Fuzzy Algorithm-based Evaluation on Teaching Ability of PE Teachers

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Abstract

In physical education, all teaching content is taught completely by the individual ability of physical education teachers. If their ability is poor, it will be difficult to achieve the periodical goal of cultivation. Therefore, it is very important to evaluate the teaching ability of PE teachers, which is both an important index to measure their teaching level and an objective performance to evaluate the teaching results of the school. To further study the evaluation system of PE teachers' teaching ability is the core issue of current PE teaching. To this end, this paper studied the construction strategy of the teaching evaluation system of PE teachers based on the computing method of mathematical fuzzy model. The application model of fuzzy algorithm in the evaluation system of teaching ability is designed by setting the evaluation index parameters and its category. The comprehensive evaluation content and quantitative criteria of the teaching ability of PE teachers are obtained according to the indicators of the evaluation model, so as to provide the theoretical basis for the further study of physical education methods.

Keywords: Fuzzy algorithm, Physical education teacher, Evaluation system.

1. RESEARCH BACKGROUND

1.1 Literature review

For a long time, the assessment of the teaching ability of PE teachers has been conducted for all the teachers, with relatively poor objectivity and scientificity and certain one-sidedness of the evaluation results (Ling, 2016). In contrast, the analysis based on the teaching characteristics of PE teachers applying mathematical fuzzy algorithm is more reasonable and comprehensive (Wan and Sun, 2016). In the actual teaching process, the teaching scope and practice of PE teachers are far different from that of other theoretical courses. Therefore, the teaching ability of PE teachers should also be evaluated from more aspects and dimensions. (Song and Du, 2012) It is possible to draw one-sided results by applying any single evaluation system, and fuzzy algorithm is an evaluation strategy for comprehensive evaluation of teaching ability.

1.2 Research purposes

The teaching ability of PE teachers cannot be limited to the evaluation of students' sports ability or athletic performance, as its one-sidedness may easily lead to the negative result of subjective assumption. In the process of teaching evaluation, fuzzy algorithm can be used to quantify the evaluation index and obtain the evaluation system that is most close to the real ability of PE teachers through comprehensive evaluation means and calculation method (Liu, 2014). The actual situation of each school and students' feedback should also be collected to evaluate objectively the PE teachers' teaching ability, and the evaluation results can inevitably reflect more objective results or rules (Mao, 2015). In the actual application process, if the fuzzy algorithm can be used effectively in the evaluation system of teaching ability, the actual situation of PE teachers can be accurately judged (Wang and Wang, 2015). It will be more conducive to the development of physical education and to cultivate students for the country in a more healthy way no matter in a variety of dimensions such as teaching direction, teaching plan, curriculum building, etc., or in some reality aspects such as students' feedback, improvement of their sport ability, etc. Therefore, fuzzy algorithm-based evaluation is a more accurate evaluation system and method designed for evaluation demand and is especially important to evaluate the teaching ability of PE teachers.
2. EVALUATION INDEX PARAMETERS OF PE TEACHERS' TEACHING ABILITY

This study is based on the Basic Standard for Higher Education Sports Work put forward by the Ministry of Education of China in 2014, the National Standard for Fitness and Health of Students, and the Guidance outline for Sports Course Teaching of National General Institutes of Higher Education. Five comprehensive evaluation indicators are proposed based on the research direction of physical education teaching in recent years combined with opinions of experts. Comprehensive evaluation indicators as the study of the primary variables are: ideological quality, professional quality, preparation before class, teaching content and teaching effect, each of which has corresponding subordinate factor reference variable set as the second variables, as shown in Table 1.

Table 1 The Evaluation System of Physical Education Teachers' Teaching Ability Evaluation System Dimension Quantitative Indicators

<table>
<thead>
<tr>
<th>Level indicators</th>
<th>project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ideological quality</td>
<td>Professional quality</td>
</tr>
<tr>
<td>focus</td>
<td>Business level</td>
</tr>
<tr>
<td>dedication to work</td>
<td>Business level</td>
</tr>
<tr>
<td>teaching</td>
<td>Business level</td>
</tr>
<tr>
<td>A teacher by worthy example</td>
<td>Curriculum arrangement</td>
</tr>
</tbody>
</table>

