FUZZY EVALUATION ON TEACHING ABILITY AND TEACHING LEVEL OF PHYSICAL TEACHERS

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1. PREFACE

Improving physical teaching quality presupposes the heightening quality of training sports talents. It is the critical link to evaluate the teacuers' ability and level for the administration of physical teaching quality. This kind of evaluation has been existing for a long time, but it has become a difficult problem unsolved, because it only determines its nature and can't have its fixed quantity or lacks the identical evaluating standard. Based on plenty of investigation and research, the writer has preliminarily founded a more scientific index system and a mathematical modal for the synthetic evaluation according to the comprehensive critical methods of Fuzzy Integral. In the light of his own working distinguishing feature, he is trying, applying the mathematical theory of modern times, to explore avenues which could give a fixed quantity to the comprehensive evaluation on physical teaching ability and teaching level.

2. BASIC PRINCIPLE AND MATHEMATICAL MODAL

Fuzzy Integral is put forward by Sugeno, a Japanese scholar, So, it's also called Sugeno Integral. Its definition is:

Suppose U is the universe of discouse.

Suppose Π is U's Λ -- measurable function, we call

$$\int_U h(x)\circ\Pi(\cdot)=\bigvee_{\lambda\in[0,1]}\quad(\lambda\wedge\Pi(H_\lambda))$$

as, to U, Π's Fuzzy Integral.

Clearly, suppose M is the induced set of m, the possible measure. If h is U's -- measurable function, then,

$$\int_U h(x)\circ m(\cdot)=h\circ M=\bigvee\{\lambda\in[0,1]:H_\lambda\cap M_\lambda\neq\phi\}$$

The latter explains the meaning of Fuzzy Integral. That is to say, $\int_U h(x)\circ\Pi(\cdot)$ is the highest level of the point H_λ and M_λ crossed. It indicates the cross possibility to both H and M. We also can say that its integral value expresses H's degree which is keeping with M.

By applying Fuzzy Integral, we can form a comprehensive evaluating modal, according to the relation between Fuzzy Integral and Inner Product from which the modal can be drawn out completely and directly.

Suppose $X=\{x_1,x_2,\cdots,x_n\}$ is the element set which are formed by several elements. P(X) is X's reserved field and gives X's vector,

$$M=(m_1,\ m_2,\ \ldots,\ m_n),$$

to every state of $H\in F(X)$ in X,

$$H=(h_1,\ h_2,\ \ldots,\ h_n),$$

H's comprehensive evaluation to M is :

$$\int_X H(x)\circ\Pi(\cdot)=H\circ M=\bigvee_{K=1}^{n}(h_K\wedge m_K)$$

Here, Π indicates P(X)'s possible measure drawn from M. Suppose the fuzzy vector M -- possible measure, is definite. We have judges, m ones. They would give an individual evaluation to the selected object A.

$$H_j = (h_{j1}, h_{j2}, \cdots, h_{jn}) \in F(X) \quad (j = 1, 2, \cdots, m)$$

is the judge j's satisfied evaluation to A.

To the definite element $x_i \in X$, we can take

$$H_1(x_i) = h_{1i}, \ H_2(x_i) = h_{2i}, \cdots, \ H_m(x_i) = h_{mi}$$

as m's sample value from X_i's total capacity. X_i indicates A's stochastic variable of the element X_i's objective evaluation. Based on the Strong Law of Large Numbers in Probability Theory, we can get $H \in F(X)$,

$$H = (h_1, h_2, \ldots, h_n)$$

H indicates A's social evaluation of the satisfied degree. We have no way to get H, but we can get m's sample value $H_1, H_2, \ldots, H_m$, which has been given. And we have

$$P\left\{\lim_{m\to\infty} \frac{1}{m}\sum_{j=1}^{m} H_j = H\right\} = 1 \qquad (1)$$

The Convergence Theorem of Fuzzy Integral sequence tells us: to the fuzzy integrable function (H, H_n, n =1,2, ...) of the finite universe of discourse,

if

$$\lim_{n\to\infty} H_n = H$$

then,

$$\lim_{n\to\infty} f_X H_n(x)\circ\Pi(\cdot) = f_X H(x)\circ\Pi(\cdot) \quad (2)$$

If we take E_0 as the real value of the comprehensive evaluation to A and E_j as individual evaluation, we get

$$E_0 = f_X H(X)\circ\Pi(\cdot) = H\circ M$$

$$E_j = f_X H_j(X)\circ\Pi(\ ) = H_j\circ M \quad j = 1,2,\ldots,m$$

When m is very big, we put (1) and (2) together, and according to the Probability Theory 1, we can get

$$f_X \frac{1}{m}\sum_{j=1}^{m} X_j(x)\circ\Pi(\cdot) \cong E_0$$

We call $f_X \frac{1}{m}\sum_{j=1}^{m} H_j(X)\circ\Pi(\cdot)$ as the capacity m's mass evaluation, $\hat{E}(m)$.

3. RESEARCHING METHODS

The main researching methods of this thesis are:

1). to look up the relevant documents on the educational evaluation.

2). to choose Delphi Method which has high reliability and to investigate the physical teachers' main element (or index) and the reliability of their teaching ability and level.

3). the experimental methods of the evaluation below.

(1). Evaluating Objects: 4 teachers of Physical Training Department of Henan University, including 3 vice-professers and 1 lecturer, who take the track and field course for the assistant class of 85'

(2). Evaluating Methods: based on the unified forms and demands, give the index its mark progressively to the 9 students of the course, whose teaching average age is more than 8 years; then do the evaluation and calculation based on the comprehensive evaluating mathematical modal of Fuzzy Integral.

4). Data treatment is done by using the electronic computer Apple Type and BASIC scientific program.

