

The Research of Adaptive Ability Evaluation Architecture for National Defense Students Based on Fuzzy Models

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Abstract

The system of adaptability evaluation for national defense students is usually qualitative. In this paper the complexity of adaptive capacity and the influence to each other of various factors are considered, a two-stage quantitative index evaluation is proposed based on fuzzy model. The ideological political quality, comprehensive quality, professional quality, physical and psychological quality constitute the first-level indices. On the basis of these four indices, eighteen secondary-level indices are refined out. the first-level indicators can be generated through secondary-level indices by using membership function, the qualitative evaluation of adaptability evaluation for the national defense students can generated by the maximum membership degree principle in the first-level indicators. Finally, a concrete example is used to show the process of this scheme which is given in the paper and the feasibility of the method.

Keywords: *fuzzy model, double indicator, membership function*

1. Introduction

Evaluation is a kind of intelligent activities of people. The complexity of evaluation and the diversity of evaluation parameters, make it to be nonlinear. So the linear evaluation model is very difficult to obtain good effect. A large number of evaluation practices have proved that the nonlinear of evaluation is caused by the uncertainty in evaluation, so nonlinear evaluation model is more suitable for evaluation activities. Generally speaking, all the evaluation problems are nonlinear, and linear evaluation is only the approximate of nonlinear evaluation within a certain range. In the actual evaluation work, an outstanding performance effect of some indices is an expression of this nonlinear characteristic. The prominent effects of index mean that the impact on the evaluation results cannot be fully reflected by increasing the weight lonely. In order to make up for the inadequacy of linear weighted method, this paper puts forward a new nonlinear fuzzy comprehensive evaluation model with prominent impact factor.

In recent years, fuzzy comprehensive evaluation method has achieved great development, and has been widely used in all walks of life in site selection evaluation, loyalty evaluation, teaching quality evaluation, performance evaluation and human resources evaluation, etc. In reference [1], fuzzy comprehensive evaluation method was applied to the logistics center location. In reference [2], online brand loyalty is evaluated comprehensively where fuzzy mathematics has been used, also the multi-level evaluation index system of online brand loyalty has been built, and they also put forward the fuzzy comprehensive evaluation model. Reference [3] is mainly on the research of the evaluation of teaching quality in higher education, and teaching quality evaluation model is established by using the analytic hierarchy process (AHP) and fuzzy comprehensive evaluation method. Reference [4] is to evaluate potential environmental impact after the implementation of the planning of land use, and based on this, the optimal solution is proposed for land planning. Reference [5] mainly studies the fuzzy comprehensive

evaluation of the difficulty degree for coal resource recovery under the buildings. A more reasonable and scientific decision schemes is put forward for coal mining. Reference [6] studies the decision problem of water-saving irrigation system. The basic elements are qualitative and quantitative indicators, the fuzzy comprehensive evaluation model is set up by the use of fuzzy membership concept.

Considering the diversity in the system of adaptability evaluation and the necessity of adaptability evaluation in the national defense students, we put forward the nonlinear fuzzy evaluation model with double stage index. By using the method, the first-level indices are generated through the 18 weighted second-level indices, based on this, the qualitative evaluation index is generated by the nonlinear maximum membership degree principle.

National defense students are the future officers in the army. National defense students should complete the prescribed academic and military training mission and achieve the training goal, and then are appointed of army cadres according to an agreement for the army. In colleges and universities, national defense students are a special group. They are the ordinary university students, and also officers in the future. After graduation, they not only have the responsibility to constructing the army but also have the responsibility of management. Therefore, the fitness of military defense, in other words, the training quality of national defense students, is of great significance for the army. It is related to what kind of cadres can be trained for the army and also related to what kind of army can be constructed. It is related to the future and hope of troops. Therefore, strengthening training quality of national defense students, realizing the seamless joint between students of national defense and army, arming their minds with scientific ideological and theoretical knowledge with advanced scientific knowledge, make sure that the future officers' ideological loyalty, academic loyalty, body loyalty, is the responsibility of college.

2. The Multilayer Indices of Adaptability

For the national defense students, in order to adapt to the army as soon as possible, to be a major player in the army, be troops running of officer, they should improve themselves from four aspects. For the national defense students, its primary evaluation factors include the following four aspects: (1) the ideological and political quality; (2) comprehensive quality; (3) professional quality; and (4) physical and mental quality. On this foundation, we establish eighteen secondary evaluation factors.

(1) The ideological and political quality

The ideological and political quality of national defense students belongs to the conception of ideology. The ideological and political constructions of the army must be placed in the most important place in the construction of the army. They can guarantee reserve officers to be "thought red, style of work hard, listen to your command, can fight". An excellent national defense student must have the ideological and political quality which including absolute loyalty quality, revolutionary ideal faith and patriotism, collectivism spirit and professional dedication.

(2) Comprehensive quality

A national defense student should remember his mission since he started school. He should become high-quality and new military talents who is both ability and political. The troops discipline, society management, learn to maximize their potential, comprehensive quality are all indispensable part. Comprehensive quality mainly includes the management ability, organizational ability, coordinating ability, expression ability and military writing ability.