3. SETTING THE SCOPE OF THE EVALUATION INDICATOR PARAMETERS

3.1 Parameters of ideological quality of PE teachers

Evaluate the ideological quality of PE teachers in the first dimension, and focus on such aspects as teaching attitude, degree of concentration, entrepreneur spirit, knowledge imparting and moral education, and role model serving. The teaching attitude refers to whether the teacher has the correct attitude in the teaching process and has a higher ideological understanding of whether the teaching of physical education can be targeted. The degree of concentration refers to the proportion of PE teachers that is devoted to teaching subjects, which aims to assess the enthusiasm of PE teachers for sports cause. Reference variables in entrepreneur spirit have been designed to judge whether teachers have great entrepreneur spirit to solve any difficulties and problems that they come across in the PE teaching through their own efforts and to avoid the negative impact brought by their possible weakness in teaching ability (Yue, 2015). Finally, knowledge imparting and moral education and role model serving can be evaluated in a comprehensive way from the ability of general teachers, which is also a standard for evaluating the ideological quality of all teachers. The sense of teaching responsibility of teachers in this aspect can be evaluated comprehensively based on the feedback information of the school leaders, director of the research group and students.

3.2 Evaluation scope of the professional quality of PE teachers

The quality of the business mentioned here refers to the quality of teaching and professional quality of PE teachers, including teaching mentality, professional level, athletic ability, specialized knowledge and construction of curriculum. On the one hand, teaching mentality aims to assess whether PE teachers can keep good teaching mentality in guidance for students, adjust the corresponding teaching direction and plan timely, and provide moderate curriculum content for students, in the case that students' academic results decline or that the class feedback information is unfavorable. The design of teaching content for students thus involves construction of curriculum and professional knowledge; if PE teachers are capable in both aspects, they can adjust the existing learning content in an appropriate way based on students' understanding and construct the teaching system or training content of higher fitness to reach the desired teaching effects (Chen and Zhou, 2010). On the other hand, athletic ability is the basic indicator for evaluating the teaching ability of PE teachers; if they are weak in this aspect, it will be difficult for them to set up the role model for students and to reach good...
teaching effects. In addition, the measurement standard for professional level aims to assess whether PE teachers can accomplish the teaching tasks timely in the prescribed period, including the time availability of imparting the specialized knowledge in sports to students and the effectiveness of summarizing students' evaluation.

3.3 Related content in PE teachers' preparation before the class

There are great differences between physical education teaching and other theoretical courses. Students need to be guided by more targeted teaching activities during the learning stage, and teaching activities are bound to involve pre-class preparation. Usually, the pre-class preparation of PE teachers involves: teaching materials, equipment, venue, teaching plan, multimedia, teaching organization, etc. The adequacy of pre-class preparation directly affects the effectiveness and completion of teaching plan. If the preparation is very sufficient, teachers can use the teaching plan to adjust the learning content according to students' performance in PE class to reach more far-reaching teaching goals. At the same time, the use of sports venues and related equipment can also enrich the sports curriculum and raise students' concentration. Using multimedia teaching to realize teaching environment simulation and combining theoretical courses with practical courses are also the teaching abilities that modern PE teachers should have. In addition, in the teaching organization activities, whether PE teachers have higher teaching ability can be evaluated from students' performance and understanding; if the teaching organization activities have great practical significance and application value, then the practice effect of teaching organization activities can be proved from students' theory achievement and academic performance.

3.4 PE teachers' ability in setting teaching contents

In the setting of physical education content, this study designed five secondary variables according to the experts' recommendations, respectively, regular course, innovation course, demonstration, teaching method and sports planning. First, regular course involves whether the course indicators required by the syllabus can be completed successfully. Second, innovation course involves whether the PE teachers in the sports course can innovate the course based on the existing course content as well as whether they can design training contents welcomed by the students according to the students' characteristics. Next, demonstration is a key index parameter for the evaluation of PE teachers' teaching ability; in the demonstration link when the sports actions are explained, if PE teachers can make standardized explanation and demonstration of each action, students will be prone to understand the grasp them easily (Zhang, 2010); otherwise, the understanding of students can be easily deviated. Finally, the applicability of teaching methods can also serve as a direct reference for measuring PE teachers' teaching ability; when students' own understanding ability is low, PE teachers should adopt optimized targeted teaching scheme according to the students' performance to achieve the goal on the whole teaching effect that it is beneficial to all the students. The applicability of the teaching method will also be reflected in the students' athletic ability and whether they meet the standard, which will lead to higher expectations of physical education (Zhu, 2010). In addition, sports planning can reflect the rationality and scientificity of the staged cultivation of students by PE teachers. When the sports planning meet the training demand for students at the current stage, their athletic ability and sports skills can be effectively improved, but if the adaptability of it is relatively low, it may have negative effects on students' sports results or even make them decline.

