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Model for evaluating the physical education teaching effectiveness of the higher colleges and universities with intuitionistic fuzzy information

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ABSTRACT

Evaluation of physical classroom teaching and learning activities throughout every aspect, to improve teaching effectiveness truly, it should be to make good use of classroom evaluation mechanism, give full play to evaluate incentives. We should grasp the psychology of students to evaluate the shock study; use and develop evaluation methods and tools to evaluate the Guidance creatively; evaluation of the content of expression common to evaluate and promote study; evaluation should reflect the interest in learning, the process of participation in sports civilization, mental health, sports performance and other aspects, seeks to evaluate the student's role play. In this paper, we investigate the multiple attribute decision making problems for evaluating the physical education teaching effectiveness of the higher colleges and universities with intuitionistic fuzzy information. We utilize the intuitionistic fuzzy Einstein weighted average (IFEWA) operator to aggregate the intuitionistic fuzzy information corresponding to each alternative and get the overall value of the alternatives, then rank the alternatives and select the most desirable one(s) according to the score function and accuracy function of the overall value of the alternatives. Finally, an illustrative example for evaluating the physical education teaching effectiveness of the higher colleges and universities with intuitionistic fuzzy information is given.

KEYWORDS

Multiple attribute decision-making (MADM); Intuitionistic fuzzy numbers; Intuitionistic fuzzy einstein weighted average (IFEWA) operator; Teaching effectiveness.

INTRODUCTION

With a new round of smooth reform process of elementary education, the ideology and model of physical education (PE) have also been greatly changed in our country. So, new PE evaluation system is badly needed to cope with this change. Moreover, the contradiction of education theory and practice should be solved quickly in order to guarantee and also put forward the reform process of the PE. Guided by the pedagogy, evaluation study and physical education theory, by mixing the theory with empirical data, this paper aims at pointing out the main features and intrinsic laws of PE evaluation, putting forward the theoretical foundation of constructing the PE evaluation system, establishing the content and comparative importance of the indexes of PE evaluation system, designing PE evaluation plan, proposing possible solution for its practical problems from both theory and practice. Under the guideline of pedagogy and evaluation study, this paper not only makes definition about evaluation, evaluation of education and PE evaluation, but also describes their logical relationships. So that the main features and intrinsic laws of the PE evaluation are revealed. After reviewing the development and reforms of the PE evaluation in and abroad, analyzing and summing up the research status quo of the scholars in and abroad, and re-recognizing and analyzing the evaluation practice of PE according to the previous research achievement, this paper discloses the position of PE evaluation in the education evaluation practice. And it is the theoretical foundation for this research paper. What's more, advantages and disadvantages in our PE evaluation are founded, so that possible strategies are proposed to solve these problems. Establish evaluation system and system of evaluation index. The feasibility and physical education evaluation system is proved and practiced based on the analysis of the theories and reality of the PE evaluation. Some methods used by the United States and Japan should learn from. For example, they make more detailed evaluation, expanding the scope of evaluation and focus on the evaluation of the overall capacity and the arrival of target evaluation. it also founding that the overall trend of the research is gradually thinning from analyzing the study of the domestic scholars, because the evaluation of PE will loss its specific guidance if they merely focus on the theoretical research or the macroeconomic research. The goal-achieving theory was still the main basis of sports teaching appraisal in the present stage. The appraisal theory and the method which by the Taylor behavior-goal theory, the Broome goal-taxonomy theory and the theory our new curriculum initiate should become the main basis of the sports teaching-appraisal theory in the present stage, this article which take our country sports teaching-appraisal situation investigation as the fact basis proposed and constructs the basic skeleton of sports teaching-appraisal system which have the instruction significance to straightens out the essential factor of the teaching appraisal work. Schools have provided favorable conditions for the reform of physical education (PE) evaluation. The research shows that notable results have been made in the reform of physical education evaluation. PE teachers fully understand the function and significance of physical education evaluation, and identify themselves with the diversification of evaluation subject, evaluation content, and evaluation methods. However, there are some problems, teachers still use end-up method to make evaluation, and the issue of multivariable evaluation can't be carried out properly. At present, the reform of PE courses has made some progress. Students increasingly realize the importance of PE, rightly understand the significance of PE study evaluation and teacher evaluation, and consciously participate in the study evaluation, all of which show that they are positive to the PE teaching evaluation reform in schools. That is the gradual relationship from the evaluation at the macro level, education evaluation to the evaluation at the macro level and the micro PE evaluation. The macro-evaluation is based on the micro-evaluation. PE evaluation belongs to micro-evaluation. Whether the choice of targets or methods, it should be specific, clear, simple and easy to operate. Therefore, it must distinguish between the macro-evaluation and PE evaluation, Because of the level of inconsistency, the evaluation activities should be differentiated. The new establishment sports teaching-appraisal target system has the operating characteristic. The appraisal-argot system for student sports study and the appraisal-argot system for teacher teaching and its assignment which is established through Delphi method and the level-analytic method, each target may decompose three; it presents the more and more thinner tendency and has provided the condition for the teaching-appraisal operation. The indexes of the system are independent as well as correlated. The sequence of the students' PE (physical education) study indexes is as followed: sentimental attitude, technology and skill, physical health and the cognition of knowledge, whereas that of the teachers' teaching evaluation indexes is: process of teaching, effect of teaching, preparation and evaluation of teaching. As is shown above, the list of evaluation indexes indicates a kind of logical relation[1-6].

