehensive evaluation is performed selective analysis.

PRINCIPLE AND PROCESS OF FUZZY COMPREHENSIVE EVALUATION

Principle: The fuzzy comprehensive evaluation is established on the basis of fuzzy set and fuzzy matrix, its main idea is.

Assume evaluation objects equal to zero; U = {u_1, u_2,…, u_n} is the evaluation indictors set and fuzzy sub-set B = {b_1, b_2,…, b_n} is indictors weight set; V = {v_1, v_2,…, v_n} is remark level which assigns weight to each evaluation and constructs the level scores set P = {p_1, p_2,…, p_n}; R is the fuzzy relation on U, X, V and $\mu R(u_i, v_i)$ denotes the membership function of u_i on level v_i which also represents the proportion of persons rated as v_i in network courses. R = (r_{ij}) is nxm-order fuzzy matrix and it is called evaluation matrix. The comprehensive matrix T = BXR(t_1, t_2,…, t_n) is the product of matrix B and R. When T is normalized, we get T* = (t^*_1, t^*_2,…, t^*_n). Then we introduce the level score matrix P and let Q = T*XP' (P' is transpose matrix of P and Q is the final evaluation results).

According the algorithms of fuzzy matrix, there are four methods to calculate the elements in T and four modes exist in the comprehensive evaluation method:

- Main factors decision M(∨, ∧). The weight of main factors is the upper bound of elements in evaluation matrix T. If good marks can be achieved in main factors and is made not less than the weight, the maximum value of T is the weight of main factors and has nothing to do with the other factors. But it will cause large information loss and lead to bias
- Main factors are dominant M(∨, •). According the evaluation aim and indicators importance to correct r_{ij} with b_i. It can make main factors dominant and the utilization of information is increased, compared to mode 1.But information loss still exists
- Uneven average mode M(⊕, ∧). It has more information loss in early data processing
- Weighted average model M(⊕, •). If the additional condition:

$$\sum_{i=1}^{n} b_i = 1 \ (0 \le b_i \le 1)$$

is satisfied, all the elements in this mode will participate in calculating and have substantial contribution to element of matrix T. It can make full use of information from various aspects and has reasonable evaluation performance

So, we take the idea of weighted average as described in mode 4. If the evaluation elements have only one hierarchy, we can directly use comprehensive evaluation method to calculate the result; if the evaluation elements are divided into multiple hierarchies, then mode 4 has to extend to multilevel fuzzy comprehensive evaluation.

Procedure: Generally, fuzzy comprehensive evaluation can be processed as follows, as is shown by Fig. 1:

Step 1: Determine the evaluation indicators system; Assume the evaluation set is U = {u_1, u_2,…, u_n} (u_i is the evaluation element)

Step 2: Determine the weight matrix A of evaluation elements. In the indictors system, weight is the importance degree of one element in the elements set and it reflects the objective existing imbalance among the indictors. The common methods to determinate the weight subjectively are expert scoring method, Delphi technique and analytic hierarchy process

Step 3: Construct comment set V. The combination of comments set is relatively flexible which can be

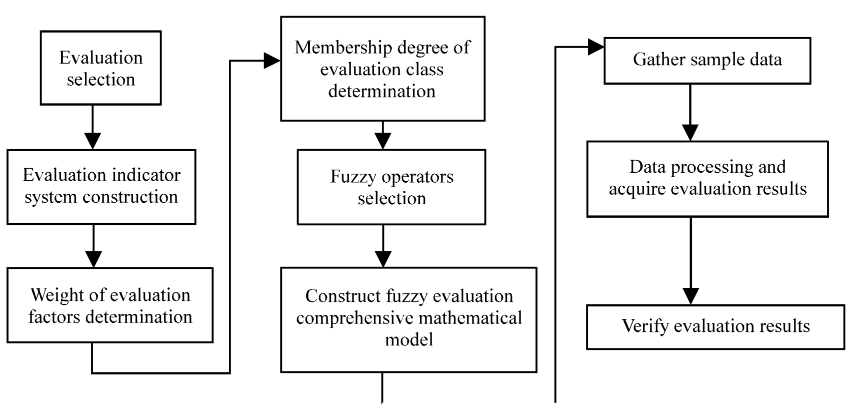

Fig. 1: Flow chart fuzzy comprehensive evaluation

determined by approximate law such as ""very well, well, general, bad ".It can be constructed as the different demand of the indicators like "very satisfied, satisfied, a little satisfied, general, not very satisfied, dissatisfied, very dissatisfied " etc. We can also use membership function to determinate the value of general comment domain by score of class and quantify integrated method