3.5 Evaluation interval of PE teachers' teaching achievements

The teaching result is a measure standard that directly reflects the teaching ability of PE teachers. In most studies, it is regarded as the final form of evaluating teachers' individual ability. In this study, the evaluation interval has five dimensions including teaching effects, teaching and research achievement, social influence, students' feedback and sports grade. First, the teaching effectiveness is the teaching ability presented based on the student's performance, and the student's outstanding performance should be partly attributed to PE teachers' support and guidance (Tong and Lin, 2017); on the contrary, it is also the external manifestation of the teaching ability of PE teachers. Second, research results are set based on academic research and judged by the results of research projects acquired during the academic year, as well as the excellent academic results obtained by PE teachers in sports activities or events and relevant results acquired by students under the PE teachers' guidance (Yao and Zhao, 2017). Third, social influence refers to the social support and corresponding feedback information obtained by the research results, and is measured by the influence strength and scope. Fourth, student feedback refers to the evaluation of the PE teachers' ability made by students graduating in past years and in that year; it requires to collect students' evaluation content and make statistics of it to obtain the comprehensive score of students' satisfaction degree of the PE teachers. Finally, sports grade involves whether the students can promote their ability after they have undergone more systematic training. The effectiveness of
the teaching results of PE teachers can be evaluated according to students’ sports level and basic sports skills and vital capacity in a certain period.

4. DESIGN OF FUZZY ALGORITHMS IN THE TEACHING ABILITY EVALUATION SYSTEM

4.1 Subset matrix of fuzzy algorithm

PE teachers’ teaching ability is composed of various factors, and in the process of comprehensive evaluation of their teaching ability, fuzzy algorithm can be used to clear the positive influence of teacher’s teaching ability on students, obtain fuzzy variables from the calculation results, and determine the extent of use of the fuzzy system in the evaluation of teaching ability. First, set S as the reference factor set of PE teachers’ comprehensive ability $S = \{s_1, s_2, ..., s_j\}$, set $Q$ as the factor subset of the teaching ability in the evaluation system, $Q = \{q_1, q_2, ..., q_d\}$; set the $i$ single ability factor of it as $D_i$, and the single factor set $D_i = \{d_{i1}, d_{i2}, ..., d_{in}\}$ is formed by $D_i$, where $i = 1, 2, ..., n$, and $d_{ij}$ is greater than 0 but less than 1; then the corresponding fuzzy subset in the evaluation set can be $Q$, and the following math matrix of the fuzzy system can be formed by $d_{ij}$ for the collection degree of $D$:

$$D = \begin{bmatrix} D_1 \\ D_2 \\ ... \\ D_n \end{bmatrix} = \begin{bmatrix} d_{11}, d_{12}, d_{13}, ..., d_{1n} \\ d_{21}, d_{22}, d_{23}, ..., d_{2n} \\ ... \\ d_{m1}, d_{m2}, d_{m3}, ..., d_{mn} \end{bmatrix}$$

(1)

4.2 Fuzzy algorithm evaluation system mathematical model

The fuzzy subset $B(s)$ in the set $S$ can be regarded as the reference weight of the teaching ability of PE teachers, and at the same time, $B(s) = \{b_1, b_2, ..., b_n\}$, where $b_i$ is greater than 0 and the calculation formula is:

$$1 = \sum_{i=1}^{n} (Q_n * S_n)$$

(2)

Based on the computing method of fuzzy mathematics theory, the mathematical model A of the evaluation system conclusion of comprehensive ability of PE teachers is obtained as follows:

$$A=(a_1)*m=(a_1, a_2, ..., a_m)=B*Q=(b_1)*m*Q_1=Q_1$$

(3)

In this fuzzy mathematical model, $B$ can be considered as the factor variable matrix type of $A$, and the operation in the matrix can obtain the result of $A$ according to the weighted average in the mathematical model, to finally determine the evaluation scope of multiple subset factor variables for PE teachers’ teaching ability as well as the feasibility or credibility in empirical study. If the numerical value of $A$ obtained in the mathematical model is close to 1, it proves that the teaching ability of PE teachers reflected in the subset $B$ is strong. On the contrary, in the case that $A$ is close to 0, it proves that the teaching ability of PE teachers in this aspect is weak, or the corresponding teaching ability does not exist at all.

