



Research Article

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## An improved evaluation approach to PE teachers using ELECTRE III method

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### ABSTRACT

*The evaluation of PE Teachers belongs to the multi-attribute decision-making problem. For this reason, an improved evaluation approach is proposed to PE teachers using ELECTRE III method. The example suggests that this proposed approach is effective and feasible.*

**Key words:** Evaluation Approach, PE Teachers, ELECTRE III Method

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### INTRODUCTION

The evaluation of PE Teachers belongs to the multi-attribute decision-making problem. The multi-attribute decision-making method is widely applied into engineering system, social system and economic system, and it is a very active branch in researches of decision-making science, system engineering, management science and operations research [1].

There are a variety of teacher evaluation methods. Based on the research status at home and abroad, there has not been a very perfect and non-controversial evaluation system, which will promote the development of evaluation theory to a certain extent. For this reason, an improved evaluation approach is proposed to PE teachers using ELECTRE III method. ELECTRE III method is a generally applied system decision-making method [2-4]. This method uses threshold function to form consistent and inconsistent priority matrixes through pairwise comparison of plans and then structure reliability matrixes.

Compared with AHP, SMART, DEA and other methods, ELECTRE III method is an incomplete compensatory (alternative) method. In other words, high scores of plans under some evaluation indexes fail to make up the deficiency of low scores under other evaluation indexes [2]. Therefore, evaluation results obtained with ELECTRE III method comply with actual conditions in a better way. The theoretical basis of ELECTRE III method is rigorous, but the processing process is quite complicated. The sorting process is the most complicated link. Moreover, evaluation results always sort only some of options [5].

### EVALUATION INDEX SYSTEM

Based on the multi-objective and multi-criterion analysis principle, this paper will establish a three-tiered judgment matrix evaluation system for PE teachers. The system contains seven evaluation indicators such as basic literacy, classroom teaching, teaching and research, sports competition, group activities, honors and rewards and academic writings. The first six ones are regarded as first-grade indicators according to which the second-grade and third-grade indicators are set, and academic writings are set as an independent single evaluation item.

(1) Basic Literacy. The 21<sup>st</sup> century has set newer and higher demands on talents training. As educators, PE teachers should learn new knowledge and methods actively and consciously to keep pace with the times. Besides, morality should be put first in teaching, so PE teachers should continuously raise their own ideological and moral level, im-

prove vocational ethics, enhance personality and ability and improve their psychological ability. They should develop multi-layer ethical education activities through scientific teaching methods to work on cultivating more high-level persons that meet the social development for our country. Its secondary indicators mainly contain ideological morality quality, vocational ethics quality, knowledge and comprehensive quality, personality and ability, psychological ability et al.

(2) Classroom Teaching. This indicator shows that the main responsibility of teachers is to impart knowledge and cultivate people. To make a good performance in each lesson is the pursuit of each conscientious teacher, so the evaluation on classroom teaching is an important means to promoting the development of students and teachers' profession and improving the quality of classroom teaching. As a result, it has become the basic element of modern teaching to make an effective and scientific classroom teaching evaluation. It is not only the precondition of a successful teaching, but also the foundation of different education decisions. The classroom teaching of PE teachers is the key part of their teaching activities and its secondary indicators mainly contain teaching objective, teaching quality, teaching process and teaching effect.

(3) Teaching and Research. The evaluation on the teaching and research of PE teachers in this system is an important means to improving the quality of sports teaching. It can effectively raise the whole teaching level of PE teachers, thus set as the first-grade evaluation indicator with such secondary evaluation contents as teaching and research ability, teaching and research achievements et al.

(4) Sports Competition. Sports competition is an important feature of physical education, also a means to embodying a school's honor. It is a kind of competition played according to certain rules between persons or groups in their physical strength, skills or mentality, with sports items as contents and fighting for the win as the direct goal. It can effectively realize physical education objective through carrying out sports competition widely. As a first-grade evaluation indicator, its secondary evaluation contents mainly contain teaching training, participation, awards, et al.

(5) Group Activities. Group activities here refer to physical activities carried out in the university which take students as the main object and natural environment and sports facilities in the university as the material basis. It is a kind of conscious organized social activity that can enrich the campus cultural life and promote the campus civilization construction. As professional talents in group activities, PE teachers have played the key role in planning, organizing and implementing campus activities. Its secondary evaluation contents contain organization and implementation of group activities et al.

(6) Honors and Rewards. Winning honors and rewards itself is a kind of evaluation on teachers. As the credit and praise of some social group for the moral behavior of teachers, honors and rewards are special, qualitative and active evaluation of special organizations on special persons. As one evaluation indicator of the PE teacher evaluation system, it will make contributions to encouraging PE teachers to work more actively for physical education, and its main evaluation contents contain awards items, levels and effect et al.

(7) Academic Writings. Academic writings refer to theoretical articles describing research achievements obtained during the research on academic problems in some scientific field. They are a significant symbol to measure the academic level and research ability of teachers. The relevant evaluation contents contain academic paper contents, level and achievements et al.

