

Research on Satisfaction Assessment of Catering Enterprises Undertaking College Canteens Based on the Fuzzy Comprehensive Evaluation Method

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Abstract: With the continuous deepening of the socialization of university logistics, accurately evaluating the service quality of social catering enterprises contracted to operate university canteens has gradually become an important part of building first-class logistics services for "double first-class" universities. To construct a quantitative evaluation system for the satisfaction of teachers and students with the university canteen, this paper adopts the fuzzy comprehensive evaluation method to build a satisfaction matrix. Without the need for professional statistical software, the traditional qualitative survey results are calculated and transformed into quantitative evaluation data, objectively evaluating the university canteen from multiple dimensions of concern to teachers and students, and urging point-to-point improvement directions. This provides a feasible canteen management solution for university logistics managers, allowing for quantitative comparison of different contracting enterprises, thereby more targeted improvement of catering service quality, and providing an effective and simple evaluation system for building world-class logistics support services.

Keywords: Fuzzy Comprehensive Evaluation Method; Social Catering Enterprises; University Canteen; Satisfaction Evaluation

1. Introduction

As the socialization of university logistics continues to deepen, the phenomenon of social catering enterprises operating university canteens has become very common. Catering enterprises pursue economic benefits; as the regulatory body, the school requires catering enterprises to ensure food safety [1] and continuously improve the satisfaction of teachers and students. Therefore, the operation contracts of university canteens often include assessment mechanisms for enterprises [2], among which an indispensable means is the satisfaction survey of teachers and students [3].

The common method of satisfaction survey is to fill out questionnaires, mainly in the form of multiple-choice questions, and to count the results of the questionnaires [4], which is conducive to understanding the operation of the canteen in all aspects, such as the variety of dishes, taste, service quality, etc. [5]. However, it is difficult to quantify the comprehensive evaluation of specific canteen operation situations. It is obviously mechanistic to require teachers and students to give an absolute score as the evaluation result, and it is not suitable as the only basis for evaluating satisfaction [6]. Therefore, it is necessary to seek a way to combine quantitative and qualitative evaluations [7], making the evaluation conclusions more credible and persuasive [8,9].

Within the same university, introducing multiple social catering enterprises is beneficial to enriching the dining choices of teachers and students, forming a positive competition, and providing a refreshing dining experience. The survey results of different canteens with similar objective conditions always have their own strengths and weaknesses, some canteens have good taste, some have excellent service, and some are price-friendly. Horizontally, it is particularly difficult to comprehensively quantify the evaluation of which is better or worse, and how to determine the ranking and implement the elimination of the last place.

The fuzzy comprehensive evaluation method can effectively quantify the qualitative evaluation into a quantitative evaluation [10], and construct a comprehensive satisfaction index for teachers and students based on an objective and quantitative statistical model [11], evaluate the service situation and contract fulfillment of catering enterprises, and accurately give whether it has the qualification for renewal [12], reduce subjective factors, and control legal risks.

This paper takes a satisfaction survey of teachers and students in a certain school as an example, uses the fuzzy comprehensive evaluation method to analyze the questionnaire, compares the satisfaction of various canteens horizontally, and uses it as an important basis for renewing the operation contract, pointing out the development direction of logistics services.

2. Research Methods and Data Sources

2.1. Research Design

2.1.1. Construction of the satisfaction survey index system for teachers and students

The satisfaction survey of the canteen operation should focus on the assessment of soft power, with clear goals and guidance for actual operation work. Thus, an index system is established, divided into three levels, as shown in Table 1.

Table 1. Satisfaction Survey Index System Diagram for Teachers and Students

First-Level Goal Layer	Second-Level Indicator	Third-Level Indicator
Overall Satisfaction of the Canteen	Food Evaluation b1	Food quality c1
		Meal Flavor c2
		Meal Variety c3
		Transparent Pricing c4
		Fair Price c5
	Hygiene Conditions b2	Food Hygiene c6
		Dining Environment c7
		Tableware c8
		Tables and Chairs c9
		Floor c10
	Service Quality b3	Waitstaff Personal c11
		Punching Accuracy c12
		Service Attitude c13
		Prompt Cleaning c14
		Complaints and Feedback c15

2.1.2. Fuzzy comprehensive evaluation method

The questionnaire survey is subject to various factors, and in response to this fuzziness, an overall evaluation is given according to the principle of membership in fuzzy mathematics [13]. Implementing the fuzzy comprehensive evaluation method, although professional statistical analysis software is accurate in calculation, it is difficult to get started, and the most common spreadsheet software appears to be more convenient and fast. This paper uses Excel software to set up formulas to calculate the evaluation survey results.