In this paper, we investigate the multiple attribute decision making problems for evaluating the physical education teaching effectiveness of the higher colleges and universities with intuitionistic fuzzy information. We utilize the intuitionistic fuzzy Einstein weighted average (IFEWA) operator to aggregate the intuitionistic fuzzy information corresponding to each alternative and get the overall value of the alternatives, then rank the alternatives and select the most desirable one(s) according to the score function and accuracy function of the overall value of the alternatives. The remainder of this paper is set out as follows. In the next section, we introduce some basic concepts related to intuitionistic fuzzy sets. In Section 3 we introduce the MADM problem deal with evaluating physical education teaching effectiveness of the higher colleges and universities with intuitionistic fuzzy information. We utilize intuitionistic fuzzy Einstein weighted average (IFEWA) operator to aggregate the intuitionistic fuzzy information corresponding to each alternative, and then rank the alternatives and select the most desirable one(s). In Section 4, an illustrative example is pointed out. In Section 5 we conclude the paper and give some remarks.

PRELIMINARIES

Based on the intuitionistic fuzzy sets[7-10], Xu &Yager[11] and Xu[12] gave some intuitionistic fuzzy aggregation operators as listed below:

For a collection of IFVs $\tilde{a}_j = (\mu_j, \nu_j)(j = 1,2,\cdots,n)$, then

(1) The intuitionistic fuzzy weighted averaging (IFWA) operator[12]:

$$\mathrm{IFWA}_\omega(\tilde{a}_1, \tilde{a}_2, \cdots, \tilde{a}_n) = \bigoplus_{j=1}^{n}(\omega_j \tilde{a}_j) = \left(1 - \prod_{j=1}^{n}(1-\mu_j)^{\omega_j}, \prod_{j=1}^{n}\nu_j^{\omega_j}\right) \quad (1)$$

Where $\omega = (\omega_1, \omega_2, \cdots, \omega_n)^T$ be the weight vector of $\tilde{a}_j (j = 1,2,\cdots,n)$, and $\omega_j > 0$, $\sum_{j=1}^{n}\omega_j = 1$.

(2) The intuitionistic fuzzy weighted geometric (IFWG) operator[11]:

$$\mathrm{IFWG}_\omega(\tilde{a}_1, \tilde{a}_2, \cdots, \tilde{a}_n) = \bigotimes_{j=1}^{n}(\tilde{a}_j)^{\omega_j} = \left(\prod_{j=1}^{n}\mu_j^{\omega_j}, 1 - \prod_{j=1}^{n}(1-\nu_j)^{\omega_j}\right) \quad (2)$$

Where $\omega = (\omega_1, \omega_2, \cdots, \omega_n)^T$ be the weight vector of $\tilde{a}_j (j = 1,2,\cdots,n)$, and $\omega_j > 0$, $\sum_{j=1}^{n}\omega_j = 1$.

(3) The intuitionistic fuzzy ordered weighted averaging (IFOWA) operator[12]:

$$\mathrm{IFOWA}_w(\tilde{a}_1, \tilde{a}_2, \cdots, \tilde{a}_n) = \bigoplus_{j=1}^{n}(w_j \tilde{a}_{\sigma(j)}) = \left(1 - \prod_{j=1}^{n}(1-\mu_{\sigma(j)})^{w_j}, \prod_{j=1}^{n}\nu_{\sigma(j)}^{w_j}\right) \quad (3)$$

Where $(\sigma(1), \sigma(2), \cdots, \sigma(n))$ is a permutation of $(1,2,\cdots,n)$, such that $\tilde{\alpha}_{\sigma(j-1)} \geq \tilde{\alpha}_{\sigma(j)}$ for all $j = 2,\cdots,n$ and $w = (w_1, w_2, \cdots, w_n)^T$ is the aggregation-associated vector such that $w_j \in [0,1]$, $\sum_{j=1}^{n} w_j = 1$.

