

## Determination of Indicators and Weights of College Teaching Evaluation System Based on KANO Model

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**Keywords:** Teaching evaluation; KANO model; evaluation index; Digital Literacy

**Abstract.** "Digital Literacy" is "survival skills in the digital age". The cultivation of this ability is mainly based on college teachers. Therefore, a reasonable evaluation of the teaching ability of teachers in the new era not only can promote the professional development of teachers, but also can effectively optimize the training programs for colleges and universities. The paper uses KANO evaluation model and entropy method mathematical model, to identify 15KANO demand classification, to screen important parts, and to calculate the weight of the indicators. It provides a new idea for the rational construction of the teaching evaluation system in colleges and universities.

### Research Significance

In 1994, the Israeli scholar Y.Eshet – Alkalai proposed the concept of “digital literacy”. Digital literacy is a comprehensive ability formed by the intersection and integration of media, network, computer and other literacy elements. It is called “survival skills in the digital age” and “important assets of the information society”. It is generally believed that the ability to criticize and use digital information creatively in social life, work and study is digital literacy. The cultivation of this ability is inseparable from the education and training of colleges and universities. Higher education needs to define the teaching concept of “digital literacy” in the subject teaching, and then cultivate students' comprehensive ability to adapt to social needs. As the main protagonist of education and teaching, teachers' professional teaching ability directly affects the quality of talents training in colleges and universities, thus affecting the effect of new engineering construction. Under the background of new engineering, how to evaluate the teaching ability of teachers is of great significance to the professional development of teachers and the promotion and optimization of colleges and universities.

Traditional teaching evaluation generally tests by the methods of leadership evaluation, peer evaluation or student evaluation. Because of the lack of statistical data and parameters, the statistical results are relatively one-sided. And scientific rules cannot be established, so the evaluation results are subjective. In the evaluation of college teachers' ability, many studies have been carried out, such as Zhang Hongyang's use of grey system theory [1], Yu Mingchuan's multi-source evaluation method [2], Zhang Youxu and Chen Wei use fuzzy mathematics evaluation method to study and evaluate [3], both Trying to improve the scientific nature of teacher evaluation through different methods. But the rating indicators have not been discussed in depth. Choosing reasonable, typical and objective evaluation indicators is very important. It can effectively avoid the distortion of teaching ability evaluation. Based on the KANO model, this paper determines the teaching evaluation index of colleges and universities centered on the students' "digital literacy" in the era of education big data, so as to provide more reasonable evaluation ideas and methods for the evaluation system.

### Principles of KANO Model

In 1984, Kano Kyu proposed the KANO model to identify the importance of relevant indicators to users, and to achieve the classification of KANO's different demand levels, the screening of key indicators, the weight calculation of hierarchical indicators, and the importance ranking. The

discriminating of the importance of traditional indicators mainly depends on the user's unidirectional cognition. The KANO model breaks through this limitation. By setting opposite questions between the positive and negative directions, to establish a nonlinear relationship between user satisfaction (SI) and user dissatisfaction (DSI) [4]. According to the importance relationship, the KANO model divides the evaluation indicators into five categories: basic indicators, expected indicators, attractive indicators, non-differential indicators and reverse demand indicators.

## Research Process

(1) The main process of this study is shown in Figure 1. Analyze the purpose and significance of the teaching ability evaluation system centered on the students' "digital literacy" in the era of education big data, and obtain relevant evaluation indicators through research.

(2) Completing the data collation and cleaning of the questionnaire through the preparation of the KANO survey questionnaire; distinguishing the categories of the evaluation indicators;

(3) Remove the results of the indifference and reverse demand, and calculate and derive the demand categories to which other indicators belong;

(4) Based on the mathematical model of entropy method, calculate the weights of indicators at all levels, and determine the order of importance of the relevant indicators of the teaching ability evaluation system according to the weight value.