4. RESULT AND ANALYSIS

1). Result

(1). From October, 1985 to June, 1986, we did 3 times to investigate individualy, by examination papers, 128 physical teachers including 28 vice-professers, 1 research fellow 99 lecturers of 24 universities in Shandong, Hebei, Henan, Neimenggu, Hubei, Shanxi, together seven provinces; screened separately the component part of the physical teachers' ability and level; founded the evaluating index system -- Element Set; and according to the formula ($\bar{m}=\frac{1}{n}\sum_{i=1}^{n}m_i$ and $\bar{e}=\frac{1}{n}\sum_{i=1}^{n}e_i$), counted out m and e (to express the reliability e's evaluating value; $\lambda \geqslant 0.75$), its result appears in Form 1:

$$\text{Element Set } X=\{x_1, x_2, \cdots, x_{10}\}$$

Here, x_1 refers to the ability of understanding the outline and applying the text books; x_2 refers to the ability of expressing; x_3 refers to the ability of setting examples; x_4 refers to the ability of teaching organizing; x_5 refers to the ability of making kinds of teaching documents; x_6 refers to the ability of creative thinking; x_7

refers to the ability of teaching research; x_8 refers to the ability of arousing students' learning interests; x_9 refers to the ability of applying the teaching methods and teaching students in accordance with their aptitude; x_{10} refers to the ability of educating.

Form 1

X	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
m	0.78	0.45	0.81	0.89	0.57	0.45	0.58	0.69	0.88	0.67
e	0.90	0.80	0.97	0.88	0.78	0.81	0.77	0.83	0.96	0.91

Based on the investigating results above, we have found a fuzzy vector which could express the possible measure.

$$M=(0.78,\ 0.45,\ 0.81,\ 0.89,\ 0.57,\ 0.45,\ 0.58,\ 0.69,\ 0.88,\ 0.67)$$

(2). After one year's learning, the 9 students evaluated the 4 teachers' ability and level, step by step, according to the index. And now we give a statistical analysis.

For example, the result to Teacher A is:

$$H_1=(0.8,\ 0.9,\ 0.7,\ 0.5,\ 0.8,\ 0.8,\ 0.8,\ 0.5,\ 0.7,\ 0.6)$$

$$H_2=(0.9,\ 0.8,\ 0.8,\ 0.6,\ 0.7,\ 0.8,\ 0.9,\ 0.4,\ 0.6,\ 0.7)$$

$$\vdots$$

$$H_9=(0.8,\ 0.7,\ 0.9,\ 0.5,\ 0.5,\ 0.7,\ 0.9,\ 0.5,\ 0.5,\ 0.6)$$

Its average vector is:

$$\frac{1}{9}\sum_{j=1}^{9} H_j=(0.8,\ 0.8,\ 0.8,\ 0.5,\ 0.7,\ 0.9,\ 0.8,\ 0.5,\ 0.6,\ 0.6)$$

$$\hat{E}(m)=\left(\frac{1}{9}\sum_{j=1}^{9} E_j\right)\circ M$$

$=4.62$ (Note: Use (+ •) operator)

$E_j=(0.9,\ 0.9,\ 0.9,\ 0.7,\ 0.8,\ 0.8,\ 0.9,\ 0.5,\ 0.7,\ 0.7)$

The same, the 4 teachers' calculating results are shown in Form 2.

Form 2

Teacher	E_j										$\hat{E}$ (m)
A	0.9	0.9	0.9	0.7	0.8	0.8	0.9	0.5	0.7	0.7	4.62
B	0.8	0.6	0.9	0.8	0.6	0.6	0.5	0.9	0.9	0.8	4.17
C	0.9	0.8	0.9	0.9	0.7	0.8	0.8	0.6	0.9	0.6	4.58
D	0.8	0.6	0.7	0.7	0.7	0.6	0.7	0.7	0.6	0.6	3.61

2), Analysis

From Form 2, we can see:

(1). From the comprehensive evaluating in group, Teacher A's ability and level are the highest of the four; Teacher C takes the second place; Teacher B is the third one; and Teacher D is the last.

(2). From the individual evaluation, the three (A,B,C), c-losed to the result of the evaluation in group, have their own characteristics. A and C, for instance, their ability and level are very closed to each other. But the students are more satisfied with A than with C in 4 aspects (x_1, x_5, x_7, x_{10}). A's marks are lower than C in 3 aspects (x_4, x_8, x_9

). And they got the same mark in the left 3 aspects (x_1, x_3, x_6). So, A's ability of researching, language expressing and applying educational elements in teaching are better than C. But in the ability of researching the teaching documents and methods, C's ability is higher than A's.

(3). From the evaluating results of this method, the best in group may not be the best in individual. From the individual evaluating, we can find much more **different** characteristics in teachers' teaching ability. By using this, we can instruct the teachers' teaching and professional training ahead.

5. CONCLUSION

1). In view of the complex nature and conceptional fuzzy property of the organization of "Sports Teaching Ability and Teaching Level", it is feasible for the evaluation to apply the comprehensive evaluating method of Fuzzy Integral.

2). This method is of wide use value. You will feel very satisfied if you use it in selecting athletes, in deciding athletic events, in comparing athletic level, etc.

3). We can have a fully use of information to do evaluation in group, "+•"Operation. It is not the only way for the individual evaluation to use "$\vee\wedge$" operator.

4). To the evaluating results, we can use a suitable treatment (e.g. method of lines). We should divide the staff who will be evaluated into several kinds in order to provide basis for the department and school evaluation. But during the process of the treatment, there should be a sliding cross region in the cross point among grades.To those between the cross value, we should adopt a prudrnt policy.

Reference

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