2014

ISSN : 0974 - 7435 Volume 10 Issue 19

BioTechnology

An Indian Journal

FULL PAPER

BTAIJ, 10(19), 2014 [11361-11366]

Applied research of the mathematical model ofthe university pe teaching quality evaluation

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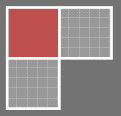
ABSTRACT

University education aims at bringing up talents with high qualities, of which university PE education is an effective way to for students to embrace comprehensive development in morality, intelligence, sports, aesthetics and labor. Based on the two-dimensional quality classification of the KANOtheory mentioned by the Kano theory, this paper improves the SERVQUAL model according to the status quo of the university PE teaching, summarized and tests the university students' evaluation of the university PE teaching qualityin both quantitative and qualitative perspectives and comes to several valuable conclusions.

KEYWORDS

University PE education; Mathematical model; Kano theory.



INTRODUCTION

Education is to cultivate students with health and independent personality in essence, especially to bring up talents with all-around development in morality, intelligence, sports, aesthetics and labor. University education is an important way to nurture talents with high qualities, the peak for school PE education and an important platform for students to learn theoretical knowledge and skills, and cultivate themselves with scientific ideas. However, considering the current university PE education, the health status of the university students is declining, which is mainly reflected as weak body, sub-health and emotional fluctuations. Apart from some objective factors, university's inadequate attention to the evaluation of the PE teaching quality is also an important reason. Due to lack of evaluation standards, the different PE teaching quality in every university is hard to be demonstrated.

In order to better evaluate the university PE teaching quality, Noriaki Kano, a professor of Tokyo University of Science, and his colleague, FumioTakahashi, published an article entitled *Motivation and Hygiene Factor* in Quality in October 1979, in which satisfactory and dissatisfaction standards were introduced into the quality management field for the first time. In 1982, Kano read his report of *Attractive Quality and Must-be Quality* in the 12thJapanese Quality Conference Annual, and officially published the report in the magazine *Quality*, which signaled the official establishment of the attractive quality theory of the KANO model.

In the late 1980s, American marketing experts A. Parasuraman, Zeithaml and Berry based onTotal Quality Management to put forward a new service quality evaluation system, which is called Service Quality Theory or SERVQUAL. At the core of the theory is the Service Quality Gap Model, which means service quality is decided by the gap between the service quality experienced by users and the users' expected service quality.

Up to now, both Kano theory and SERVQUAL theory have been adopted by many industries to evaluate their service quality. These mature theories are also applicable to the service evaluation of university teaching. According to the status quo of the university PE teaching, this paper employs the two-dimensional quality classification of the KANO theory to improve the Service Quality Gap Model of the SERVQUAL theory and summarize and test the university students' evaluation of the university PE teaching quality in both quantitative and qualitative perspectives. The evaluation results of the paper boast some referential value.

KANO THEORY AND ITS APPLICATION VALUE IN TEACHING EVALUATION

Since Kano puts forward the KANO theory, a two-dimensional perception of the satisfaction degree of the quality attributes and the customer's satisfaction degree has been established. According to the objective service performance and the customers' subjective feeling, KANO theory divides quality attributes into five categories: 1) Attractive Quality (A): "These attributes provide satisfaction when achieved fully, but do not cause dissatisfaction when not fulfilled;" 2) One-dimensional Quality (O): "These attributes result in satisfaction when fulfilled and dissatisfaction when not fulfilled;"3) Must-be Quality (M): "These attributes are taken for granted when fulfilled but result in dissatisfaction when not fulfilled;" 4) Indifferent Quality (I): "Thee attributes refer to aspects that are neither good nor good, and they do not result in either customer satisfaction or customer dissatisfaction;" and 5) Reverse Quality: "These attributes result in satisfaction when fulfilled and dissatisfaction when not fulfilled."

The traditional perception of the teaching quality is one-dimensional. In other words, the attributes of the teaching quality result in satisfaction when fulfilled and dissatisfaction when not fulfilled. However, the one-dimensional evaluation of teaching quality is too narrow, which cannot fully show students' evaluation. Thus, KANO theory and SERVQUAL theory can be adopted to evaluate the satisfaction degree of university's teaching quality to help university teachers learn students' demands and summarize the factors influencing students' satisfaction degree of university's teaching quality.

