Assessing the Training Effect of Top Social Sports Instructors using Fuzzy Comprehensive Evaluation

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Abstract — In this paper, 500 first grade social sports instructors after being trained in Jiangsu have been conducted using tracking questionnaire survey for: i) the months of research in terms of working area, ii) age structure, iii) education level, iv) working life, v) guiding project, vi) development situation, vii) development effect and viii) treatment levels. The evaluation index system of the training effect on instructors was stablished and the score situation obtained using fuzzy comprehensive evaluation method and factor analysis. The study shows that training the instructors was more positively innovated and the training work was further strengthened and improved. The skill demonstration and the communication activities of the instructors were better organized, the volunteer service brand activities were developed and their system construction better promoted.

Keywords - Fuzzy comprehensive evaluation; First grade social sports instructor; Training; Effect evaluation

I. INTRODUCTION

The social sports instructor has formally entered the classification system of Chinese occupation from August, 2001, which indicates that the social sports work is not the spare-time job or the part-time job. At present, the sports population account for about 33.9% of the populations in China. The number of social sports instructors is about more than 650 thousand and the ratio of the social sports instructors and the total population is about 1: 4600. Taking Germany for example, there are more than 80 million populations in Germany and there are about 2 million sports workers, that is, there will be a social sports instructor in 4050 people in average. It can be expected that in the middle of this century, if the proportion of China’s sports population develops to about 50% and about 750 million, even according to the 1/3 of Germany level, the social sports instructor team in our country should be at least 5 million people or more. Therefore, the cultivation of social sports instructors should be one of the important goals of the training strategy of physical education professionals.

In recent five years, the development of the social sports instructors in Jiangsu province has been on the rise. Especially in Xuzhou, Nantong and Huai’an, the increase is the most obvious and it shows the linear upward trend. The social sports instructors have become the important force and the valuable human resources to promote the development of national fitness industry. Therefore, it is necessary to strengthen the construction of social sports instructors and constantly create a new situation of social sports instructors.

Currently, it is necessary to strengthen the outstanding work of first grade social sports instructor training while increasing the number of social sports instructors. On the one hand, it is demanded to form the long-term mechanism of talent cultivation through the training work of first grade social sports instructor. On the other hand, it is required to strengthen the training work of first grade social sports instructors, build the volunteer service brand activities of social sports instructors, organize the skill demonstration and the communication activities of social sports instructors and maintain the sustainability of the work and the development of social sports instructors so as to further highlight the social values of social sports instructors. In summary, the effect evaluation of the training work of social sports instructors has important practical significance.

II. RESEARCH METHOD

A. Acquisition of Raw Data

500 first grade social sports instructors in Jiangsu training points are selected as the research objects.

The survey is divided into three parts: (1) The field survey in the guidance points of research objects. It is required to randomly select two leaders and two masses for each object. 2000 questionnaires are issued and 1920 questionnaires are collected. (2) The research of the status of research objects after being trained. The contents include the working area, the age structure, the education level, the working years, the guiding projects, the development situation, the development effect and the treatment levels, etc. (3) the selected 20 experts have issued the questionnaires. The performance indicators of the social sports instructors in Jiangsu in the later training period have been summarized selected and transmitted to experts. The indicators are finally established after being modified.
B. Factor Analysis

Factor analysis is to integrate variables with complex relationship into several factors. In multivariate analysis, it is also a statistical method to process dimension reduction. Factor analysis is established and developed based on the research process of psychology. There is a saying that the only contribution of psychology to natural science is the factor analysis method. With the continuous in-depth study over the years, the analysis method has been improved gradually and it could be applied to the intelligence and character research as well as the study of attitude, learning. It is even extended to non-psychology area, such as geography, geology, and biology. It is an effective mathematical model to explain the relationship between things.

