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Research on Evaluation Methods and Models of Teaching Ability of Aerobics Based on Multiple Intelligences Theory

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Abstract

Teaching ability of aerobics is crucial to the development of aerobics athletes. It is also an effective way to evaluate the qualification of an aerobics coach. Aerobics teaching has many limitations. Current evaluation model of teaching ability of aerobics is far from complete. Thus, this paper proposes an optimized evaluation method and model of teaching ability of aerobics based on multiple intelligence theory. It constructs an evaluation index system of teaching ability of aerobics, taking into account aerobics teaching design, teaching implementation and teaching effective. Indicators are assigned weight. By analyzing the grey correlation degree between different indicators of teaching ability of aerobics and the optimal indicator, we can get the evaluation result for teaching ability of aerobics. An empirical study proves that the evaluation method has efficacy.

Keywords: *multiple intelligence theory; aerobics; teaching ability; evaluation method and model; grey correlation analysis*

1. Introduction

Aerobics teaching is crucial to produce excellent aerobics athletes [1-3]. However, as a newly developing subject, the evaluation system and method of teaching ability are far from mature. Though experts and scholars have studied it from different perspectives [4-7], there lacks a unified or standard index system and evaluation model of teaching ability of aerobics. What's more, current evaluations on teaching ability of aerobics have many limitations. For example: (1) the evaluation subjects are one-folded. The correlation and interaction between subjects are not clear. So teaching ability of aerobics cannot be measured in a scientific way; (2) the evaluation only focuses on one or several types of ability. So teaching ability of aerobics cannot be measured in a comprehensive way; (3) grade evaluation is always qualitative. And there are no quantitative models. So teaching ability of aerobics cannot be measured in a quantitative way. Thus, this paper proposes evaluation method and model of teaching ability of aerobics based on multiple intelligence theory [8-10]. It constructs an evaluation index system and an evaluation model according to grey correlation analysis [11-13] to fulfill the purpose of evaluating teaching ability of aerobics.

2. Evaluation Index System of Teaching Ability of Aerobics based on Multiple Intelligence Theory

Multiple intelligence theory was first proposed by Howard Gardner, a developmental psychologist from Harvard Graduate School of Education. He holds that one's learning ability includes Verbal/Linguistic ability, Logical/Mathematical ability, Visual/Spatial

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ability, Bodily/Kinesthetic ability), Musical/Rhythmic ability, Inter-personal/Social ability, (Intra-personal/Introspective ability, Naturalist ability and so on. The evaluation of teaching ability of aerobics based on multiple intelligence theory can better reveal the relationship between teaching and learning, and thus measures the teaching ability of aerobics from multiple perspectives. This paper constructs the evaluation index system from teaching design ability, teaching implementation ability and teaching effectiveness.

2.1. Evaluation Index System of Design Ability of Aerobics Teaching

The design ability is used to measure preparations and basic qualities of teaching. Main components of the design ability are shown in Table 1.

Table 1. Evaluation Index System of Design Ability of Aerobics Teaching

Evaluation system	Evaluation indicator
Evaluation index system of design ability of aerobics teaching R^1	Teaching-planning ability r_{01}^1
	Advancement of teaching method r_{02}^1
	Familiarity with the textbook r_{03}^1
	Abundance of teaching content r_{04}^1
	Completion of teaching tasks r_{05}^1
	Innovation of teaching style r_{04}^1
	Image processing ability r_{07}^1
	Action choreographing capability r_{08}^1
	Music choreographing capability r_{09}^1
	Number of subjects on teaching reform r_{10}^1
	Number of papers on teaching reform r_{11}^1
	Number of subjects on scientific research r_{12}^1

2.2. Evaluation Index System of Implementation Ability of Aerobics Teaching

The implementation ability is used to measure teaching content and implementation of teaching. Main components of the design ability are shown in Table 2.

Table 2. Evaluation Index System of Implementation Ability of Aerobics Teaching

Evaluation system	Evaluation indicator
Evaluation index system of implementation ability of aerobics teaching R^2	Language application ability r_{01}^2
	Professional knowledge r_{02}^2
	Sense of direction r_{03}^2
	Action teaching ability r_{04}^2
	Sense of music r_{05}^2
	Teamwork r_{06}^2
	Innovation ability r_{07}^2
	Appreciation ability r_{08}^2
	Knowledge integration ability r_{09}^2
	Teaching management ability r_{10}^2

2.3. Evaluation Index System of Effectiveness of Aerobics Teaching

The teaching effectiveness is used to measure the effectiveness of teaching. Main components of the design ability are shown in Table 3.