SATISFACTION EVALUATION OF UNIVERSITY'S PE TEACHING QUALITY

Evaluation indexes

According to the status quo of the university PE teaching, the requirements of important index of professional evaluation and the principles of KANO theory, this paper establishes five evaluation indexes, including tangibles, reliability, responsiveness, assurance and empathy, to evaluate the university PE teaching quality. To put it specifically, tangibles refer to the tangible teaching ground; reliability refers to PE teachers' ability to fulfil the teaching tasks; responsiveness refers to PE teachers' willingness to help students to learn; assurance refers to PE teachers' professional knowledge and their ability to convey trust and confidence; and empathy refers to whether PE teachers can help students by putting themselves in students' shoes.

Questionnaire survey design

The University PE Teaching Quality Questionnaire Survey designed by this paper refers to the SERVQUAL model put forward by A. Parasuraman, Zeithaml and Berry and suggestions of experts and students. According to KANO theory, the questionnaire surveys students' positive and negative evaluations of university PE teaching quality. There are five scales for

the scoring of different answers, namely 1 point stands for "Like," 2 points for "Take for granted," 3 points for "No impression," 4 points for "Acceptable" and 5 points for "Dislike." The questionnaire survey is anonymous by choosing university students of certain area as the respondents. All the questionnaires are delivered at random. Finally, 500 copies are handed out, of which 481 are collected, and the valid questionnaires are 452, registering a validity percentage of 90.4%.

Summary of the questionnaire survey

Reliability and validity of the questionnaires

After all the questionnaires are collected, the general correlation method and students' T test are adopted to analyze the questionnaire result. All the T tests reach the significant level ($P < 0.05$) as well as all the generation correlation tests ($P < 0.05$). All the questions are saved for the preparation of later analysis. Firstly, assume the reliability of various sub-scales and total scales is Cronbach's coefficient. When $x>0.7$, it suggests the reliability is relatively high; when $0.35<x<0.7$, it suggests the reliability is so-so; and when $x< 0.35$, it suggests the reliability is low. The five-dimensional x coefficients of the questionnaire's positive questions are namely 0.85 for intangibles, 0.82 for reliability, 0.74 for responsiveness, 0.66 for assurance, 0.80 for empathy and 0.86 for total scales.

As an important way to cultivate high quality talents, university education is the peak of school PE education and an important platform for students to learn theoretical knowledge and skills and to establish scientific ideas. However, considering the current university PE education, the health status of the university students is declining, which is mainly reflected as weak body, sub-health and emotional fluctuations. Apart from some objective factors, university's inadequate attention to the evaluation of the PE teaching quality is also an important reason. Due to lack of evaluation standards, the different PE teaching quality in every university is hard to be demonstrated.

Attributes classification

The questionnaire survey offers a clear picture of students' positive and negative evaluations of university PE teaching quality. According to the frequency of the answer of each question, the percentage of various attributes is statistically analyzed. Finally, the quality attribute of different questions is classified. (See TABLE 1)

TABLE 1 : Two-dimensional quality classification

Lack Have	Like	Take for granted	No impression	Acceptable	Dislike
Like	Q	A	A	A	O
Take for granted	R	I	I	I	M
No impression	R	I	I	I	M
Acceptable	R	I	I	I	M
Dislike	R	R	R	R	Q

Note: "A" stands for "Attractive Quality;""O" stands for "One-dimensional Quality;""M" stands for "Must-be Qualities;""Indifferent Quality;""R" stands for "Reverse Quality;" and "Q" stands for disputable answers.

Calculation of quality satisfaction degree

Though TABLE 1 provides the two-dimensional quality classification, it is inevitable to accurately know students' satisfaction degree when different quality attributes are fulfilled and their dissatisfaction when unfulfilled. To the end, this paper adopts KANO two-dimensional questionnaire survey to put forward quality index formula. Through the formula, students' satisfaction degree and dissatisfaction degree can be worked out when certain quality attribute is fulfilled and unfulfilledrespectively. This is regarded as an important standard for the improvement of quality attributes. The closer the coefficient is to "0," the smaller the influence of the quality attribute on students; and the closer the quality attribute is to "1," the bigger the influence of the quality attribute on students.