(3) Professional quality

The world's new military revolution is fierce, but the key of the military power lies in the information technology. So, the important task for modern military construction is on

the shoulder of the national defense students. In order to undertake the responsibility, national defense students must love the professional they studied. They also need to study continuously, unremitting pursuit, and accurate grasp the professional knowledge frontier. Professional quality includes solid foundation knowledge, rich knowledge structure and professional skills, familiar with the frontier of professional insight.

(4) Physical and mental qualities

The body is the capital of revolution. As the identity of future soldiers, national defense students need more strict self-discipline, adhere to the requirements of qualified military personnel, rigorous training, indomitable willpower, strong bones, plastic body, improve military skills, health up physical and mental qualities. Physical and mental qualities include thrifty physique, healthy psychology, and physical stamina tough, excellent military skills.

3. Elements of Fuzzy Evaluation Model

Based on the analysis above, the training quality of national defense students can be measured by four first-grade indices and eighteen second-grade indices. See Table 1.

Table 1. Adaptability Evaluation Indices

Target layer	First-grade indices	Second-grade indices
Adaptability U	Ideological and political quality U1	Absolute loyalty quality U11
		Revolutionary ideals and beliefs U12
		Patriotism spirit U13
		Collective spirit U14
		Professional dedication spirit U15
	Comprehensive quality U2	Management ability U21
		Organizational ability U22
		Coordination ability U23
		Expression skill U24
		Military writing ability U25
	Professional quality U3	Sturdy basic knowledge U31
		A wealth of knowledge structure U32
		Familiar professional skill U33
		Frontier professional insight U34
	Physical and mental qualities U4	Thrifty physique U41
		Healthy psychology U42
		Physical stamina tough U43
		Excellent military skills U44

The adaptability of national defense students involves a variety of factors, the weightings of the various factors are different from each other and they have fuzzy relation between various factors. So a multi-level fuzzy comprehensive evaluation is appropriate. By constructing multi-level fuzzy comprehensive evaluation model,

balancing weights of each factor, the evaluation results can better reflect the reality [9-11].

4. The Adaptability Evaluation

(1) Fuzzy comprehensive evaluation model

Fuzzy comprehensive evaluation method is a broader method that applies in fuzzy mathematics. This class of problem often encounters in the evaluation of a certain thing. It because the object under the evaluation is determined by many factors. Each of these factors makes a separate comment and all factors make a comprehensive reviews, this is a problem of comprehensive evaluation. Fuzzy comprehensive evaluation is a method which is under fuzzy environment; consider the impact of multiple factors.

(2) The basic idea of fuzzy evaluation

The boundary of many things are not very significantly, it is difficult to attributed them to certain category in evaluation, so we first evaluate the individual factors, and then fuzzy comprehensive evaluation of all factors, to prevent the omission of any statistical information and the loss of information in the midway.

(3)The steps of establishing fuzzy comprehensive evaluation model

To select set of objects; To determine the index set; Establish a weight set; To determine the set of reviews; Identify the evaluation matrix; To obtain a comprehensive set of fuzzy evaluation, namely ordinary matrix multiplication; to give the final results of the evaluation set. We will establish the fuzzy comprehensive evaluation model of this article.

1 The evaluation factors set

Let U denote evaluation set, there are four evaluation factors.

$$U = (U_1, U_2, U_3, U_4)$$

Where $U_i, i = 1, 2, \dots, 4$ is evaluate factors.

2 Determine the evaluation set

Let V denote evaluation set, there are four evaluation ranks.

$$V = (V_1, V_2, V_3, V_4)$$

Where $V_1 =$ outstanding, $V_2 =$ good, $V_3 =$ general, $V_4 =$ poor .

3 Determine the weight set

According to the army feedback and expert investigation, the weight of each factor can be determined as follows.

$$A = (0.3, 0.3, 0.2, 0.2)$$

$$A_1 = (0.3, 0.2, 0.15, 0.15, 0.2)$$

$$A_2 = (0.3, 0.2, 0.15, 0.15, 0.2)$$

$$A_3 = (0.2, 0.2, 0.3, 0.3)$$

$$A_4 = (0.25, 0.25, 0.25, 0.25)$$

4 Establish fuzzy evaluation matrix

Let R denote evaluation set, B denote vector of grade of membership.

