The application of comprehensive evaluation system on martial arts teachers’ work ability based on fuzzy mathematical model

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ABSTRACT
This paper uses fuzzy mathematical theory and fuzzy comprehensive evaluation method to give the evaluation mathematical model and evaluation methods, finds a more objective and quantitative teaching evaluation method, and ultimately conducts comprehensive evaluation on the martial arts teacher’s level. Through layers of selection, the experts select out these 11 evaluation indexes and the weighting coefficients, which reflect the essence of the teachers’ work, fit the current actual needs of evaluation on teachers’ work ability, and have good application value.

KEYWORDS
Fuzzy mathematics; Martial arts teacher; Evaluation system.

INTRODUCTION
In recent years, martial arts are in the rapid development in the world, and increasingly gets people’s attention; the 2008 Beijing Olympic Games, even took the martial arts as a competitive item, showing in front of the world. Meanwhile in the country, martial arts competitions of all sizes have gradually expanded, the number of participants increases every year, and the influence grows increasingly. Meanwhile the demand for professional martial arts teachers is also increasingly urgent. At present, for the assessment of the level of martial arts instructors we took some assessment measures and methods. But the method of assessing ranks lacks quantitative criteria, subjective, which is not conducive to the selection of highly qualified referees. Moreover highly qualified and high-level coach teams are vital to the development of Chinese martial arts career.

To this end, we apply the fuzzy comprehensive evaluation method, conduct comprehensive evaluation on the work ability of the martial arts teachers, by introducing the mathematical model, evaluates on the teacher’s level.

THE ESTABLISHMENT OF FUZZY MATHEMATICS THEORY MODEL

Since 1965, the fuzzy mathematics has gain increasing attention. Since then, the fuzzy topology, fuzzy measure theory and the general terms in mathematics areas are developed on the basis of fuzzy sets and fuzzy logic, and they are the mathematical tools to study the problem that is of obscurity even fuzzy boundaries in the real world.

Evaluation index selection
In the establishment of the evaluation index, based
The application of comprehensive evaluation system on martial arts teachers' teaching capacity, not only taking into account the points and surfaces of the evaluation, but also the school's teaching conditions and the actual results of the final evaluation. While insisting on the principle of combining qualitative and quantitative, for some indicators that are difficult to quantify, we use the qualitative evaluation method of numerical value conversion on the basis of the qualitative description. Based on the principles of combining fuzzy and comparability, it simplifies the number of evaluation index, requires the indicators of same level do not overlap, no causal relationship between them, and pays attention to the reasonable evaluation level of the various indicators, requires participating personnel be familiar with the standards, uniform standards, be fair and realistic, tries to make the fuzzy membership by the evaluation staff close to the same, thus makes it easy for them to do the same level same classification and same homogeneous comparison and easy to form a reliable conclusion.

Based on the above ideological principles of the evaluation index determination, first of all, design a variety of related factors for the research on this project, then, use the expert investigation method to 23 specialists and professors’ suggestions that have been engaged in physical education, and strive to unify the evaluation criteria. From the expert’s response results, it has a clear convergence trend, finally, analyze and classify a variety of collected information material, establish the evaluation index system of martial arts teacher’s teaching capacity, as shown in TABLE 1.

**TABLE 1: Evaluation index range of Martial arts teacher’s teaching ability**

<table>
<thead>
<tr>
<th>Main aspects</th>
<th>Related indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Ideology and morality</td>
<td>1. Professionalism</td>
</tr>
<tr>
<td></td>
<td>2. the spirit of dedication</td>
</tr>
<tr>
<td></td>
<td>3. materials studying</td>
</tr>
<tr>
<td></td>
<td>4. explanation and demonstration</td>
</tr>
<tr>
<td></td>
<td>5. Organization teaching</td>
</tr>
<tr>
<td></td>
<td>6. application methods</td>
</tr>
<tr>
<td></td>
<td>7. Movement load</td>
</tr>
<tr>
<td></td>
<td>8. Classroom discipline</td>
</tr>
<tr>
<td></td>
<td>9. Knowledge Innovation</td>
</tr>
<tr>
<td></td>
<td>10. student enthusiasm for learning</td>
</tr>
<tr>
<td>B. Teaching Ability of Martial Arts</td>
<td>11. skills grasping situation of students</td>
</tr>
<tr>
<td>C. Teaching Achievement of Martial Arts</td>
<td></td>
</tr>
</tbody>
</table>

For the teaching capacity evaluation of sports specialized teachers, this paper uses multilevel comprehensive evaluation method of fuzzy mathematics and designs an evaluation model; the specific steps are as follow:

Suppose the evaluation factors set

\[ U = \{u_1, u_2, \ldots, u_n\} \]

Then:

\[ U_1 = \text{Ideology and morality} = \{u_1, u_2\} \]

\[ U_2 = \text{Teaching Ability of Martial Arts} = \{u_3, u_4, u_5, \ldots, u_9\} \]
$U^3 =$ Teaching Achievement of Martial Arts
$= \{u10, u11\}$

Set the comment set
$X=\{poorer, bad, medium, good, excellent\}$
$=\{x1, x2, x3, x4, x5\}$, respectively classify in accordance with 20 points, 40 points, 60 points and 80 points, then $X_j=\{1, 2, 3, 4, 5\}$ can be seen as a fuzzy set of scores section set $J = \{20, 40, 60, 80, 100\}$, as shown in TABLE 2:

TABLE 2 : The membership of the various scores section's reviews

<table>
<thead>
<tr>
<th>Scores</th>
<th>20</th>
<th>40</th>
<th>60</th>
<th>80</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.25</td>
<td>0.75</td>
</tr>
<tr>
<td>good</td>
<td>0</td>
<td>0</td>
<td>0.25</td>
<td>0.5</td>
<td>0.25</td>
</tr>
<tr>
<td>medium</td>
<td>0</td>
<td>0.25</td>
<td>0.5</td>
<td>0.25</td>
<td>0</td>
</tr>
<tr>
<td>bad</td>
<td>0.25</td>
<td>0.5</td>
<td>0.25</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>poorer</td>
<td>0.25</td>
<td>0.25</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

(1) Weight distribution

$m1 = (m1(1), m2(1)) = (0.4, 0.6)$

$m2 = (m1(2), m2(2), \ldots, m7(2))$

$= (0.1, 0.15, 0.1, 0.1, 0.15, 0.1, 0.3)$

$m3 = (m1(3), m2(3), m3(3)) = (0.2, 0.45, 0.35)$

$m0 = (m1(0), m2(0), m3(0)) = (0.15, 0.6, 0.25)$

(2) Single factor evaluation

From TABLE 2 we can find the evaluation results of a single factor. Such as the evaluation results of $u1$ is good, then the corresponding evaluation result is $(0, 0, 0.25, 0.2, 0.25)$. Then you can line up the judgment results of various factors and form the comprehensive evaluation transformation matrix $RI$.

Comprehensive evaluation method

Comprehensive Evaluation of the first layer $Z1$

$Z_{11} = M_1 * R_1, Z_{12} = M_2 * R_12, Z_{13} = M_3 * R_13$, respectively, are the membership vectors for the three factors of the second layer on the score vector $(20, 40, 60, 80, 100)$.

Wherein the matrix $M$ is the scores based on the experience of the judges and the relevant leaders, conduct comprehensive statistics and determine the corresponding weights of various levels.

$M$ is the scores based on the experience of the judges and the relevant leaders, conduct comprehensive statistics and determine the corresponding weights of various levels.

TABLE 3 : Weights of all levels

<table>
<thead>
<tr>
<th>Ideology and morality (M1)</th>
<th>Professionalism</th>
<th>the spirit of dedication</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>45%</td>
<td>55%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teaching Ability of Martial Arts (M2)</th>
<th>explanation and demonstration</th>
<th>organization teaching</th>
<th>the application method</th>
<th>the movement load</th>
<th>the classroom discipline</th>
<th>knowledge innovation</th>
<th>materials studying</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25%</td>
<td>10%</td>
<td>25%</td>
<td>15%</td>
<td>5%</td>
<td>10%</td>
<td>10%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teaching Achievement of Martial Arts (M3)</th>
<th>student enthusiasm for learning</th>
<th>skills grasping situation of students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>68%</td>
<td>32%</td>
</tr>
</tbody>
</table>

Arrange $Z_{11}, Z_{12}, Z_{13}$ in turn into comprehensive evaluation membership matrix:

$P_{11} = \begin{pmatrix} Z_{11} \\ Z_{12} \\ Z_{13} \end{pmatrix}$

Calculate the comprehensive assessment scores $Y, Y = Z_{11} \times P^T, P$ is scores matrix in the membership degree table of first-grade referee, $P^T$ is the transposed matrix of $P$.

The provision is shown in TABLE 4:

TABLE 4 : Teacher's grade classification

<table>
<thead>
<tr>
<th>Grades</th>
<th>Teacher's grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-81</td>
<td>First-grade Martial arts Teacher</td>
</tr>
<tr>
<td>80-75</td>
<td>Second-grade Martial arts Teacher</td>
</tr>
<tr>
<td>74-60</td>
<td>Third-grade Martial arts Teacher</td>
</tr>
<tr>
<td>&lt;60</td>
<td>Unqualified</td>
</tr>
</tbody>
</table>

THE APPLICATION OF FUZZY MATHEMATICS EVALUATION MODEL

Suppose during the game process of a teacher, af-
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	er assessment the professionalism is excellent, the spirit of risk is good, materials studying is good, explanation and demonstration is excellent, organization teaching is medium, the application method is medium, the movement load is medium, the classroom discipline is good, knowledge innovation is excellent, student enthusiasm for learning is excellent, skills grasping situation of students is good.

(1) Conduct comprehensive evaluation of the first layer:

Ideology and morality:

\[ Z_{11} = M_1 \times R_{11} \]

\[ = (0.45, 0.55) \times \begin{pmatrix} 0 & 0 & 0.25 & 0.75 \\ 0 & 0.25 & 0.5 & 0.25 \end{pmatrix} \]

\[ = (0, 0.14, 0.39, 0.48) \]

Teaching Ability of Martial Arts:

\[ Z_{12} = M_2 \times R_{12} \]

\[ = (0.25, 0.15, 0.05, 0.2, 0.1) \]

Teaching Achievement of Martial Arts:

\[ Z_{13} = M_3 \times R_{13} \]

\[ = (0.68, 0.32) \]

(2) Conduct comprehensive evaluation of the second layer:

\[ R = (R_1, R_2, R_3) \]

\[ Z = M \times R = (0.45, 0.35, 0.2) \]

Finally calculate the composite score, according to the score assess the teacher’s level.

\[ Y = Z \cdot P^T = \begin{pmatrix} 0.04 & 0.22 & 0.4 & 0.35 \end{pmatrix} \]

The results show that the teacher is regarded as a first-grade teacher after a comprehensive evaluation.

Conclusions

The purpose and nature of Martial arts teacher’s evaluation is to promote the teacher’s capacity, and the most importantly to improve the quality of personnel training. Through the above established mathematical model evaluation criteria, evaluation on martial arts teachers are divided into three levels of rating, which makes the talent selection quantitative, combines qualitative with quantitative, makes the evaluation on workability more scientific and rational, can better promote the development of martial arts teachers’ work.

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