The quality index calculation formula is shown as below:

Satisfaction coefficient =(A+O)/(A+O+M+I);

Dissatisfaction coefficient =(O+M)/(A+O+M+I) ;

RESEARCH RESULT AND ANALYSIS

Two-dimensional quality classification of KANO theory

It can be seen from TABLE 2: Among the 23 quality attributes, there are 9 Must-be Quality attribute, accounting for 39.1% of the total; 5 Attractive Quality attribute, accounting for 21.7%; and the quality attribute classification of the 18^{th} attribute is disputable, which is thus eliminated. Besides, it can be seen that there are no Reverse Quality attribute and

Indifferent Quality attribute, which further verifies the reliability of the questionnaire and also suggests university students' affirmative evaluation of the university PE teaching quality. Theoretically speaking, Metzler thought that Must-be Quality attribute is the most important standard, following by One-dimensional Quality attribute, Attractive Quality attribute and finally Indifferent Quality attribute. The final expression gained is M>O>OA>I, which coincides with the survey result of this paper.

TABLE 2 : PE teaching quality attributes classification and analysis result

Indexes	Attribute items	A	O	M	I	R	Q	Classification
Tangibles	1. Teaching ground environment	20.4	51.8	19.6	7.1	0.3	0.8	O
	2. Teaching ground space	19.6	50.8	20.2	8.2	0.3	1.0	O
	3. Teaching ground maintenance	21.9	50.8	16.8	9.9	0.3	0.3	O
	4. Quantity and quality of devices used in PE classes	18.4	45.2	24.2	11.7	0.5	0	O
Reliability	5.Teachers' introduction of the teaching syllabus at the beginning of the term	29.6	15.6	40.1	12.5	1.5	0.8	M
	6. Teachers' employment of different teaching methods to help students	54.1	18.9	7.4	18.4	0.5	0.8	A
	7. Teachers' demonstration of correct sports techniques to help students	10.9	20.5	54.4	13.4	0.3	0.5	M
	8. Teachers' discussion about sports techniques with students	17.8	21.9	37.5	22.0	0.3	0.5	M
Responsiveness	9. Teachers' employment of PE devices to assist in their teaching	16.2	17.1	46.1	19.8	0.3	0.5	M
	10. Teachers taking sports together with students	55.5	16.9	4.9	22.3	0	0.5	A
	11.Teachers' immediate adjustment of their teaching styles and content according to students'physical ability	26.9	43.5	13.8	15.1	0.5	0.3	O
	12. Teachers' design of diversified PE courses for students	19.1	21.7	40.5	18.2	0	0.5	M
	13. Teachers' immediate rectification of students' wrong sports techniques	15.0	19.0	46.3	18.4	0.3	1.0	M
	14.Teachers' immediate resolution of students' questions	22.7	44.1	12.1	15.9	0	0.3	O
Assurance	15. Teachers' provision of individual guidance	49.2	17.6	6.4	25.8	0.8	0.3	A
	16. Teachers' organization of sports contests	40.6	19.6	5.1	31.6	2.0	1.0	A
	17. Teachers' warm-up activities with students	28.3	16.8	14.8	38.3	1.5	0.3	M
	18. Teachers' emphasis on sports notes	22.2	27.0	23.5	26.5	0.5	0.3	Q
Empathy	19.Learning and improvement of sports techniques under teachers' guidance	43.4	28.9	8.8	18.1	0	0.8	A
	20. Teachers' creation of happy learning atmosphere	23.1	17.6	46.7	11.8	0.5	0.3	M
	21. Teachers' respect for students' opinions and communication with students	21.8	56.4	12.1	9.2	0	0.5	O
	22.Teachers' affinity	27.3	57.9	6.1	8.3	0	0.5	O
	23. Teachers' praise for excellent students	24.2	21.8	36.3	17.9	0	0.8	M

After improved calculation of the quality satisfaction degree, the dissatisfaction coefficient of "teaching ground environment""Quantity and quality of devices used in PE classes" and "teaching ground space" is the highest. Inadequate PE ground facilities and devices are major factor arousing students' dissatisfaction of university PE education quality. Therefore, universities should pay great attention to completing the PE ground and PE devices. Based on that, universities should actively employ various resources to expand PE projects to meet students' demands of PE courses and improve students' satisfaction degree of the university PE teaching quality.