$$R = (R_1, R_2, R_3, R_4), \quad R_n = (r_{n1}, r_{n2}, r_{n3}, r_{n4})$$

$$B_n = A_n \circ R_n = (A_{n1}, A_{n2}, A_{n3}, A_{n4}) \circ \begin{pmatrix} r_{11} & r_{12} & \cdot & \cdot & \cdot & r_{1j} \\ r_{21} & r_{22} & \cdot & \cdot & \cdot & r_{2j} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ r_{m1} & r_{m2} & \cdot & \cdot & \cdot & r_{mj} \end{pmatrix} = (b_{n1}, b_{n2}, \dots, b_{nm})$$

$$B = A \circ R = (A_1, A_2, \dots, A_m) \circ \begin{pmatrix} r_{11} & r_{12} & \cdot & \cdot & \cdot & r_{1j} \\ r_{21} & r_{22} & \cdot & \cdot & \cdot & r_{2j} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ r_{m1} & r_{m2} & \cdot & \cdot & \cdot & r_{mj} \end{pmatrix} = (b_1, b_2, \dots, b_m)$$

According to the principle of maximum membership, adaptability evaluation can be obtained. For the same criteria of national defense students, operators

$$M (\bullet \oplus)$$

can be used and which will generate fuzzy evaluation.

$$s_k = \min \left(1, \sum_{j=1}^m A_j r_{jk} \right), k = 1, 2, \dots, n$$

For the upcoming graduation of a national defense student, the judging panel is composed of 20 teachers and classmates, and the data are shown in Table II.

Table 2. The Evaluation Table of Adaptability

First-grade index	Second-grade index	Evaluation			
		Outstanding	Good	General	Poor
Ideological and political quality U1	Absolute loyalty quality U11	0.4	0.3	0.3	0
	Revolutionary ideals and beliefs U12	0.3	0.2	0.5	0
	Patriotism spirit U13	0.5	0.4	0.1	0
	Collective spirit U14	0.2	0.2	0.6	0
	Professional dedication spirit U15	0.3	0.3	0.3	0.1
Comprehensive quality U2	Management ability U21	0.2	0.7	0.1	0
	Organizational ability U22	0.1	0.3	0.4	0.2
	Coordination ability U23	0.4	0.4	0.2	0
	Expression ability U24	0	0.2	0.8	0
	Military writing ability U25	0.5	0.2	0.3	0
Professional quality U3	Sturdy basic knowledge U31	0.5	0.3	0.1	0.1
	A wealth of knowledge structure U32	0.3	0.3	0.3	0.1
	Familiar with professional	0.5	0.3	0.2	0

	skills U33				
	Frontier professional insight U34	0.6	0.2	0.2	0
Physical and mental qualities U4	Thrifty physique U41	0.1	0.2	0.4	0.3
	Healthy psychology U42	0.8	0.2	0	0
	Physical stamina tough U43	0.6	0.2	0.2	0
	Excellent military skills U44	0.3	0.3	0.2	0.2

First, each sub-set of fuzzy comprehensive evaluation factor calculation yields:

$$B_1 = A_1 \circ R_1 = (0.345, 0.28, 0.355, 0.02)$$

$$B_2 = A_2 \circ R_2 = (0.24, 0.4, 0.32, 0.04)$$

$$B_3 = A_3 \circ R_3 = (0.49, 0.27, 0.20, 0.04)$$

$$B_4 = A_4 \circ R_4 = (0.45, 0.225, 0.2, 0.125)$$

$$B = A \circ R = (0.3635, 0.303, 0.2825, 0.051)$$

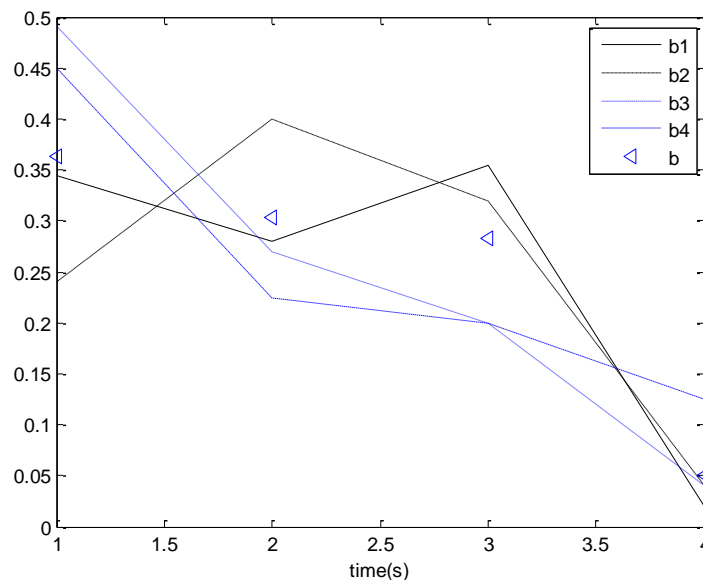


Figure 1. Evaluation of Adaptability

They are shown in Figure 1. According to the principle of maximum membership, the adaptability of the student is excellent, his ideological and political quality, professional quality, physical and mental qualities are excellent; the overall quality is good, coincidences with the actual situation.

5. Conclusion

Based on fuzzy model, to evaluate and analysis the adaptive ability of national defense students, a fuzzy comprehensive evaluation model is established, which consists of four first-grade indices and eighteen second-grade indices. A numerical example is given to show the feasibility of this research method. The result shows that the method meets the practical requirements of fuzzy evaluation.

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