Factor analysis (R type) mathematical model:

\[ X = A \cdot F + \varepsilon \]

The three basic problems solved by factor analysis: (1) The estimation of factor loading matrix \( A \). (2) Obtain a reasonable explanation for the factor, conduct the orthogonal transformation for factor loading matrix. (3) Present the score of each variable (or sample) on \( A \) for exploring the meaning of factors. The factor analysis method is established to find out the common factors and group them and then explain the meaning of each factor, so as to scientifically analyze the practical problems. When the structure of the factor load matrix \( X \) cannot be used to explain the main factor, conduct right multiplication for an orthogonal matrix by \( A \) (i.e., conduct an orthogonal transformation for \( A \)).

Conduct an orthogonal transformation for \( A \) based on linear algebra knowledge, and there is a rotation in the corresponding coordinate system, which is conducive to explaining the meaning of factors.

C. Fuzzy Comprehensive Evaluation

Generally speaking, the fuzzy comprehensive evaluation involves three elements. Assume there are \( m \) factors related to the object being evaluated, denoted by \( U = \{u_1, u_2, \cdots, u_m\} \), which are also called factor set. Assume that there are \( M \) possible comments, denoted by \( V = \{v_1, v_2, \cdots, v_m\} \), which are called judge set. As each factor has different position and plays different role, there is a measurement criteria, namely, the weight, denoted by \( A = \{a_1, a_2, \cdots, a_m\} \).

C1. Comprehensive Evaluation Steps

Fuzzy comprehensive evaluation steps are shown as follows:

\[ r_i = \{r_{i1}, r_{i2}, \cdots, r_{im}\} \]

Step1 Set the factor set \( U = \{u_1, u_2, \cdots, u_m\} \).

Step2 Set the evaluation set \( V = \{v_1, v_2, \cdots, v_m\} \).

Step3 Conduct simple element evaluation and obtain \( r_i = \{r_{i1}, r_{i2}, \cdots, r_{im}\} \).

Step4 Construct comprehensive evaluation matrix:
C2. Definition of Operator

In the comprehensive evaluation, there are different models based on different definitions of operator.

(1) Model I: $M(\wedge, \vee)$ - the main factor determining type.

The calculation method is shown as follows:

$$b_j = \max\{a_i \cdot r_{ij}, i = 1, 2, \cdots, n ; j = 1, 2, \cdots, m\} \quad (5)$$

The evaluation results of this model are determined by the factor which plays a major role in the overall evaluation, and other factors will not affect the evaluation. Relatively speaking, this model is suitable for the situation that the optimal one in single evaluation is the optimal one in comprehensive evaluation.

(2) Model II: $M(\cdot, \vee)$ - the main factor prominent type.

The calculation method is shown as follows:

$$b_j = \max\{a_i \cdot r_{ij}, i = 1, 2, \cdots, n ; j = 1, 2, \cdots, m\} \quad (6)$$

The model is somewhat similar to model I but it is more refined, for it not only highlight the main factors, but also take into account other factors. This model is applicable to the range that model I is not applicable, which means the situation that various factors cannot be distinguished but need to be refined.

(3) Model III: $M(\cdot, +)$ - the weighted average type.

The calculation method is shown as follows:

$$b_j = \frac{1}{n} \sum_{i=1}^{n} a_i \cdot r_{ij} \cdot (j = 1, 2, \cdots, m) \quad (7)$$

This model takes into consideration of all the influence factors based on their significance. Relatively speaking, it is necessary to integrate the optimal situation.

(4) Model IV: $M(\wedge, \oplus)$ - take a small upper bound.

The calculation method is shown as follows:

$$b_j = \min\left\{ \left( \frac{1}{n} \sum_{i=1}^{n} a_i \cdot r_{ij} \right) \right\} \cdot (j = 1, 2, \cdots, m) \quad (8)$$

To use the model, each $a_i$ cannot be too large, otherwise it is likely that all the $b_j$ is 1; each $a_i$ cannot be too small, otherwise it is likely that all the $b_j$ is equal to the sum of each $a_i$. This will lead to the loss of relevant information of single-factor evaluation.

(5) Model V: $M(\wedge, +)$ - the balanced average type.

The calculation method is shown as follows:

$$b_j = \sum_{i=1}^{n} \frac{a_i \cdot r_{ij}}{r_0} (j = 1, 2, \cdots, m) \quad (9)$$

In the above formula, $r_0 = \sum_{i=1}^{n} r_{ij}$. This model is suitable for the comprehensive evaluation of the elements in matrix $R$.