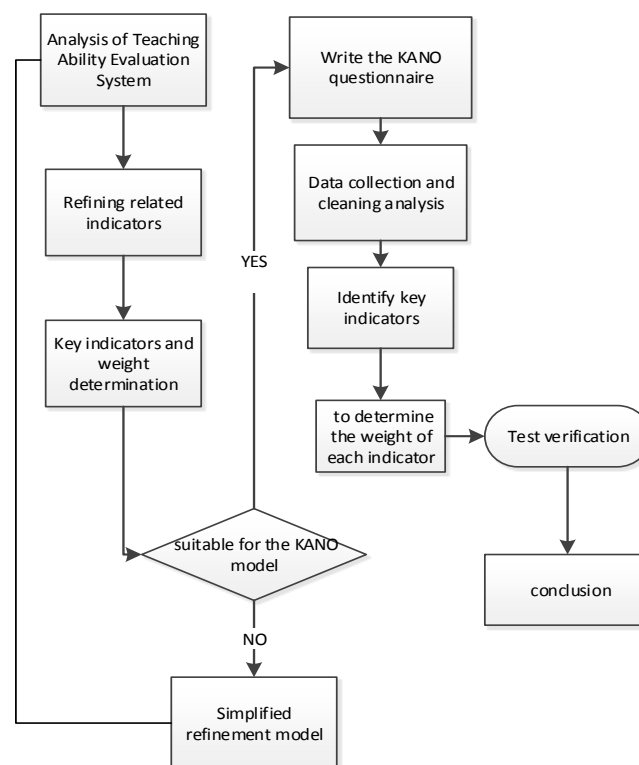


Figure. 1 Process of the research

## To Establish the Mathematical Model

1) Construct a decision matrix. The evaluation index is  $n$ , and the indicators are evaluated for  $m$  respondents.  $a_{ij}$  indicates that the  $i$ -th survey object scores the  $j$ -th index and finally forms a

decision matrix  $A = (a_{ij})_{m \times n}$ . The scores are based on the Level 5 Likert scale, which is divided into five levels: minor, unimportant, general, important, and very important. The corresponding scores are 1, 2, 3, 4, and 5.

2) Normalize the decision matrix A. Use to normalize the decision matrix A and get it.

3) Calculate the entropy value of the the indicator  $c_j$ ,

$$c_j = \sum_{i=1}^m b_{ij} \ln b_{ij}, i=1, 2, \dots, m, j=1, 2, \dots, n$$

$$e_j = \frac{1}{c_j}, j=1, 2, \dots, n$$

4) Calculate the weight of each indicator. , indicator weight

$$u_j = \frac{e_j}{\sum_{j=1}^n e_j}, \sum_{j=1}^n u_j = 1$$

## Case Study

According to the relevant literature <sup>[5-8]</sup>, the research and interviews of college teachers, and the author's practical understanding, this study has constructed 15 relevant indicators from the aspects of teachers' basic conditions, work ability, research results, digital literacy, etc.

1) Design the Kano questionnaire and complete the survey. The questionnaire was held on the university campus. Representative senior students, first-line professional teachers and teaching work managers in the school were selected as the research objects. A total of 150 questionnaires were distributed and 114 copies were collected.

2) Organize and clean the survey data to determine the indicator category. As shown in Table 1, when the positive and negative questions have different answers, the category of the indicator can be determined according to the table, M is the basic indicator, which is the indicator of the evaluation system; O is the expected indicator, if there is this indicator, the system The evaluation is more ideal; A is a charismatic indicator, expecting such evaluation indicators; R means that customers do not need this characteristic; I means that the research object does not care about this indicator, Q indicates controversial results, generally belongs to the questionnaire design error, or belongs to The attitude of the research object, I and Q need to be eliminated.

Table 1 KANO classification

index	Negative problem (without ××)					
Positive (with ×)	Scale	like	Must be	Don't care	Can endure	dislike
	like	Q	A	A	A	O
	Must be	R	I	I	I	M
	Don't care	R	I	I	I	M
	Can endure	R	I	I	I	M
	dislike	R	R	R	R	Q

3) Apply KANQ model to determine key indicators

The KANO model determines the sensitivity of the indicator by judging the satisfaction and dissatisfaction of the research object's influence on the indicator, and then determines the key

factors of the system evaluation. Satisfactory influence (SI) and dissatisfied influence (DSI) calculation methods are shown in the formula, and the calculation results are shown in Table 2.

