Multi-attribute Comprehensive Evaluation of Job Satisfaction Based on the Entropy and TOPSIS Method: Evidence from University Teachers

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Abstract. As the direct undertaker of teaching and scientific research work in universities, university teachers' job satisfaction is very important to the smooth development of various jobs in universities. In order to solve the problem that it is difficult to accurately quantify and objectively evaluate the job satisfaction of university teachers, this paper proposes an evaluation index system and evaluation method for university teachers' job satisfaction based on the entropy weight method and the method. Firstly, this paper defines the connotation of university teachers' job satisfaction from a systematic perspective, and builds an evaluation index system for university teachers' job satisfaction. Secondly, the expert's experience scoring was revised by applying the entropy weight method, and a more objective and accurate index weight was determined. Finally, TOPSIS method is used to comprehensively evaluate the job satisfaction of university teachers. The research results of this paper can be used to understand the level of teachers' job satisfaction in universities, and provide useful decision support for improving teachers' job satisfaction.

Keywords: Entropy weight method · TOPSIS method · Multi-attribute comprehensive evaluation · Job satisfaction

1 Introduction

The research of job satisfaction firstly appeared in the research report of the Hawthorne experiment conducted by Mayo (1933) [10], and he believed that job satisfaction is a morale-boosting psychological state that can have a positive impact on labour motivation and productivity. Scholars generally believe that job satisfaction is a psychological state that people positively reflect on the job itself, salary, promotion, job pressure, and interpersonal relationships with leaders and colleagues in the process of working [7, 11]. College teachers are the backbone of the social intellectual group. They are not only the main bearers and implementers of educational activities, but also the imparters of knowledge, the enlighteners of moral education, and the cultivators of students' skills. Teacher's job satisfaction refers to the sense of completion and satisfaction that teachers feel in their work, and it is an important concept to measure teachers' work status

[16]. The university teachers' job satisfaction directly affects the work enthusiasm and work performance of university teachers, which in turn affects the quality of teaching and research and the quality of student training in universities. The university teachers' job satisfaction is an important support for the construction of university teachers, and it is also an important direction and theoretical basis for reforming and improving the management mechanism of universities.

The current research on job satisfaction of university teachers can be mainly divided into two categories: firstly, quantitative research on the status quo of university teachers' job satisfaction. Secondly, the current studies mainly focus on the relationship between specific influencing factors and university teachers' job satisfaction [2, 14]. As for the research methods of teachers' job satisfaction, the method of theoretical speculation is generally adopted, which is carried out in a top-down deductive way [20]. However, this method ignores that the essence of teachers' job satisfaction is the evaluation of job value feedback and individual emotional cognition, which is characterized by a strong subjective sense. Thus, it is difficult to achieve accurate evaluation and analysis of teachers' real work situations and job satisfaction. Investigating the current situation of university teachers' job satisfaction and analysing the factors that affect university teachers' job satisfaction are crucial to correcting the unreasonable orientation of current university education evaluation and establishing a scientific evaluation system that helps improve teachers' job satisfaction.

Afshar and Mehdi (2016) [1] stated the most crucial factors contributing to poor job performance insufficient subject and pedagogic knowledge, unequal attention to individual students, lack of professional commitment, interpersonal relationship problems, and demotivation. Liu et al. (2018) [9] employed survey research in China to investigate the relationships among teacher evaluation, teacher self-efficacy, and teacher job satisfaction, and found that teachers' perceptions of their evaluation have a significant explanatory power on their job satisfaction. Quan (2016) [12] measures teachers' job satisfaction based on the factors such as economic income, working conditions, management, work itself, and self-realization, and the study shows that teachers' job satisfaction is positively correlated with teachers' job performance. Based on the conservation of resource theory, Li (2019) [8] explores the impact of the three dimensions(value consistency, demand-supply fit and demand-ability fit) of person-organization fit on the job satisfaction of young college teachers, and the mediating role of work-family balance in this path. Suzanne and Matthew (2017) [13] examined how social capital, teacher efficacy, and organizational support increase teacher job satisfaction, found that teacher efficacy mediated the relationship between teacher's trust and academic advice relationships and job satisfaction, and perceived organizational support strengthened the relationship between teacher efficacy and job satisfaction. Dong et al. (2022) used the fuzzy comprehensive evaluation method to comprehensively evaluate and compare the job satisfaction of scientific research, teaching, and teaching and scientific research teachers. The improvement of the job satisfaction level of university teachers has a positive effect on the establishment of a "people-oriented" education system, which is conducive to colleges and universities to attract and retain talents, promote the work enthusiasm of teachers, and then improve the universities' teaching quality and comprehensive impact.