### THE IMPROVED ELECTRE III METHOD

In order to sort options, it needs to establish precedence relations. If the decision-making issue  $I = \{K, C, W, G, U\}$  faced ELECTRE III method  $K = \{k_i | i = 1, 2, \dots, n\}$  is made as option;  $C = \{c_i | i = 1, 2, \dots, m\}$  as decision-making index set;  $W = \{w_i | i = 1, 2, \dots, m\}$  as evaluation index weight set;  $G = \{g_i | i = 1, 2, \dots, m\}$  as evaluation index function set;  $\forall a \in K, g_j(a)$  as the evaluation value of Plan  $a$  under the evaluation index  $c_j$ ;  $U = \{u_i | i = 1, 2, \dots, h\}$  as decision maker preference structure set; and  $h$  as the number of decision maker.  $Q = \{q_i | i = 1, 2, \dots, m\}$  stands for difference-free threshold friction set of various indexes in the ELECTRE III;  $P = \{p_i | i = 1, 2, \dots, m\}$  as preference threshold friction set of various indexes in the ELECTRE III-I;  $V = \{v_i | i = 1, 2, \dots, m\}$  as veto threshold friction set of various indexes in the ELECTRE III. Any two options  $a$  and  $b$  are defined as follows:

(1) Consistent priority matrix  $C$ . The consistent priority index  $C(a, b)$  stands for the degree of Plan  $a$  superior than

Plan  $b$ . All consistent priority indexes constitute consistent priority matrix. Its size is defined as follows.

$$C(a, b) = \frac{1}{w} \sum_{j=1}^m w_j c_j(a, b)$$

Where

$$w = \sum_{j=1}^m w_j$$

$$c_j(a, b) = \begin{cases} 1, & g_j(a) + q_j(g_j(a)) \geq g_j(b) \\ 0, & g_j(a) + p_j(g_j(a)) \leq g_j(b) \\ \frac{p_j(g_j(a)) + g_j(a) - g_j(b)}{p_j(g_j(a)) - q_j(g_j(a))}, & \text{other} \end{cases}$$

(2) Inconsistent priority matrix  $D$ . The inconsistent priority index  $d_j(a, b)$  stands for the degree of Plan  $a$  inferior to Plan  $b$  (the definition of this index can eliminate alternative defect of options under different indexes). All inconsistent priority indexes constitute inconsistent priority matrix. Its size is defined as follows.

$$d_j(a, b) = \begin{cases} 1, & g_j(a) + p_j g_j(a) \geq g_j(b) \\ 0, & g_j(a) + v_j g_j(a) \leq g_j(b) \\ \frac{g_j(a) - g_j(b) - p_j(g_j(a))}{v_j g_j(a) - p_j g_j(a)} \end{cases}$$

(3) Reliability matrix  $S$ . The reliability index  $s(a, b)$  stands for the reliability degree of Plan  $a$  inferior to Plan  $b$ . All reliability indexes constitute consistent reliability matrix. Its size is defined as follows.

$$s(a, b) = \begin{cases} C(a, b), & d_j(a, b) \leq C(a, b), \forall j \\ C(a, b) \prod_{j \in J(a, b)} \frac{1 - d_j(a, b)}{1 - C(a, b)}, & J(a, b) \end{cases}$$

Wherein,  $J(a, b)$  indicates the index set of  $d_j(a, b) > C(a, b)$ .

Options are subject to partial sorting with ELECTRE III method through a complicated distillation algorithm by utilizing the information in the reliability matrix. This sorting process needs additional introduction of threshold value, further increasing decision makers' use difficulty.

A simplified and reliable sort algorithm is provided for ELECTRE III method by introducing three concepts of consistent reliability, inconsistent reliability and net reliability. The consistent reliability is used to describe the degree of Plan  $a$  superior than other plans. Its size is defined as follows.

$$\Phi^+(a) = \sum_{b \in K} s(a, b), \quad \forall a \in K$$

The inconsistent reliability  $\Phi^-(a)$  is used to describe the degree of other plans superior than Plan  $a$ . Its size is defined as follows.

$$\Phi^{-}(a) = \sum_{b \in K} s(b, a), \quad \forall a \in K$$

The net reliability  $\Phi(a)$  is the difference between consistent reliability and inconsistent reliability. Its size is defined as follows.

$$\Phi(a) = \Phi^{+}(a) - \Phi^{-}(a), \quad \forall a \in K$$

Options can be fully sorted according to the size of net reliability  $\Phi(a)$ .

### EXPERIMENTAL RESULTS

Consistent reliability, inconsistent reliability and net reliability of options can be obtained according to the reliability matrix  $S_1$ , as shown in Table 1.

Table 1 Reliabilities ( $S_1$ ) of various Plans

	$\Phi^{+}$	$\Phi^{-}$	$\Phi$
PE 1	4.9	4.9	0
PE 2	5.6	4.4	1.2
PE 3	5.6	4.5	1.1
PE 4	5.3	4.8	0.5
PE 5	5.6	4.6	1
PE 6	5.3	4.4	0.9
PE 7	0.7	5.4	-4.7

The sort results of improved ELECTRE III method are obtained according to the net reliability: (“ $a \rightarrow b$ ” indicates that  $a$  is superior to  $b$ )

$$PE2 \rightarrow PE3 \rightarrow PE5 \rightarrow PE6 \rightarrow PE4 \rightarrow PE1 \rightarrow PE7$$

The sort results of standard ELECTRE III method are shown as follows.

$$\{PE2, PE3, PE5\} \rightarrow \{PE1, PE6\} \rightarrow \{PE4, PE7\}$$

According to the comparison of sort results, it is obviously shown that the improved ELECTRE III-I change some sorting of the standard ELECTRE III into full sorting, which is more convenient for decision makers to compare options and make decisions.

### CONCLUSION

Main contributions of this paper include: an improved evaluation approach is proposed to PE teachers using ELECTRE III method. The example suggests that this proposed approach is effective and feasible.

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