Step 4: Give scores to each element of the indictors system. During the evaluation, due to different views of persons, the same object may be looked as "very well" by some people while as "general" by others. So we can take the form of question are, to give scores of each element in the indicators system

Step 5: Construct fuzzy evaluation matrix R. After the process of comments in step 4, the fuzzy evaluation matrix is constructed. Assume the comments set is V and it has n classed, then $V = \{V_1, V_2,\ldots,V_n\}$. m evaluation elements are given, then the fuzzy relation between U and V can be expressed by evaluation matrix R:

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ r_{n1} & r_{n2} & \cdots & r_{nm} \end{bmatrix}_{ik}$$

rij (i = 1, 2,..., m; j = 1, 2,..., n) denotes the membership of indicator to give evaluation of class j

Step 6: Calculate the first-class evaluation matrix. Give comprehensive evaluation to each sub element set and let the weight assignment of element in Ui as $A_i = (a_{i1}, a_{i2},\ldots, a_{in})$. Then we have the first-class evaluation matrix:

$$H_i = A_i \bullet R = (h_{i1}, h_{i1}, \ldots, h_{in}), (i = 1, 2, \ldots m) \quad (1)$$

Step 7: Calculate the second-class evaluation matrix. Take Ui as an element marked as $U = \{U_1, U_2,\ldots, U_s\}$. So, U is an element set here. Each Ui denotes some character of U, as a part of it. The weight matrix $B = (b_1, b_2,\ldots, b_n)$ can be decided with AHP method. Then the second-class evaluation matrix is:

$$E = B.H \quad (2)$$

Step 8: Make comprehensive evaluation. If membership is adopted for decision, E is also used; Without membership we can make weight assignment for each class and set the acquired set as V':

$$V' = \begin{bmatrix} P_1 \\ P_2 \\ P_3 \\ P_4 \\ P_5 \end{bmatrix}$$

So, E.V' is the demand value of comprehensive evaluation results

Step 9: Liability test. We should make hypothesis testing for the evaluation results of web-based study, to testify the reliability of this result which is often judged by t-test: if the result does not lie in refusing domain, then the result is accepted; else it need to reconsider the design of evaluation model

NETWORKED COURSE EVALUATION SYSTEM DESIGN BASED ON FUZZY THEORY

Systematic architecture structure: According to features of systematic design principle and networked evaluation and combining Web application technology based on Internet distribution dynamic, we designed systematic architecture structure, as is shown by Fig. 2. This system is divided into three layers on logic which are data service layer, functional module layer and user browsing interface layer. User interface layer is on the client machine, affair service layer is located in Web server and application program server and data service layer is situated in database server. This structure is helpful to develop networked course system model, balance systematic loading, maintain system and guarantee information security at the same time.

Hierarchical fuzzy comprehensive evaluation model: If weight vector A and fuzzy relationship matrix R are given, compound operation of fuzzy matrix is applied and fuzzy comprehensive model of evaluation indicator system on networked course effect can be correspondingly established. These two levels' fuzzy comprehensive evaluation model is shown as Fig. 3.

Therefore, mathematical model of the first layer's evaluation vector is:

$$\underset{\sim}{B}_{1i} = \underset{\sim}{A}_{ik} \, o \, \underset{\sim}{R}_{ik} \quad (3)$$

R is considered to represent evaluation matrix of group k in the first layer, A represents weightiness vector corresponding to R* and Ajk represents evaluative vector of group k in the solved first layer. The above formula can also be represented as:

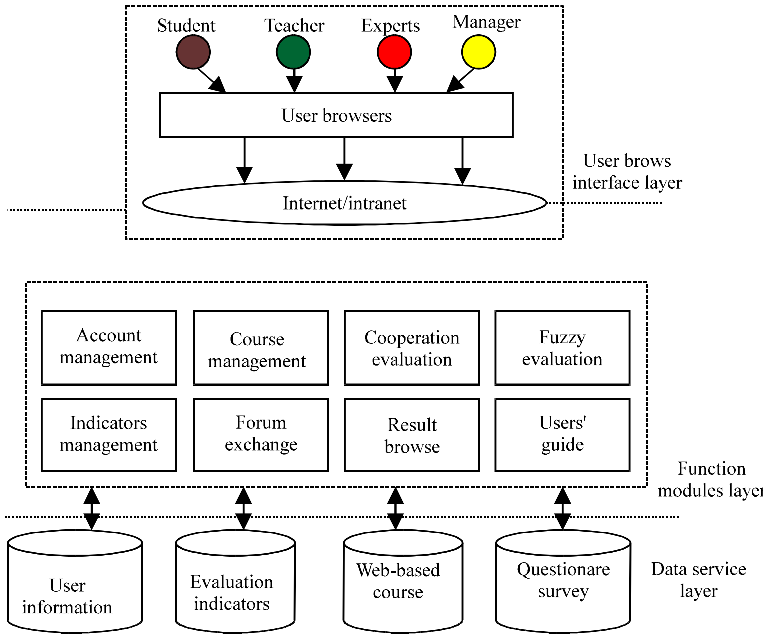

Fig. 2: System structure

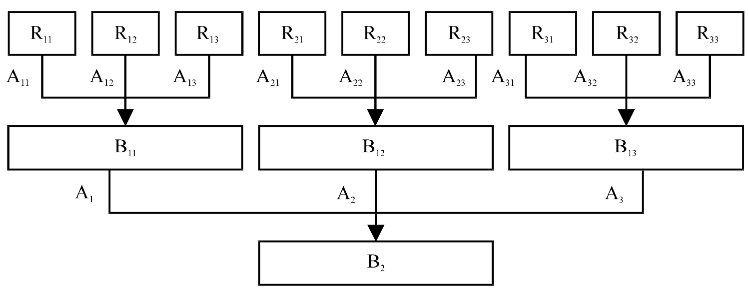

Fig. 3: Sketch map of two layered fuzzy comprehensive evaluation model

$$(b_1, b_2, \ldots, b_n)_{li} = (a_1, a_2, \ldots, a_n)_{ik} \circ \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ r_{n1} & r_{n2} & \cdots & r_{nm} \end{bmatrix}_{ik} \tag{4}$$

Assume there are n evaluative samples and bi represents i evaluative vector element in the first layer, an represents the weight of k evaluative factor corresponding to i evaluative vector and rij refers to the element of evaluative matrix. This formula can acquire evaluative vector Bji after performing compound operation and normalization:

$$\underset{\sim}{B}_{li} = (b_1, b_2, b_3, \ldots, b_n) \tag{5}$$

The total evaluative vector can be acquired if evaluative vector of each group in the first layer is performed synthesis in the second time in the second layer:

$$\underset{\sim}{B}_2 = \underset{\sim}{A}_p \circ \underset{\sim}{R}_p \tag{6}$$

Indicator weight determination based on analytic hierarchy process: First, the indicators are performed double comparison on their importance degree with the same level and are assigned values according to Table 1 to get comparison values which is shown as Table 2. if the scoring value of importance degree is even number, comparative importance between two evaluative indicators is shown to be fallen in between odd values.

Membership function is applied to determine values of commonly evaluated universe of discourse with adopting classification scoring. Then, the method of re-quantification synthesis is determined. The simplest quantification is that each classification is individually assigned values as 5, 4, 3, 2, 1 and then membership degree with each ranking is also set. Membership degree can be given through following membership function:

Table 1: Comparison rules of indicators' importance

Value	Relative importance	Description
1	Equally important	The contributions to degree is equivalent
3	A little important	According to experience, the prior is favorable
5	Important	According to experience, the prior is more favorable
7	Much more important	The prior has obvious advantage
9	Extremely important	Importance degree of the prior is very high

Table 2: Value for comparison

Value	A_1	A_2	A_3	…	A_n
A_1	1	A_{12}	a_{13}	…	a_{1n}
A_2	a_{21}	1	a_{23}	…	a_{2n}
A_3	A_{31}	A_{12}	1	…	a_{3n}
…	…	…	…	…	…
A_n	a_{n1}	a_{n2}	a_{n3}	…	1

Table 3: Membership degree of evaluation class

Evaluation class	Very A	A little A	A	Not very A	Not A
μ_A	0.90	0.74	0.61	0.50	0.41

$$\mu(\mu_n) = e^{-\frac{2n-1}{10}} \quad (7)$$

Quantification of qualitative ratings can be set according to above formula to get Table 3.

ANALYSIS ON KEY MODULE

According to overall design idea in the system, systematic realization process of networked course evaluation explores six functional modules which are user management module, questionnaire module, indicator system maintenance module, data handling module, collaborative communication module and fuzzy evaluation module. Fuzzy evaluation module is the core module in this system and it mainly completes following functions: networked course scanning, checking evaluation indicator, evaluating investigation, fuzzy comprehensive evaluation and results presentation. Since, this study adopts two-level fuzzy comprehensive evaluation model, the sub module handling of fuzzy comprehensive evaluation is divided into two steps to describe.