$$SI = (A+O) / (A+O+M+I) \quad (1)$$

$$DSI = -1 \times (O+M) / (A+O+M+I) \quad (2)$$

Table 2 results of indicator SI\DSI

Capability indicator	SI	DSI	Capability indicator	SI	DSI
degree	0.42	-0.39	Professional curriculum construction ability	0.42	-0.69
Unit assessment	0.48	-0.40	Curriculum practice test ability	0.48	-0.60
Continuing education experience	0.47	-0.45	competition Winning	0.47	-0.41
Teaching reward	0.65	-0.63	Research Papers	0.55	-0.43
computer skill	0.60	-0.47	Affinity	0.54	-0.64
Foreign language level	0.57	-0.49	Student evaluation satisfaction	0.68	-0.59
Teaching plan design ability	0.38	-0.73	Satisfactory peer review	0.64	-0.59
Classroom knowledge update ability	0.68	-0.59			

The SI value of each evaluation index is the abscissa, and the DSI value is the ordinate to form a sensitivity matrix. Taking the origin 0 as the center, the evaluation index 0.5 is the radius of the arc, and the farther away from the far point, the greater the sensitivity, the statistical ability can determine the teaching plan design ability, professional curriculum construction ability, student evaluation satisfaction, curriculum practice The ability to test and the ability to update classroom knowledge is a key element, that is, basic needs. According to the survey results, the requirements of each category are re-encoded.

#### 4)Indicator weight

All indicators are classified into three categories according to the KANO level. The three types of indicators M, O, and A are called first-level indicators, and the weight values of the evaluation system are calculated according to the entropy method mathematical model. The values are shown in Table 3. The subdivision index under the M, O, and A categories is called the secondary index, and the weight value is calculated by the same level index weight calculation method. The integrated weight value is the product of the first and second index weights, as shown in Table 3.

Table 3 index weighting and ranking

Primary indicators and weights	Secondary indicators	Secondary indicator weight	Comprehensive weight	Order of importance
Mandatory indicator 0.47074	course platform Course design innovation Student evaluation teaching design knowledge update ability	0.11403	0.053678	2
		0.09181	0.043219	4
		0.09804	0.046151	3
		0.11497	0.054121	1
		0.06349	0.029887	8
Expectation indicator 0.30513	degree Continuing education computer skill Foreign language Affinity	0.10802	0.03296	7
		0.04582	0.013981	11
		0.07757	0.023669	9
		0.03778	0.023669	13
		0.06531	0.011528	10
Glamour indicator 0.20901	Satisfactory peer review Teaching reward competition Winning Research Papers	0.11402	0.019928	6
		0.11502	0.034791	5
		0.05778	0.035096	12
		0.04376	0.012077	14
		0.03233	0.009146	15

## Research Results

According to the hierarchical theory of Maslow's needs, the needs at the lowest level need to be met. As shown in Table 5, the necessary indicators, expected indicators, and attractive indicators in the teaching evaluation system indicators are KANO level one indicators, and the necessary index weights are the highest. The teaching evaluation system needs to meet such indicators to the greatest extent.

The above 15 secondary demand indicators can be divided into three different types. The first type is the teaching design and implementation ability evaluation indicators, including the professional curriculum platform construction information, curriculum design innovation, teaching design diversity, student evaluation satisfaction, classroom knowledge update ability. Secondly, it is the evaluation index of the personal quality ability of the implementers, such as degree education, unit assessment, continuing education experience, computer level, foreign language level, and affinity. The last category is the evaluation indicators for the research, teaching and research results of the implementers, such as teaching awards, competition awards, and research papers. According to the analysis of weight results, the demand for instructional design and implementation ability in the secondary demand indicators is higher than the demand for the individual quality and scientific research results of the implementers.

## Conclusion

Based on the typicality, operability and achievability of evaluation indicators, this paper takes the indicators of college teaching evaluation system centered on cultivating students' "digital literacy" as the research object. Based on extensive investigation and verification, the selected 15 categories are selected. The evaluation indicators are evaluated for importance. With the KANO evaluation

model and the entropy method mathematical model, the KANO demand classification, screening, weight calculation and importance ranking of 15 categories of evaluation indicators are realized, which provides a new idea for the rational construction of the teaching evaluation system in colleges and universities.

### **Acknowledgement**

Focus research topics of TianJin Educational work(China)-“Research on Comprehensive Teaching Strategies of Professional Teaching Centered on College Students' Digital Literacy”

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