Table 3. Evaluation Index System of Effectiveness of Aerobics Teaching

Evaluation system	Evaluation indicator
Evaluation index system of effectiveness of aerobics teaching R^3	Number of teaching awards r_{01}^3
	Number of scientific research awards r_{02}^3
	Number of qualified students r_{03}^3
	Ratio of excellent students r_{04}^3
	Number of race with student participation r_{05}^3
	Number of awards obtained by students r_{06}^3
	Social service ability of students r_{07}^3
	Innovation ability of students r_{08}^3
	Techniques of students r_{09}^3
	Social satisfaction on students r_{10}^3

3. Evaluation and Model of Teaching Ability of Aerobics

3.1. Weight of Indicators of Teaching Ability of Aerobics based on AHP

To make the weight of indicators more objective, accurate and reasonable, AHP is introduced to assign the weight. Experts are invited to score on indicators. Here we can get the initial judgment matrix $\boldsymbol{T}$, namely,

$$\boldsymbol{T}=\begin{bmatrix} t_{11} & \cdots & t_{1i} & \cdots & t_{1n} \\ \vdots & \cdots & \vdots & \cdots & \vdots \\ t_{i1} & \cdots & t_{ii} & \cdots & t_{in} \\ \vdots & \cdots & \vdots & \cdots & \vdots \\ t_{n1} & \cdots & t_{ni} & \cdots & t_{nn} \end{bmatrix} \tag{1}$$

Where t_{ij} is the judgment value, n is the number of indicators. There is $1 \le i, j \le n$.

Obtain the Maximum Eigenvalue $max\left(\lambda_t\left(\boldsymbol{T}\right)\right)$ of judgment $\boldsymbol{T}$, so the consistency indicator R_{CI} is:

$$R_{CI}=\left(max\left(\lambda_t\left(\boldsymbol{T}\right)\right)-n\right)/\left(n-1\right) \tag{2}$$

The consistency ratio R_{CR} is:

$$R_{CR}=R_{CI}/R_{RI} \tag{3}$$

If R_{CI} and R_{CR} can meet the threshold, the weight w_i of indicator is:

$$w_i=\sum_{j=1}^{n} p_{ij} / \sum_{i=1}^{n}\sum_{j=1}^{n} p_{ij} \tag{4}$$

Thus, the weight sequence $\boldsymbol{W}$ of indicators of teaching ability of aerobics is:

$$\boldsymbol{W}=\left[w_1,\cdots,w_i,\cdots,w_n\right] \tag{5}$$

3.2. Evaluation Model of Teaching Ability of Aerobics based on Grey Correlation Analysis

Some indicators of teaching ability of aerobics are qualitative while others are quantitative. Thus, it is necessary to standardize them to apply grey correlation analysis. Qualitative indicators are shifted to quantitative description through fuzzy language, as is shown in Table 4.

Table 4. The Shift of Qualitative indicators

Value of quantity	Definition	
	Positive indicator	Negative indicator
1.0	Excellent	Unbearable
0.8	Good	Undesirable

0.6	Mediocre	Poor
0.4	Poor	Mediocre
0.2	Undesirable	Good
0	Unbearable	Excellent
0.1,0.3,0.5.0.7, 0.9	Between two values of quantity	

If a quantitative indicator j is a positive indicator and its initial value of quantity is r_{ij}, so the value of quantity after standardization is v_{ij}:

$$v_{ij} = \left(r_{ij} - \min_{1\le i\le m} r_{ij}\right) / \left(\max_{1\le i\le m} r_{ij} - \min_{1\le i\le m} r_{ij}\right) \tag{6}$$

Where m is the number of evaluation subject.