Therefore, aiming at the evaluation of university teachers' job satisfaction, this paper will investigate the key influencing factors and indicators of university teachers' job satisfaction, and puts forward corresponding comprehensive evaluation methods, in order to provide suggestions and references for promoting the job satisfaction level of university teachers.

2   Index System of University Teachers' Job Satisfaction

The job satisfaction index system of university teachers should be an organic whole composed of a series of interrelated indicators that can accurately reflect the job satisfaction of university teachers. In order to accurately measure the job satisfaction of university teachers, referring to the previous literature on teachers' job satisfaction [4, 11, 20], combined with the work characteristics and work content of university teachers, and based on the principles of typicality and integrity of index content, quantifiable index and authenticity of data, this paper selects the indicators reflecting university teachers' job satisfaction from the aspects of teaching and scientific research, interpersonal relationship, organizational support and fair mechanism. Then, a three-tier evaluation index system of university teachers' job satisfaction is constructed in Table 1.

3   Evaluation Method of University Teachers' Job Satisfaction

The evaluation of university teachers' job satisfaction is a complex decision-making problem [4]. The whole evaluation process involves theories of organizational culture, organizational incentives, and social exchanges. It can be seen that the evaluation of university teachers' job satisfaction is a typical multi-objective evaluation problem. Currently, there are many multi-objective evaluation methods that have been put forward [4, 17]. Among them, when the job satisfaction of university teachers is taken as the evaluation object, the evaluation comments used by experts are often subjective and vague, which undoubtedly brings great difficult to the evaluation of university teachers' job satisfaction. Based on the above problems, this paper combines the subjective judgment of experts with the objective situation of teachers' work in colleges and universities, uses the entropy weight method to determine the weight of the evaluation index of university teachers' job satisfaction, and adjusts the subjective deviation of the expert judgment through the scientific weight coefficient. Then, the TOPSIS method is used as a comprehensive evaluation method to obtain the final ideal evaluation result.

3.1   Overview of Entropy Weight and TOPSIS

The concept of entropy is derived from thermodynamics and is a statistical physics and information theory term denoting a measure of uncertainty. The entropy weight method is an objective weighting method combining qualitative and quantitative analysis [17]. It determines the index weight according to the amount of information transmitted to the decision maker by each index. According to the definition and principle of the entropy weight method, when the entropy value of an index is larger, it means that the effective

Table 1. The evaluation index system of university teachers' job satisfaction

Objective	First-level index	Second-level index
Evaluation of university teachers' job satisfaction	Teaching and research work	Sense of achievement in research work
		Sense of achievement in teaching work
		Completion of research work
		Completion of teaching work
	Interpersonal relationship	Colleague Relationship Satisfaction
		Student Relationship Satisfaction
		Leader relationship satisfaction
		Off-campus social relations Satisfaction
	Organizational support	Hardware condition support
		Leader support
		Organizational culture support
	Fairness mechanism	Promotion mechanisms
		Treatment and benefits
		Cultivation and growth mechanisms

information provided by the index is less, its role in the comprehensive evaluation is less important, and its weight is smaller; Conversely, the larger the entropy value is, the more effective information the indicator provides, the greater the role it plays in the comprehensive evaluation, and the greater its weight [15].

The TOPSIS method is a common method in systems engineering. It is mainly used for multi-objective evaluation and decision-making analysis of limited schemes. It has many advantages, for example, there is no requirement for sample content, no requirement for sample data distribution, simple calculation process, and intuitive analysis of results [6, 19]. The analysis idea of TOPSIS is: in the original matrix based on normalization, find the optimal solution and the worst solution (represented by the positive ideal solution and negative ideal solution) in the finite solution, and then the distance between the evaluation object and the optimal solution and the worst solution is calculated respectively, and the relative proximity (closeness) between the evaluation object and the optimal solution is obtained, which is used as the basis for evaluating the pros and cons. The TOPSIS model does not have too many requirements on the number of indicators and sample size, and using the entropy method to measure the actual sample data can exclude the influence of subjective rating factors, so as to obtain more objective

results [18], which can effectively improve the objectivity and accuracy of evaluation analysis of university teachers' job satisfaction [3].

3.2 Entropy Weight-TOPSIS Method

The entropy weight-TOPSIS and its calculation process are shown as following steps:

For the evaluation of university teachers' job satisfaction with m teachers and n evaluation indicators, the initial data matrix can be denoted as $X = (x_{ij})_{m \times n}$.