5. METHODS FOR BUILDING THE PE TEACHERS’ TEACHING ABILITY EVALUATION MODEL

In the process of calculation using the fuzzy mathematical model, the actual direction of physical education teaching must be referred to complete the construction of the entire evaluation system through the corresponding index weight and the single index model. In this process, the direct interaction relation of any variables should be considered to evaluate the individual teaching ability of PE teachers with different proportion weight systems. Refer to the formation elements of 5 1-level variables and 25 2-level variables based on the fuzzy mathematical model designed in this study; the quantitative analysis of PE teachers’ teaching ability should be subject to the actual teaching feedback and be measured through single indexes and index weights:

5.1 Measurement scale of single indexes

In the evaluation of the teaching ability of PE teachers, the corresponding variables can be regarded as two forms of expression, both objective assessment and subjective evaluation. It is difficult to meet the corresponding standard of measurement and scale. Therefore, it is necessary to design the corresponding single classified index according to the quantitative standard, and the total proportion of them is the postulated conditions close to the actual situation (Li, 2011). If the double-index of empiricism and objectivity can be used
for the measurement, the teaching ability of PE teachers will also be relatively objectified. The data information can also be objectively counted and evaluated through dividing the fuzzy scale and obtaining corresponding parameters in multiple targeted indexes. Subjective description and objective statistical measurement scale are shown in Table 2.

### Table 2 Subjective Description and Objective Statistical Measurement Scale

<table>
<thead>
<tr>
<th>level</th>
<th>The average (Y)</th>
<th>standard deviation (Z)</th>
<th>total proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The optimal</td>
<td>Y+1.30Z</td>
<td>+1 up</td>
<td>10</td>
</tr>
<tr>
<td>good</td>
<td>Y+0.65Z</td>
<td>+1 to 1.30Z</td>
<td>25</td>
</tr>
<tr>
<td>general</td>
<td>0.65Z</td>
<td>constant</td>
<td>50</td>
</tr>
<tr>
<td>poor</td>
<td>Y-0.65Z</td>
<td>-1 to -1.30Z</td>
<td>25</td>
</tr>
<tr>
<td>The worst</td>
<td>Y-1.30Z</td>
<td>-1 down</td>
<td>10</td>
</tr>
</tbody>
</table>

### 5.2 Index weights for evaluating the teaching ability

In the process of evaluating PE teachers’ teaching ability, the analysis mode of the index weights must be discussed based on the actual situation, and the weight proportion of max eigenvector in D matrix can be taken as the corresponding reference basis (Shen and Ji, 2013). Distinguish the evaluation task type reasonably and make proper adjustment based on the evaluation target and professional degree, so as to work out the comprehensive weight value for measuring all the indexes, as shown in Table 3.

### Table 3 Evaluate the Index Weight of Teaching Ability

<table>
<thead>
<tr>
<th>The main factors</th>
<th>weightings</th>
<th>indicators</th>
<th>quantitative</th>
<th>characteristic</th>
<th>weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching process</td>
<td>0.45</td>
<td>Curriculum and organization</td>
<td>0.1</td>
<td>Method and demonstration</td>
<td>0.2</td>
</tr>
<tr>
<td>Teaching effect</td>
<td>0.3</td>
<td>Teaching achievements</td>
<td>0.25</td>
<td>The research results</td>
<td>0.25</td>
</tr>
<tr>
<td>Teaching thought</td>
<td>0.15</td>
<td>Teaching attitude</td>
<td>0.3</td>
<td>focus</td>
<td>0.3</td>
</tr>
<tr>
<td>Teaching preparation</td>
<td>0.1</td>
<td>Lesson plans to write</td>
<td>0.6</td>
<td>Equipment use</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### 6. CONCLUSIONS

To conduct the mathematical fuzzy model-based analysis for the evaluation of PE teachers’ teaching ability has high operability and predictability as it can probe into teacher's personal ability in different dimensions of teaching. However, in the actual application process, the evaluation of teachers needs to be adjusted according to the actual situation of each school and the feedback information of the students (Li, 2013), so as to better adapt to the actual situation of PE teachers of the school; what is especially important is that the systematic planning of the fuzzy calculation mode in this evaluation system is still at the research stage, and the practice results need to be confirmed through further research. It can be used for the innovation of the teaching mode and for the comprehensive reference of the systematic evaluation to provide theoretical basis for adjusting the teaching mode. However, if the result of the calculation is far from the empirical judgment, the reference value of the secondary variable should be adjusted according to the actual situation so as to obtain more accurate evaluation information.

### REFERENCES