(4) The intuitionistic fuzzy ordered weighted geometric (IFOWG) operator[11]:

$$\mathrm{IFOWG}_w(\tilde{a}_1, \tilde{a}_2, \cdots, \tilde{a}_n) = \bigotimes_{j=1}^{n}(\tilde{a}_{\sigma(j)})^{w_j} = \left(\prod_{j=1}^{n}\mu_{\sigma(j)}^{w_j}, 1 - \prod_{j=1}^{n}(1-\nu_{\sigma(j)})^{w_j}\right) \quad (4)$$

Where $(\sigma(1), \sigma(2), \cdots, \sigma(n))$ is a permutation of $(1,2,\cdots,n)$, such that $\tilde{\alpha}_{\sigma(j-1)} \geq \tilde{\alpha}_{\sigma(j)}$ for all $j = 2,\cdots,n$ and $w = (w_1, w_2, \cdots, w_n)^T$ is the aggregation-associated vector such that $w_j \in [0,1]$, $\sum_{j=1}^{n} w_j = 1$.

In the following, we shall introduce the Einstein operations on intuitionistic fuzzy sets and analyze some desirable properties of these operations. Motivated by Einstein operations, let the t-norm T and t-conorm S be Einstein product T" and Einstein sum S" respectively, then the generalised intersection and union on two IFSs A and B become the Einstein product (denoted by $\tilde{a}_1 \otimes_\varepsilon \tilde{a}_2$) and Einstein sum (denoted by $\tilde{a}_1 \oplus_\varepsilon \tilde{a}_2$) on two IVIFSs $\tilde{a}_1$ and $\tilde{a}_2$, respectively, as follows[13-14].

$$\tilde{a}_1 \otimes_\varepsilon \tilde{a}_2 = \left(\frac{\mu_1\mu_2}{1+(1-\mu_1)(1-\mu_2)}, \frac{\nu_1+\nu_2}{1+\nu_1\nu_2}\right) \quad (5)$$

$$\tilde{a}_1 \oplus_\varepsilon \tilde{a}_2 = \left(\frac{\mu_1+\mu_2}{1+\mu_1\mu_2}, \frac{\nu_1\nu_2}{1+(1-\nu_1)(1-\nu_2)}\right) \quad (6)$$

$$\lambda\tilde{a}_1 = \left(\frac{(1+\mu_1)^\lambda - (1-\mu_1)^\lambda}{(1+\mu_1)^\lambda + (1-\mu_1)^\lambda}, \frac{2\nu_1^\lambda}{(2-\nu_1)^\lambda + \nu_1^\lambda}\right), \lambda > 0; \quad (7)$$

$$\left(\tilde{a}_1\right)^{\lambda}=\left(\frac{2\mu_1^{\lambda}}{(2-\mu_1)^{\lambda}+\mu_1^{\lambda}},\frac{\left(1+\nu_1\right)^{\lambda}-\left(1-\nu_1\right)^{\lambda}}{\left(1+\nu_1\right)^{\lambda}+\left(1-\nu_1\right)^{\lambda}}\right),\lambda>0. \quad \textbf{(8)}$$

Definition 4.[13] Let $\tilde{a}_j=\left(\mu_j,\nu_j\right)\left(j=1,2,\cdots,n\right)$ be a collection of intuitionistic fuzzy values, and let IFEWA: $Q^n\to Q$, if

$$\begin{aligned}&\mathrm{IFEWA}_{\omega}\left(\tilde{a}_1,\tilde{a}_2,\cdots,\tilde{a}_n\right)\\&=\overset{n}{\underset{j=1}{\oplus_{\varepsilon}}}\left(\omega_j\tilde{a}_j\right)\\&=\left(\frac{\prod_{j=1}^{n}\left(1+\mu_j\right)^{\omega_j}-\prod_{j=1}^{n}\left(1-\mu_j\right)^{\omega_j}}{\prod_{j=1}^{n}\left(1+\mu_j\right)^{\omega_j}+\prod_{j=1}^{n}\left(1-\mu_j\right)^{\omega_j}},\frac{2\prod_{j=1}^{n}{\nu_j}^{\omega_j}}{\prod_{j=1}^{n}\left(2-\nu_j\right)^{\omega_j}+\prod_{j=1}^{n}{\nu_j}^{\omega_j}}\right)\end{aligned} \quad \textbf{(9)}$$

Where $\omega=\left(\omega_1,\omega_2,\cdots,\omega_n\right)^T$ be the weight vector of $\tilde{a}_j\left(j=1,2,\cdots,n\right)$, and $\omega_j>0$, $\sum_{j=1}^{n}\omega_j=1$, then IFEWA is called the intuitionistic fuzzy Einstein weighted averaging (IFEWA) operator.