The PE teaching quality evaluation system in this paper is focused on students, and the attribute of its indexes reflects students' attention degree. In view of the above conclusions, Must-be Attribute should firstly be improved. For

example, teachers should introduce to students their teaching syllabus at the beginning of the term' teachers employ different teaching methods to help students; and teachers demonstrate correct sports techniques to help students. Students take all these attributes for granted. When these attributes are fulfilled, students will not increase their satisfaction degree of the teaching quality; while when unfulfilled, students will show dissatisfaction to the teaching quality.

The second quality attribute calling for improvement is One-dimensional Quality, which includes the hardware devices, such as the teaching ground environment, teaching ground maintenance, quantity and quality of devices used in PE classes, and the software situation, such as teachers' immediate adjustment of teaching methods and content and teachers' immediate resolution of students' questions. Students take all these attributes for granted. However, if any lacks, they will become dissatisfied with the PE teaching quality. Therefore, the improvement of One-dimensional Quality attribute refers to not only the improvement of hardware devices, such as PE ground devices, but also teachers' provision of care and targeted guidance to teachers in the process of teaching sports techniques.

Besides, Attractive Quality attribute should also be improved. For example, teachers can employ different teaching methods to help students; teachers show respect for students' opinions and communicate with them; and teachers create happy learning atmosphere. Universities can regard this attribute as their competition capital. If teachers can employ different teaching methods for teacher-student interaction, the PE teaching quality can be greatly improved, which is also the best strategy to improve students' satisfaction degree of PE teaching quality.

Calculation of quality satisfaction degree

The TABLE 3 shows satisfaction coefficient of "teachers' affinity""teachers' creation of happy learning environment" and "teachers' respect for students opinions and communication with students" is quite high, which suggests that students will show higher satisfaction degree for the PE teaching quality if the PE teachers think for students and show special attention to them. However, the dissatisfaction coefficient of "teaching ground environment""quality and quantity of devices used in PE classes" and "teaching ground space" is the highest, which suggests the incomplete university PE teaching environment and devices, thus arousing students' dissatisfaction.

TABLE 3 : Improvement indexes of PE teaching quality attributes (partial)

Attribute item	Satisfaction coefficient	Index order	Dissatisfaction coefficient	Index order
1. Teaching ground environment	0.73		0.72	1
2. Teaching ground space	0.71		0.72	2
4. Quality and quantity of devices used in PE classes	0.67		0.71	3
6.Teachers' employment of different teaching methods to help students	0.46	22	0.57	
9.Teachers' employment of PE devices to assist in their teaching	0.64		0.23	22
14.Teachers' immediate resolution of students' questions	0.73		0.22	23
15.Teachers' provision of individual guidance to students	0.67		0.24	21
17.Teachers' warm-up activities with students	0.46	23	0.32	
18. Teachers' emphasis on the sports notes	0.50	21	0.51	
20.Teachers' creation of happy learning atmosphere	0.85	2	0.45	
21. Teachers' respect for students' opinions and communication with students	0.81	3	0.59	
22.Teachers' affinity	0.86	1	0.64	

CONCLUSIONS AND SUGGESTIONS

Among the 23 quality attributes of this paper's survey report, there are 9 Must-be Quality attribute, accounting for 39.1% of the total; and 5 Attractive Quality attribute, accounting for 21.7%.This suggests students tend to have a positive evaluation of the university PE teaching quality. Must-be Quality should be firstly be improved, followed by One-dimensional Quality and Attractive Quality, which should be improved in the long-term perspective

The two-dimensional quality attribute classification method does not stay the same. The original Must-be Quality attribute may be turned into Indifferent Quality attribute due to the changes of time and environment. From the research

result of customer psychology and the verified conclusions, it can be seen that Attractive Quality, One-dimensional Quality and Must-be Quality can change from one to the other in turn. In other words, Attractive Quality may gradually turn into One-dimensional Quality after a period of time and finally turn into Must-be Quality. The change rule suggests the progressiveness of students' demands and the difficulty to satisfy students' demands. Therefore, the same questionnaire should be employed to conduct tracing investigation on a regular basis. Only in this way can the students' real demands be satisfied and the students' satisfaction degree of university PE teaching quality be increased.

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