The model established in this paper adopts the operator of the main factor determining type.

III. RESULTS AND ANALYSIS

A. Establishment of the Evaluation Indicators of the Training Effect

The evaluation index system is the essential concept system of evaluation objects which should be isomorphic with the evaluation object. In order to make the evaluation index system of the training effect of social sports instructors fully cover the training and improve the structure validity of index system, the author has issued Delphi questionnaire to experts for two times. According to the results of questionnaire survey, the contents of index have been determined to judge whether the training is worth. At the same time, the points that need to be improved have been also pointed out and the situation formed by objectives has been detected to determine whether the training should be continued so as to find better training methods and establish the future training guidelines. After two rounds of Delphi expert investigation, it is required to calculate the agreed persons of experts and scholars for an index term. The proportion of each index is above 80% to reach the selection standard. In addition, for the analysis of the stability of expert opinions, the average value of the stability is $\geq 70\%$.

| TABLE 1 EVALUATION INDEX SYSTEM OF THE TRAINING EFFECT OF THE FIRST GRADE SOCIAL SPORTS INSTRUCTORS IN JIANGSU PROVINCE |
|---------------------------------|-----------------|-----------------|
| First grade index | Second grade index | Third grade index |
| Reaction $A_1$ | Satisfaction of participants for curriculum contents $A_{11}$ | Satisfaction of participants for curriculum arrangement $A_{12}$ |
| Satisfaction of participants for test process $A_{13}$ | Satisfaction of participants for training materials $A_{14}$ | Satisfaction of participants for training teachers $A_{15}$ |

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The calculation steps of the maximum eigenvalue and the eigenvector are shown as follows:

Step 1: Calculating the product of the elements in each row of \( A \);

Step 2: Calculating \( m \) root mean square of \( M_j \);

Step 3: Conducting the normalization for eigenvectors to get the weight vector \( W \);

Step 4: Calculating the maximum eigenvalue \( \lambda_{\text{max}} \) of \( A \):

\[
M_i = \prod_{j=1}^{n} a_{ij}, i = 1, 2, 3, \ldots, n \tag{10}
\]

\[
W_i = \sqrt{M_i}, i = 1, 2, 3, \ldots, n \tag{11}
\]

\[
W_i = W_i / \sum_{j=1}^{n} W_j, i = 1, 2, 3, \ldots, n \tag{12}
\]

\[
\lambda_{\text{max}} = \sum_{i=1}^{n} \frac{(A \cdot W_i)}{n W_i}, i = 1, 2, 3, \ldots, n \tag{13}
\]

**TABLE 2 ANALYSIS RESULTS OF THE INFLUENCE DEGREE OF EACH FACTOR IN THE LEARNING LEVEL**

<table>
<thead>
<tr>
<th>A11</th>
<th>A12</th>
<th>A13</th>
<th>A14</th>
<th>A15</th>
<th>A16</th>
<th>Eigen vector</th>
<th>Consistency checking</th>
</tr>
</thead>
<tbody>
<tr>
<td>A11</td>
<td>4.3552</td>
<td>5.3172</td>
<td>2.2392</td>
<td>5.3437</td>
<td>4.7570</td>
<td>0.3995</td>
<td>( \lambda_{\text{max}} = 6.3801 )</td>
</tr>
<tr>
<td>A12</td>
<td>0.2359</td>
<td>0.0000</td>
<td>0.2298</td>
<td>0.3153</td>
<td>0.4332</td>
<td>2.1387</td>
<td>0.0975</td>
</tr>
<tr>
<td>A13</td>
<td>0.1922</td>
<td>0.4936</td>
<td>0.0000</td>
<td>0.2305</td>
<td>0.3143</td>
<td>3.3297</td>
<td>0.0598</td>
</tr>
<tr>
<td>A14</td>
<td>0.4498</td>
<td>3.2978</td>
<td>4.4042</td>
<td>0.0000</td>
<td>0.4198</td>
<td>1.4447</td>
<td>0.1691</td>
</tr>
<tr>
<td>A15</td>
<td>0.3105</td>
<td>2.2433</td>
<td>3.1655</td>
<td>2.3598</td>
<td>0.0000</td>
<td>2.2099</td>
<td>0.2009</td>
</tr>
<tr>
<td>A16</td>
<td>0.2011</td>
<td>0.4573</td>
<td>0.7512</td>
<td>0.6780</td>
<td>0.4520</td>
<td>1.0000</td>
<td>0.0699</td>
</tr>
<tr>
<td>sum</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Judging the matrix has the satisfactory consistency. Therefore, the weights of (A11, A12, A13, A14, A15, A16) are \([0.3995 \ 0.0975 \ 0.5998 \ 0.1691 \ 0.2099 \ 0.0599]\).
B. Analysis Results of Fuzzy Evaluation Factors