2.1.3. Data source

The survey questionnaire respondents are 535 teachers and students who often eat in the school canteen, including 236 respondents for Canteen A and 299 for Canteen B.

2.2. Data source

The survey object is different canteens at the same location with the same management system, consistent raw material procurement channels, and similar years of use of facilities and equipment, only different operating enterprises introduced by the school as the operating body. The questionnaire design adopts the Likert scale form, and the higher the score, the higher the satisfaction of the diners with the canteen.

3. Satisfaction Fuzzy Comprehensive Evaluation Process

3.1. Determination of indicator weights

The Analytic Hierarchy Process combines qualitative and quantitative analysis to decompose the

main causes of the problem [14], and considers the hierarchical, systematic aggregation combination of interrelated and subordinate relationships [15]. First, qualitatively determine the judgment matrix, and the elements of the judgment matrix use a relative scale, and the matrix elements are valued by the 1-9 scale method [16,17], thereby determining the weight.

First, based on the valuation of the canteen managers of a certain school, construct the judgment matrix of each factor and level, and then perform consistency checking on the matrix. Calculate the geometric mean G of the judgment matrix, normalize and organize to obtain the weight W_i , and then calculate the weighted sum to obtain the consistency check result. The geometric mean G_{b1} is calculated using the formula $GEOMEAN$, the weight $W_{b1} = G_{b1} / (G_{b1} + G_{b2} + G_{b3})$, and the weighted sum M_{b1} is calculated using the formula $MMULT$. The judgment matrix for the Second-Level Indicator is in Table 2, and the judgment matrix for the Third-Level Indicator is in Table 3.

Finally, perform CR consistency check on the hierarchical single ordering. If the CR value is greater than 0.1, the test is not qualified, and it is necessary to correct the judgment matrix until it meets the satisfactory consistency standard.

$$CR = \frac{(M/W-n)}{(n-1) \times RI} \tag{1}$$

M is the weighted sum

W is the weight

n is the unique non-zero eigenvalue of the matrix, and n takes 3 for a third-order matrix

RI is read from the table of average random consistency indices

After calculation, the consistency check results of Tables 2 to 3 for the judgment matrices of the criterion layer and sub-criterion layer are $CR=0$, with satisfactory consistency.

Table 2. Judgment Matrix of the Second-Level Indicators

	b1	b2	b3	G	W	M
b1	1	5	7	3.2711	0.7447	2.2340
b2	1/5	1	7/5	0.6542	0.1489	0.4468
b3	1/7	5/7	1	0.4673	0.1064	0.3191

Table 3. Judgment Matrix Third-Level Indicator

	c1	c2	c3	c4	c5		G	W	M
c1	1	2	5	7	3		2.9137	0.4595	2.2976
c2	1/2	1	5/2	7/2	5/2		1.4568	0.2298	1.1488
c3	1/5	2/5	1	7/5	3/5		0.5827	0.0919	0.4595
c4	1/7	2/7	5/7	1	3/7		0.4162	0.0656	0.3282
c5	1/3	2/3	5/3	7/3	1		0.9712	0.1532	0.7659
	c6	c7	c8	c9	c10	c11	G	W	M
c6	1	5	7	7	3	3	3.6077	0.4646	2.7876
c7	1/5	1	7/5	7/5	3/5	3/5	0.7215	0.0929	0.5575
c8	1/7	5/7	1	1	3/7	3/7	0.5154	0.0664	0.3982
c9	1/7	5/7	1	1	3/7	3/7	0.5154	0.0664	0.3982
c10	1/3	5/3	7/3	7/3	1	1	1.2026	0.1549	0.9292
c11	1/3	5/3	7/3	7/3	1	1	1.2026	0.1549	0.9292
	c12	c13	c14	c15			G	W	M
c12	1	3	5	7			3.2011	0.5966	2.3864
c13	1/3	1	5/3	7/3			1.0670	0.1989	0.7955
c14	1/5	3/5	1	7/5			0.6402	0.1193	0.4773
c15	1/7	3/7	5/7	1			0.4573	0.0852	0.3409