(1) A dimensionless treatment of X matrix should be made firstly, and then get the normative matrix $Y = (y_{ij})_{m \times n}$, that is,

$$y_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \tag{1}$$

$i = 1, 2, 3..., m; j = 1, 2, 3..., n$

(2) Calculating the weight of the jth indicator of the ith teacher, that is η_{ij}.

$$\eta_{ij} = \frac{y_{ij}}{\sum_{i=1}^{m} y_{ij}} \tag{2}$$

(3) Calculating the entropy value e_j of the j indicator.

$$e_j = -\frac{1}{\ln m} \sum_{i=1}^{m} \eta_{ij} \ln \eta_{ij}, \; (j = 1, 2, 3 \ldots, n) \tag{3}$$

(4) Calculating the difference coefficient ψ_j for the j indicator.

$$\psi_j = 1 - e_j \tag{4}$$

For the j indicator, the larger the difference coefficient ψ_j, the more important the role of the indicator in the university teachers' job satisfaction evaluation; conversely, the smaller the χ_j, the less important the role of the indicator in the evaluation.

(5) Calculating the weight w_j of the j indicator.

$$w_j = \frac{\psi_j}{\sum_{j=1}^{n} \psi_j} \tag{5}$$

(6) Establishing the weighted data matrix $Z = (z_{ij})_{m \times n}$, where the element z_{ij} is:

$$z_{ij} = w_j y_{ij} \tag{6}$$

(7) Determining the positive ideal value Z^+ and the negative ideal value Z^- of the index, where are the maximum and minimum value of the evaluation object. The calculation formula is shown as follows

$$Z^+ = \left(z_1^+, z_2^+ \ldots, z_j^+\right) = \left\{\max z_{ij}\right\}$$

$$Z^- = \left(z_1^-, z_2^- \ldots, z_j^-\right) = \left\{\min z_{ij}\right\} \tag{7}$$

Table 2. The grades according to the value of relative closeness

Relative closeness	Grades	Status of job satisfaction
0–0.2	Level 1	Very dissatisfied
0.2–0.4	Level 2	Dissatisfied
0.4–0.6	Level 3	Generally satisfied
0.6–0.8	Level 4	Satisfied
0.8–1	Level 5	Very satisfied

(8) Calculating the Euclidean Distance of each evaluation object to the positive and negative ideal points。

$$E_i^- = \sqrt{\sum_{j=1}^{n} (z_{ij} - z_j^-)^2}$$
$$E_i^+ = \sqrt{\sum_{j=1}^{n} (z_j^+ - z_{ij})^2} \qquad (8)$$

$i = 1, 2, 3...,m; j = 1, 2, 3...,n$

(9) Calculating the relative closeness between the index value and the ideal solution of each evaluation object λ_i。

$$\lambda_i = \frac{E_i^-}{E_i^+ + E_i^-} \qquad (9)$$

(10) Evaluating each evaluation object according to the value of relative closeness. The greater the value of relative closeness λ_i, the higher the job satisfaction of the teachers; The smaller the value of relative closeness λ_i, the lower the job satisfaction of the teachers. Referring to the research Duan et al. (2022) [5], this study divides the status of the job satisfaction of university teachers into five grades according to the value of relative closeness (see Table 2).

4   Conclusions

The job satisfaction evaluation of university teachers can help universities to understand the work status and job satisfaction level of their teachers, so as to provide decision-making reference for better formulating the talent management policies, improving job design systems, optimizing organizational environment atmosphere, and stimulating work enthusiasm. From a system perspective, this paper constructs an evaluation index system for university teachers' job satisfaction with four dimensions including Teaching and research work, interpersonal relationship, Organizational support, and Fairness mechanism. This paper uses the entropy weight method to revise the expert's experience scoring results, determines the weight of the job satisfaction evaluation index, avoids the subjectivity of the traditional expert evaluation method and other multi-level and multi-index weight determination methods, and makes the evaluation results more objective,

accurate and more in line with reality. Then, based on the entropy weight method, the TOPSIS method is used to comprehensively evaluate the job satisfaction level of university teachers. The calculation process of the entropy weight method and the TOPSIS method is simplified, efficient and organized, and can achieve accurate and efficient evaluation results of the job satisfaction status of university teachers. To sum up, the evaluation system of university teachers' job satisfaction and corresponding evaluation method established in this paper are reasonable and practical, which can not only judge the comprehensive level of university teachers' job satisfaction, but also analyses the pros and cons of each university teacher's job satisfaction, and provide decision-making basis for improving the job satisfaction level of university teachers.

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