The factor analysis results of the four characteristic indexes of the second grade index in the evaluation index system of the training effect of the first grade social sports instructors in Jiangsu province are shown in Figure 1.

![Factor analysis results of characteristic indexes](image1)

The factor analysis results of the four characteristic indexes after the fuzzy evaluation are shown in Figure 2.

![Factor analysis results of the characteristic indexes after fuzzy evaluation](image2)

C. Scores of the Training Effect of Social Sports Instructors

The evaluation index system of the training effect of social sports instructors includes four first grade indexes, respectively “reaction”, “learning”, “behavior” and “result”. The project weights are respectively 4.31%, 14.12%, 55.87% and 25.70%. The “behavior” is the most important. The “reaction” layer includes six evaluation indexes; the “learning” layer includes five evaluation indexes; there are six evaluation indexes of “behavior” changes; the “result” layer contains three evaluation indexes. The “working methods of participants” and the “number of people guided by participants” are two important contents for the evaluation of the training effect of the social sports instructors.

<table>
<thead>
<tr>
<th></th>
<th>Mean value</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reaction</td>
<td>3.85</td>
<td>0.723</td>
</tr>
<tr>
<td>Learning</td>
<td>3.77</td>
<td>0.639</td>
</tr>
<tr>
<td>Behavior</td>
<td>3.57</td>
<td>0.771</td>
</tr>
<tr>
<td>Result</td>
<td>3.51</td>
<td>0.798</td>
</tr>
</tbody>
</table>

In Table 7, it can be found that the mean value of the participants in the training “reaction” of the first grade social sports instructors in Jiangsu province is 3.85, which is close to the satisfaction status and that indicates that the selections of training materials and curriculum contents as well as the teaching arrangement are reasonable. The mean value in the aspect of “behavior” is 3.57, which indicates that the number of people guided by participants has reached a higher level and the higher requirements of training. After the training of the first grade social sports instructors, the guidance for masses has become more targeted, accurate and comprehensive. It greatly improved the guiding efficiency. The methods employed by participants in the guiding process have been improved after being trained and it is more reasonable, vivid and flexible to use a variety of ways for guidance so as to make the masses easier to learn and practice as well as improve the success rate of learning and practicing a project. Then, the development of the local characteristic projects has been promoted.

IV. Conclusion

At present, the training of the first grade instructors in Jiangsu province is in order and the training contents are mainly based on the theoretical knowledge. The specific project knowledge can meet the needs of the trainees to a certain extent and the training contents are practical. The overall education structure of trainees is relatively low and the people received the professional physical education are less. The category division is lacked, the social status is weak, the occupation consciousness is not strong and the work lacks of motivation. The number of the guidance for the first grade instructors who are actually engaged in the work of guidance become less in one week and the time cost for one guidance becoming shorter. The number of guided people is less and the overall attendance is low. The questionnaire is designed according to the index system of the public sports service performance to conduct the actual evaluation for the public sports service performance. The fundamental purpose to cultivate and establish a social sports instructor team is to benefit the guidance work of social sports instructors. It is required to mobilize the enthusiasm and the initiative of social sports instructors,
give full play to the roles of the social sports instructors, strengthen the training and improve the special skill levels. According to the relevant rules, it is necessary to manage the guidance work of social sports instructors so as to promote the healthy development of this team as well as actively and effectively play its due role.

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