3.2. Calculation of satisfaction fuzzy evaluation

Through the test, the influencing factors of the satisfaction of teachers and students are determined, and the weight assignment of each factor is established. The questions of the survey questionnaire are determined. The next step is to establish the evaluation set for each question, that is, the evaluation set for each factor is established = (Satisfied, Comparatively satisfied, General, Comparatively dissatisfied, Dissatisfied) = (5, 4, 3, 2, 1). Regarding the third-level indicators from c1 to c5, the process begins with

tallying the number of respondents for each option within the evaluation set. Following this, the proportion of respondents for each option is calculated. Ultimately, the satisfaction evaluation matrix is derived using the fuzzy comprehensive evaluation model. It is shown in Table 4.

Table 4. Sub-item Evaluation of Food Evaluation b1

Score	c1	c2	c3	c4	c5	Comprehensive Evaluation Value	Comprehensive Score
5	0.44	0.2	0.17	0.65	0.57	0.39	1.97
4	0.38	0.36	0.5	0.12	0.11	0.33	1.31
3	0.1	0.4	0.27	0.03	0.03	0.17	0.51
2	0.08	0.04	0.04	0.17	0.28	0.10	0.21
1	0	0	0.02	0.03	0.01	0.01	0.01
Sub-item Evaluation	4.18	3.72	3.76	4.19	3.95	-	4.00
Weight	0.4595	0.2298	0.0919	0.0656	0.1532	-	-

For the 236 questionnaires of Canteen A, the number of people evaluated as "Satisfied" for c1-c5 are 104, 47, 40, 153, and 135, respectively, and the ratio to the total number of people is shown in Table 4.

The weight is filled in according to the calculated results. From this, the comprehensive evaluation value of "Satisfied" is calculated using the formula MMULT, the normalization is equal to the comprehensive evaluation value divided by the cumulative sum of the comprehensive evaluation values, $\text{normalization} \times 5 = 1.97$, and the cumulative score of the food evaluation b1 item is obtained. Thus, the food evaluation b1 item score of Canteen A is calculated to be 4.00.

Following this method, the item scores of hygiene situation b2 and service quality b3 are calculated to be 4.33 and 4.24 (Table 5), respectively.

Furthermore, the overall satisfaction of the first-level goal layer, that is, the overall satisfaction of teachers and students, is calculated, see Table 5. From this, the comprehensive satisfaction score of Canteen A is calculated to be 4.08.

Table 5. Comprehensive Evaluation of Teachers' and Students' Satisfaction in Canteen A

Score	b1	b2	b3	Comprehensive Evaluation Value	Comprehensive Score
5	0.39	0.59	0.66	0.45	2.25
4	0.33	0.19	0.05	0.28	1.11
3	0.17	0.18	0.25	0.18	0.54
2	0.10	0.02	0	0.08	0.16
1	0.01	0.01	0.05	0.01	0.01
Sub-item Evaluation	4.00	4.33	4.24	-	4.08
Weight	0.74	0.15	0.11	-	-

4. Evaluation Results and Analysis

4.1. Satisfaction evaluation

Taking the evaluation results of Canteen A as an example, the comprehensive satisfaction score is calculated to be 4.08 which is greater than the comparative satisfaction of 4 points and less than the satisfaction of 5 points. According to the principle of maximum membership degree, the comprehensive evaluation value is 0.45, which is the highest among the five evaluation sets and above the "satisfied" level. This indicates that the overall satisfaction of teachers and students with Canteen A is at a satisfactory level.

Food evaluation b1 is the core influencing factor in the overall evaluation, with a weight of 0.7447 (Tables 2) among all second-level indicators, accounting for the largest proportion and being the most concerned aspect for teachers and students in the canteen. Canteen A's food evaluation score is 4.00 (Table 5), with the maximum membership value of 0.39, falling into the "comparatively satisfied"

level. It is evident that there is still room for improvement in Canteen A's food situation to reach the "satisfied" level. Compared to the scores of 4.33 for hygiene situation b2 and 4.24 for service quality b3, both of which are at the "satisfied" level, the score for food situation b1 is the lowest among teachers and students. In summary, the food situation is the focus of Canteen A managers' work in the next stage, and the specific direction of work needs to extend and analyze the scores of the third-level indicators. The sub-item evaluation of food evaluation b1 also reflects the sub-item scores and weights of the five third-level indicators from c1 to c5, from which the degree of concern from teachers and students can be seen. The most concerned food quality c1 scored 4.18 (Table 4), with a high satisfaction level; the highest satisfaction score was 4.19 for clear pricing c4, mainly because clear pricing is an aspect with a lower difficulty coefficient in canteen management; the lowest satisfaction score was 3.72 for food taste c2, which can be the focus of improving the food situation b1 in the next step.