It can be easily proved that the IFEWA operator has the following properties[13].

Theorem 1. (Idempotency) If all $\tilde{a}_j\left(j=1,2,\cdots,n\right)$ are equal, i.e. $\tilde{a}_j=\tilde{a}$ for all j, then

$$\mathrm{IFEWA}_{\omega}\left(\tilde{a}_1,\tilde{a}_2,\cdots,\tilde{a}_n\right)=\tilde{a} \quad \textbf{(10)}$$

Theorem 2. (Boundedness) Let $\tilde{a}_j\left(j=1,2,\cdots,n\right)$ be a collection of IFVN, and let

$$\tilde{a}^{-}=\min_j\tilde{a}_j,\ \tilde{a}^{+}=\max_j\tilde{a}_j$$

Then

$$\tilde{a}^{-}\le\mathrm{IFEWA}_{\omega}\left(\tilde{a}_1,\tilde{a}_2,\cdots,\tilde{a}_n\right)\le\tilde{a}^{+} \quad \textbf{(11)}$$

Theorem 3. (Monotonicity) Let $\tilde{a}_j\left(j=1,2,\cdots,n\right)$ and $\tilde{a}'_j\left(j=1,2,\cdots,n\right)$ be two set of IFVNs, if $\tilde{a}_j\le\tilde{a}'_j$, for all j, then

$$\mathrm{IFEWA}_{\omega}\left(\tilde{a}_1,\tilde{a}_2,\cdots,\tilde{a}_n\right)\le\mathrm{IFEWA}_{\omega}\left(\tilde{a}'_1,\tilde{a}'_2,\cdots,\tilde{a}'_n\right) \quad \textbf{(12)}$$

MODEL FOR EVALUATING THE PHYSICAL EDUCATION TEACHING EFFECTIVENESS OF THE HIGHER COLLEGES AND UNIVERSITIES WITH INTUITIONISTIC FUZZY INFORMATION

Let $T=\left\{S_1,S_2,\cdots,S_m\right\}$ be a discrete set of schools. Let $G=\left\{G_1,G_2,\cdots,G_n\right\}$ be a set of attributes. The information about attribute weights is completely known. Let $\omega=\left(\omega_1,\omega_2,\cdots,\omega_n\right)$ be the weight vector of attributes, Where $\omega_j\ge0$, $j=1,2,\cdots,n$. Suppose that $\tilde{R}=\left(\tilde{r}_{ij}\right)_{n\times m}=\left(\mu_{ij},\nu_{ij}\right)_{n\times m}$ is the intuitionistic fuzzy decision matrix, where μ_{ij} indicates the degree that the alternative A_i satisfies the attribute G_j given by the decision maker, ν_{ij} indicates the degree that the alternative A_i doesn't satisfy the attribute G_j given by the decision maker D_k, $\mu_{ij}\subset\left[0,1\right]$, $\nu_{ij}\subset\left[0,1\right]$, $\mu_{ij}+\nu_{ij}\le1$, $i=1,2,\cdots,m$, $j=1,2,\cdots,n$, $k=1,2,\cdots,t$.

In the following, we apply the IFEWA operator to MADM for for evaluating the physical education teaching effectiveness of the higher colleges and universities with intuitionistic fuzzy information.

Step 1. Utilize the decision information given in matrix $\tilde{R}$, and the IFEWA operator

$$\tilde{r}_i=\left(\mu_i,\nu_i\right)=\text{IFEWA}_\omega\left(\tilde{r}_{i1},\tilde{r}_{i2},\cdots,\tilde{r}_{in}\right),\ i=1,2,\cdots,m. \quad \textbf{(13)}$$

to derive the collective overall preference values $\tilde{r}_i\left(i=1,2,\cdots,m\right)$ of the alternative S_i,where $\omega=\left(\omega_1,\omega_2,\cdots,\omega_n\right)^T$ is the weighting vector of the attributes.

Step 2. Calculate the scores $S\left(\tilde{r}_i\right)\left(i=1,2,\cdots,m\right)$ of the collective overall intuitionistic fuzzy preference values $\tilde{r}_i\left(i=1,2,\cdots,m\right)$ to rank all the alternatives $S_i\left(i=1,2,\cdots,m\right)$ and then to select the best one(s).

Step 3. Rank all the schools $S_i\left(i=1,2,\cdots,m\right)$ and select the best one(s) in accordance with $S\left(\tilde{r}_i\right)$ and $H\left(\tilde{r}_i\right)$ $\left(i=1,2,\cdots,m\right)$.