If a quantitative indicator j is a negative indicator, expression (6) becomes:

$$v_{ij} = \left(\max_{1\le i\le m} r_{ij} - r_{ij}\right) / \left(\max_{1\le i\le m} r_{ij} - \min_{1\le i\le m} r_{ij}\right) \tag{7}$$

Thus, we can get the standard series $\boldsymbol{v}_o$ for grey correlation analysis, namely,

$$\begin{aligned} \boldsymbol{v}_o &= \left[v_{o1},\cdots,v_{oj},\cdots,v_{on}\right] \\ &= \left[\max_{1\le i\le m} v_{i1},\cdots,\max_{1\le i\le m} v_{ij},\cdots,\max_{1\le i\le m} v_{on}\right] \end{aligned} \tag{8}$$

The grey correlation coefficient η_{ij} between indicator j about subject i and the standard series $\boldsymbol{v}_o$ is:

So the grey correlation matrix $\boldsymbol{\eta}$ is:

3.3. The Realization of Evaluation Model of Teaching Ability of Aerobic

Based on weight sequence $\boldsymbol{W}$, the grey correlation degree δ between the subject and the standard series $\boldsymbol{v}_o$ is:

Suppose the grey correlation degree of the index system R^k about subject i is $\delta_i^{R^k}$, the grey correlation matrix $\boldsymbol{\delta}^R$ is:

If the weight of the index system is w_{R^k}, the comprehensive weighed grey correlation degree about the subject i is κ_i:

According to κ_i, we can find out the optimal subject of teaching ability of aerobics, following the principle expressed as (14):

$$\kappa_o = \max\left[\kappa_1,\cdots,\kappa_i,\cdots,\kappa_m\right] = \kappa_p \tag{14}$$

Subject p has the best teaching ability of aerobics.

4. Empirical Study

Institute of Physical Education implemented talent projects and produced many excellent players. This plays an active role in promoting the development of the institution. So, it is significant to evaluate the performance of students in the talent projects. This paper takes students in the talent projects as the subjects in order to test the model. Tables 5, 6 and 7 show evaluation data of three talents.

Table 5. Evaluation Data of Three Subjects for Design Ability of Aerobics Teaching

Evaluation system	Evaluation indicator	Evaluation data		
		A	B	C
Evaluation index system of design ability of aerobics teaching R^1	Teaching-planning ability r_{01}^1	0.90	0.90	1.00
	Advancement of teaching method r_{02}^1	1.00	0.90	0.80
	Familiarity with the textbook r_{03}^1	0.90	1.00	0.90
	Abundance of teaching content r_{04}^1	1.00	0.85	0.90
	Completion of teaching tasks r_{05}^1	1.00	1.00	0.90
	Innovation of teaching style r_{04}^1	1.00	1.00	0.85
	Image processing ability r_{07}^1	0.90	0.85	1.00
	Action choreographing capability r_{08}^1	1.00	0.90	0.90
	Music choreographing capability r_{09}^1	1.00	0.90	0.90
	Number of subjects on teaching reform r_{10}^1	3	2	2
	Number of papers on teaching reform r_{11}^1	6	7	8
	Number of subjects on scientific research r_{12}^1	4	2	3

Table 6. Evaluation Data of Three Subjects for Implementation Ability of Aerobics Teaching

Evaluation system	Evaluation indicator	Evaluation data		
		A	B	C
Evaluation index system of implementation ability of aerobics teaching R^2	Language application ability r_{01}^2	0.85	1.00	0.90
	Professional knowledge r_{02}^2	1.00	0.90	0.85
	Sense of direction r_{03}^2	0.90	1.00	0.80
	Action teaching ability r_{04}^2	0.95	0.90	1.00
	Sense of music r_{05}^2	0.85	1.00	0.90
	Teamwork r_{06}^2	0.80	1.00	0.90
	Innovation ability r_{07}^2	1.00	0.90	1.00
	Appreciation ability r_{08}^2	1.00	0.90	0.85
	Knowledge integration ability r_{09}^2	1.00	0.85	0.80
	Teaching management ability r_{10}^2	0.90	1.00	1.00

Table 7. Evaluation Data of Three Subjects for Effectiveness of Aerobics Teaching

Evaluation system	Evaluation indicator	Evaluation data		
		A	B	C
Evaluation index system of effectiveness of aerobics teaching R^3	Number of teaching awards r_{01}^3	1	1	1
	Number of scientific research awards r_{02}^3	1	0	1
	Number of qualified students r_{03}^3	3	4	4
	Ratio of excellent students r_{04}^3	0.33	0.25	0
	Number of race with student participation r_{05}^3	12	16	16
	Number of awards obtained by students r_{06}^3	4	5	5
	Social service ability of students r_{07}^3	1.00	0.85	0.95
	Innovation ability of	0.85	1.00	0.85

	students r_{08}^3			
	Techniques of students r_{09}^3	1.00	0.85	1.00
	Social satisfaction on students r_{10}^3	1.00	0.80	0.85
	Social satisfaction on students r_{10}^3	1.00	0.80	0.85

According to the evaluation model of teaching ability of aerobics proposed in this paper based on grey correlation analysis, we can get the grey correlation coefficient for each evaluation subject, as is shown in Table 8, 9 and 10.