Fuzzy comprehensive evaluation on the second-class indicators: Evaluation information collected by questionnaire is shown as Table 4:

- The second-class fuzzy comprehensive evaluation matrix R1 is formed:

$$R_1 = \begin{bmatrix} 0.8 & 0.2 & 0 & 0 \\ 0.9 & 0.1 & 0 & 0 \\ 0.7 & 0.3 & 0 & 0 \\ 0.6 & 0.3 & 0.1 & 0 \end{bmatrix}$$

Table 4: Information table of the questionnaire

First-class indicator	Second-class indicator	Matched very much	Matched	Not confirmed	Not matched
	Course description	16	4	0	0`

- Weight assignment of indicator X1 on course content is A1 = {0.2 0.3 0.3 0.2}
- Calculate X1 on membership vector of indicator set V as:

$$B_1 = A_1 \bullet R_1 = \{0.2 \quad 0.3 \quad 0.1 \quad 0\} \quad (8)$$

- After normalization, since ΣB_1 =0.2+0.3+0.1+0 = 0.1<1, B'_1 = (0.33 0.43 0.14 0) is acquired according to Eq. 9:

$$\sum B_i' = B_i / \sum B_I = 1 \quad (9)$$

- The result single-class fuzzy comprehensive evaluation is acquired

According to maximized membership degree theory, since the percentage of B1 belong to "Good" is maximized, fuzzy comprehensive scale of this course content indicator rates "Good". In order to find out comprehensive result more directly, fuzzy data can be converted into common data, with setting scoring scope of "Excellent" is from 81 to 95, setting scoring scope of "Good" is from 80 to 65, setting scoring scope of "Middle" is from 65 to 50 and setting scoring scope of "Bad" is below 50.

$$Q_1 = B_1'.P' = 0.33\times95+0.43\times80+0.14\times0.65+0\times50 = 74.85 \quad (10)$$

Total evaluation score of course content indicator is 74.85 with corresponding rating is lower than "Good" level.

Fuzzy comprehensive evaluation on the first-class indicators: Similarly, the acquired membership vector of teaching design X2, technical design X3 and teaching management X4 on evaluation set V is successively as: B2 = (0.17 0.47 0.28 0.18), B3 = (0.13 0.40 0.36 0.11), B4 = (0.14 0.36 0.39 0.12).Then the first-class indicator of this courseware's acquired membership matrix on evaluation set V is:

$$R = \begin{bmatrix} 0.3 & 0.3 & 0.1 & 0 \\ 0.17 & 0.47 & 0.28 & 0.18 \\ 0.13 & 0.40 & 0.36 & 0.11 \\ 0.14 & 0.36 & 0.39 & 0.12 \end{bmatrix}$$

Table 5: Evaluation results of system

First-class indictors	Second-class indictors	Single-class fuzzy evaluation matrix	Single-class fuzzy comprehensive evaluation results
Course content	Course description 0.2	0.8 0.2 0 0	73.15
	Target accordance 0.3	0.9 0.1 0 0	Single-class fuzzy comprehensive evaluation matrix
	Scientificity 0.3	0.7 0.3 0 0	
	Content block 0.2	0.6 0.3 1 0	0.43 0.29 0.14 0
First-class indicators fuzzy evaluation matrix R			
	Course content		0.3 0.3 0.1 0
	Teaching design		0.17 0.47 0.28 0.18
	Technology design		0.13 0.40 0.36 0.11
	Teaching management		0.14 0.36 0.39 0.12
	First-class fuzzy comprehensive evaluation class matrix		0.25 0.44 0.125 0.1875
	First-class comprehensive evaluation results		76.45

The membership vector of courseware quality indicator on evaluation set is:

$$B = A \bullet R = (0.2 \;\; 0.35 \;\; 0.1 \;\; 0.15) \tag{11}$$

Normalized, B' = (0.25 0.44 0.125 0.188).

Single-class fuzzy comprehensive evaluation result is acquired:

$$Q = B'.P' = 74.65 \tag{12}$$

Total evaluation score is 73.15 and data indicate that network course quality is lower than good level.

Finally, the generated evaluation results in the system are shown as Table 5.

CONCLUSION

Along with the multimedia and the network technology, the network course evaluation is a new education evaluation. It is an important subject in network course evaluation system from the perspective of information science research. After consulting a large number of phases Based on the data and settlement, this study made a deep research on this theme. The proposed scheme is a beneficial attempt, the web-based course evaluation fuzzy comprehensive evaluation method, the existence of a PE Evaluate the design quality of network curriculum and network curriculum guidance.

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