Step 4. End.

NUMERICAL EXAMPLE

Sporting interest means that students actively engaged the mental tendencies of priority to study or exercise. Sporting interest has an important effect in teaching effect, show that: Redirection function; Strengthen function, and have the positive effect of creative for sports activities. We can start from the following aspects for foster sports interest in gymnastic opening classes, definite purpose in learning sports, improved physical teaching content and methods; improved physical teaching content and methods. We must teaching students in accordance with their aptitude; Adapt "Happy sport mode of teaching". There is a panel with five possible college public physical schools $A_i\left(i=1,2,3,4,5\right)$ to select. The experts select four attribute to evaluate the five college public physical schools: (1)G_1 is the environment of teaching and studying; (2)G_2 is the management of teaching information; (3)G_3 is the curriculum design and target; (4)G_4 is the empathy and the teaching practice. The five possible college public physical schools $A_i\left(i=1,2,3,4,5\right)$ are to be evaluated using the intuitionistic fuzzy information by the decision maker under the above four attributes whose weighting vector $\omega=\left(0.20,0.40,0.10,0.30\right)^T$), as listed in the following matrix.

$$\tilde{\boldsymbol{A}}=\begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \\ A_4 \\ A_5 \end{array}\begin{array}{c} \begin{array}{cccc} G_1 & G_2 & G_3 & G_4 \end{array} \\ \begin{bmatrix} (0.3,0.7) & (0.4,0.2) & (0.6,0.2) & (0.4,0.3) \\ (0.3,0.2) & (0.5,0.4) & (0.3,0.4) & (0.2,0.6) \\ (0.2,0.6) & (0.3,0.2) & (0.7,0.2) & (0.4,0.6) \\ (0.4,0.5) & (0.7,0.3) & (0.3,0.6) & (0.3,0.5) \\ (0.3,0.6) & (0.4,0.6) & (0.5,0.5) & (0.6,0.2) \end{bmatrix} \end{array}$$

Then, we utilize the approach developed to evaluate physical education teaching effectiveness of the higher colleges and universities in order to select the best college public physical school.

Step 1. Utilize the IFEWA operator, we obtain the collective overall preference values $\tilde{r}_i$ of the college public physical schools $A_i\left(i=1,2,3,4,5\right)$.

$$\tilde{r}_1=\left(0.365,0.412\right),\tilde{r}_2=\left(0.415,0.378\right),\tilde{r}_3=\left(0.459,0.341\right)$$
$$\tilde{r}_4=\left(0.572,0.325\right),\tilde{r}_5=\left(0.453,0.276\right)$$

Step 2. Calculate the scores $S\left(\tilde{r}_i\right)\left(i=1,2,3,4,5\right)$ of the overall intuitionistic fuzzy values $\tilde{r}_i\left(i=1,2,3,4,5\right)$

$S(\tilde{r}_1) = -0.047, S(\tilde{r}_2) = 0.284, S(\tilde{r}_3) = 0.118$

$S(\tilde{r}_4) = 0.247, S(\tilde{r}_5) = 0.177$

Step 3. Rank all the college public physical schools $A_i\ (i = 1,2,3,4,5)$ in accordance with the scores $S(\tilde{r}_i)$ $(i = 1,2,3,4,5)$ of the overall intuitionistic fuzzy values $\tilde{r}_i\ (i = 1,2,3,4,5)$: $A_2 \succ A_4 \succ A_5 \succ A_3 \succ A_1$, and thus the most desirable college public physical school is A_2.

CONCLUSION

Evaluation of physical classroom teaching and learning activities throughout every aspect, to improve teaching effectiveness truly, it should be to make good use of classroom evaluation mechanism, give full play to evaluate incentives. We should grasp the psychology of students to evaluate the shock study; use and develop evaluation methods and tools to evaluate the Guidance creatively; evaluation of the content of expression common to evaluate and promote study; evaluation should reflect the interest in learning, the process of participation in sports civilization, mental health, sports performance and other aspects, seeks to evaluate the student's role play. In this paper, we investigate the multiple attribute decision making problems for evaluating the physical education teaching effectiveness of the higher colleges and universities with intuitionistic fuzzy information. We utilize the intuitionistic fuzzy Einstein weighted average (IFEWA) operator to aggregate the intuitionistic fuzzy information, then rank the alternatives and select the most desirable one(s) according to the possibility degree between the overall values of the alternatives. Finally, an illustrative example for evaluating the physical education teaching effectiveness of the higher colleges and universities with intuitionistic fuzzy information is given.

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