Table 8. Gray Correlation Coefficient of Design Ability of Aerobics Teaching for Three Subjects

Evaluation system	Evaluation indicator	Evaluation data		
		A	B	C
Evaluation index system of design ability of aerobics teaching R^1	Teaching-planning ability r_{01}^1	0.714	0.714	1.000
	Advancement of teaching method r_{02}^1	1.000	0.714	0.556
	Familiarity with the textbook r_{03}^1	0.714	1.000	0.714
	Abundance of teaching content r_{04}^1	1.000	0.625	0.714
	Completion of teaching tasks r_{05}^1	1.000	1.000	0.714
	Innovation of teaching style r_{04}^1	1.000	1.000	0.625
	Image processing ability r_{07}^1	0.714	0.625	1.000
	Action choreographing capability r_{08}^1	1.000	0.714	0.714
	Music choreographing capability r_{09}^1	1.000	0.714	0.714
	Number of subjects on teaching reform r_{10}^1	1.000	0.667	0.667
	Number of papers on teaching reform r_{11}^1	0.500	0.875	1.000
	Number of subjects on scientific research r_{12}^1	1.000	0.333	0.500

Table 9. Gray Correlation Coefficient of Implementation Ability of Aerobics teaching for Three Subjects

Evaluation system	Evaluation indicator	Evaluation data		
		A	B	C
Evaluation index system of implementation ability of aerobics teaching R^2	Language application ability r_{01}^2	0.400	1.000	0.500
	Professional knowledge r_{02}^2	1.000	0.500	0.400
	Sense of direction r_{03}^2	0.500	1.000	0.333
	Action teaching ability r_{04}^2	0.667	0.500	1.000
	Sense of music r_{05}^2	0.400	1.000	0.500
	Teamwork r_{06}^2	0.333	1.000	0.500
	Innovation ability r_{07}^2	1.000	0.500	1.000
	Appreciation ability r_{08}^2	1.000	0.500	0.400
	Knowledge integration ability r_{09}^2	1.000	0.400	0.333
	Teaching management ability r_{10}^2	0.500	1.000	1.000

Table 10. Gray Correlation Coefficient of Effectiveness of Aerobics Teaching for Three Subjects

Evaluation system	Evaluation indicator	Evaluation data		
		A	B	C
Evaluation index system of effectiveness of aerobics teaching R^3	Number of teaching awards r_{01}^3	1.000	1.000	1.000
	Number of scientific research awards r_{02}^3	1.000	0.111	1.000
	Number of qualified students r_{03}^3	0.333	1.000	1.000
	Ratio of excellent students r_{04}^3	1.000	0.340	0.111
	Number of race with student participation r_{05}^3	0.333	1.000	1.000
	Number of awards obtained by students r_{06}^3	0.385	1.000	1.000
	Social service ability of students r_{07}^3	1.000	0.455	0.714
	Innovation ability of	0.455	1.00	0.455

	students r_{08}^3			
	Techniques of students r_{09}^3	1.000	0.455	1.00
	Social satisfaction on students r_{10}^3	1.000	0.385	0.455

Thus, we can get the grey correlation matrix of index system for each subject, namely,

According to weight assignment in AHP, the weigh for each index system is 0.186, 0.356 and 0.458. So the comprehensive weighed grey correlation sequence is:

From the sequence, we can see subject A is the best among three subjects from the Institute of Physical Education.

5. Conclusions

Targeting at limitations of the analysis of teaching ability of aerobics, this paper proposes an evaluation method and model of teaching ability of aerobic based on multiple intelligence theory. Its contributions lies in: (1) it first constructs the evaluation index system of teaching ability of aerobics based on multiple intelligence theory while taking into account design, implementation and effectiveness of aerobics teaching, making the evaluation more reasonable and scientific; (2) it constructs the grey correlation analysis model in which quantitative and qualitative evaluation are combined, making the evaluation easier to operate; (3) the index system of teaching ability of aerobics is quite clear with definite physical definitions, and easy to achieve on the computer. It provides support for the intelligent analysis of teaching ability of aerobics; (4) the empirical study proves that the model can serve the research purpose well.

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