The ideal hygiene situation b2 is a fundamental element of university canteens, and food safety has a "veto" position in various evaluations. This conclusion is reflected by the highest score of 4.33 among the second-level indicators obtained by the hygiene situation b2. Among the third-level indicators, food hygiene c6, with a weight of 0.4646 (Table 3), becomes the most concerned content in b2, and the score of 4.39 is also at the satisfactory level; the personal hygiene of waiters c11 obtained the most satisfactory sub-item score of 4.40; even the lowest score of 4.10 for dining environment hygiene c7 is still higher than the comparatively satisfied 4 points.

Service quality b3 is a distinctive highlight in evaluating university canteens. Although its weight allocation is only 0.1064 compared to b1 and b2, the importance of service quality should not be underestimated. Even if the dishes are healthy, hygienic, and reasonably priced, poor service can also ruin a good dining experience. Canteen A's service quality b3 score of 4.24 is still satisfactory.

4.2. Comparison of Two Canteens

Referring to the method mentioned above, calculate the comprehensive score of Canteen B and compare the satisfaction evaluation of teachers and students between two canteens with similar objective conditions within the same school, as shown in Table 6. The comprehensive evaluation score shows that Canteen B scored 4.24, higher than Canteen A, indicating a better overall management level. At the second-level indicator level, Canteen B's scores in the three aspects of food evaluation b1, hygiene situation b2, and service quality b3 are all better than those of Canteen A.

Table 6. Comparison of Satisfaction Evaluation between Canteen A and Canteen B for Teachers and Students

	b1	c1	c2	c3	c4	c5	
CanteenA	4.00	4.18	3.72	3.76	4.19	3.95	
CanteenB	4.19	4.38	3.59	4.09	4.78	4.34	
	b2	c6	c7	c8	c9	c10	c11
CanteenA	4.33	4.39	4.10	4.22	4.11	4.34	4.40
CanteenB	4.40	4.55	4.08	3.97	4.01	4.40	4.51
	b3	c12	c13	c14	c15		
CanteenA	4.24	4.33	4.06	4.23	4.07		
CanteenB	4.30	4.44	4.22	3.97	3.94		
	Comprehensive Score						
CanteenA	4.08						
CanteenB	4.24						

Among the 15 third-level indicators, Canteen A outperformed Canteen B in six aspects: meal flavor c2, dining environment c7, tableware hygiene c8, chair hygiene c9, timely cleaning c14 and handling complaints and feedback c15. Canteen A is superior to Canteen B in these six aspects, but the total weight of these six aspects is 0.2265, indicating a lower degree of importance for the influencing factors. On the other hand, the remaining nine third-level indicators have a combined weight of 0.7735, where Canteen B scored higher, thus directly determining its advantageous position in this evaluation.

Conversely, although Canteen A's overall performance is slightly behind Canteen B, it does not underperform in all indicators. Within the six third-level indicators of hygiene situation (b2), Canteen A has the advantage in three; and among the four third-level indicators of service quality (b3), Canteen A leads in two. In these two areas (b2 and b3), the two canteens appear to be evenly matched. Canteen B's higher scores in certain items are due to the higher weight of its advantageous indicators, but it still

needs to learn from Canteen A's experiences and practices to improve hygiene and service details in meal provision.

5. Conclusion

In the new era, new demands are placed on university logistics services. This paper uses the fuzzy comprehensive evaluation method and Analytic Hierarchy Process as fundamental approaches, referencing questionnaire survey data from two canteens at a certain school, to construct an evaluation system for the satisfaction of teachers and students with university catering services. By employing widely used statistical software Excel, traditional qualitative survey results are transformed into quantitative evaluation data. This provides an effective and straightforward evaluation system for university logistics management departments, especially those in charge of catering services, to strengthen the standardized management of university canteens, enhance their educational role, and build first-class canteens in world-class universities. This system offers targeted improvements to logistics service solutions.

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