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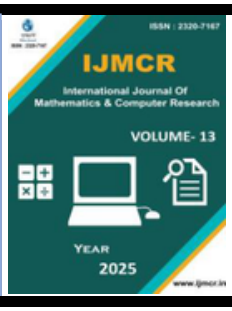

Implementation of Analytical Hierarchy Process (AHP) for Ranking Consumers Satisfaction Criteria in the Mathematics Dan Science Learning Center

Dwi Nur Yunianti[1], Elok Sudibyo[2], Erlix Rakhmad Purnama[3], Evangelista Lus W Palupi[4]

[1]Department of Mathematics,UniversitasNegeriSurabaya,Indonesia
[2]Department of Science, Universitas Negeri Surabaya, Indonesia
[3]Department of Biology, Universitas Negeri Surabaya, Indonesia
[4]Department of Mathematics Education, Universitas Negeri Surabaya, Indonesia

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Corresponding Author:
Dwi Nur Yunianti

ABSTRACT

Customer satisfaction is defined as a measurement that determines the level of customer satisfaction with the products, services and capabilities of a service provider. In this article, we determine the priority order of criteria that influence the customer satisfaction in the mathematics and science learning center using the AHP method.

Based on the results of the AHP method, the main priority criterion is responsibility of providing information related to services with weight criterion is 0.216.

KEYWORDS: Customer satisfaction, AHP method, criteria, priority order, mathematics and science learning center services

I. INTRODUCTION

User satisfaction is the level of assessment carried out by consumers to assess the products or services received by consumers. User satisfaction can be determined by the quality of services provided by a service provider. In general, service quality is seen based on five criteria. They are tangible, reliability, responsiveness, assurance and empathy [1]. Bad quality of service can give disadvantages for service providers. Meanwhile, good service quality can give benefits for service providers.

The mathematics and science learning center is a provider of mathematics and science learning development services. The consumers of the learning center are students and teachers from elementary and junior high school. In business, the mathematics and science learning center must guarantee that the services can satisfy the consumers. So, determining the priority order of criteria that can influence the user satisfaction is needed. In this article, we use AHP method as a decision support system for ordering the criteria.

A decision support system is a computer-based system that utilizes certain data and models with the aim of assisting decision making to solve problems in determining and making the right decisions [2]. Several decision making methods for determining the order of alternatives based on criteria are Simple Additive Weighting Method (SAW), Weighted Product Method (WP), TOPSIS, AHP, EDAS, Preference Selection Index Method (PSI), and ELECTRE. Analytical Hierarchy Process (AHP) is a decision making method developed by Saaty in 1970. Research related to AHP has been studied by several researchers, namely [3]- [7]. Apart from that, research related to the combination of AHP and TOPSIS was also studied by [8], [9], [10]. In this article, we use the AHP method to determine the order of providing information related to services, availability of information about product services, knowledge and reliability of human resources in product services, easiness of users getting information about products, easiness of requests the product service , transparency of fee for using the product services, responsibility of handling complaints

The criteria

II. AHPMETHOD

This research requires information about assessments of each criterion form respondents. The respondents are consumers of the mathematics and science learning center. The information is taken through questionnaire. Next, the information is processed with AHP.

The following steps are AHP's steps which have been constructed by Saaty :

1) Arrange a hierarchy of the problems faced. The problem to beresolved is broken downintoits elements, namely

criteria and alternatives, then arranged into a hierarchical structure.

2) Carry out assessments between criteria through pairwise comparisons on a comparison scale of 1 to 9 (as shown in Table 1) which is represented in a pairwise comparison matrix.

Table 1. Information about level of importance of criteria

Level of importance	Information
1	Both elements are equally important
3	One element is slightly more important than the others
5	One element is more important than the others
7	One element is absolutely more important than the others
9	One element is absolutely more important than the others
2,4,6,8	Values between two values of adjacent considerations

Pairwise comparison matrix is

$$A = [a_{ij}] = \begin{bmatrix} a_{11} & a_{12} & a_{13} & \cdots & a_{1n} \\ a_{21} & a_{22} & a_{23} & \cdots & a_{2n} \\ a_{31} & a_{32} & a_{33} & \cdots & a_{3n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & a_{n3} & \cdots & a_{nn} \end{bmatrix}$$

where a_{ij} is the relative importanceofeach criterion to other criteria, n is number of criteria,andi,j=1,2,.., n

3) Calculate the normalized valueoftherelative importance of each criterion to the other criteriainpairwise comparison matrix which as represented matrixB.

$$B = [b_{ij}] = \begin{bmatrix} b_{11} & b_{12} & b_{13} & \cdots & b_{1n} \\ b_{21} & b_{22} & b_{23} & \cdots & b_{2n} \\ b_{31} & b_{32} & b_{33} & \cdots & b_{3n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ b_{n1} & b_{n2} & b_{n3} & \cdots & b_{nn} \end{bmatrix}$$

Where $b_{ij} = \frac{a_{ij}}{p_j}$ and $p_j = \sum_{i=1}^{n} a_{ij}$, $j = 1,2,\ldots,n$

a_{ij} is entry of matrix A.

4) Construct a criterion weight matrix

$$W = [w_i] = \begin{bmatrix} w_1 \\ \vdots \\ w_n \end{bmatrix}$$

where $w_i = \frac{1}{n}\sum_{j=1}^{n} b_{ij}$

5) Calculate ratio consistency CR with steps

$$\lambda_{max} = \sum_{i,j=1}^{n} p_j . w_i$$

$$CI = \frac{\lambda_{max} - n}{n-1}$$

$$CR = \frac{CI}{RI}$$

where RI is the Random Consistency Index, seen from Table 2.

If the consistency ratio is less or equal to 0.1, the data calculation results can be justified or are consistent.

Table 2. RandomConsistencyIndex

Ordo of Matrix	RI
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

III. RESULTS

In this article, we have 11 consumers as respondents of questionnaire for this research. The respondents give values of the level of importance of a criteria which compared to other criteria. The criteria are shown as Table 3.

Table 3. Notation of Criteria

Criteria	Notation
Responsibility of providing information related to services	C1
Availability of information about product services	C2
Knowledge and reliability of human resources in product services	C3
Easiness of users getting information about products	C4
Easiness of requests the product service	C5
Transparency of fee for using the product services	C6
Responsibility of handling complaints	C7

Next step is processing data with AHP method. The steps are

1) Construct pairwise comparison matrix which entries of the matrix are results of the questionnaires from 11 respondents.

The following table is representation of pairwise comparison matrix of each criterion.

Table 4. Pairwise comparison matrix

Criteria	C1	C2	C3	C4	C5	C6	C7
C1	1.00	2.00	1.00	1/2	3.00	2.00	3.00
C2	1/2	1.00	1.00	2.00	2.00	1/2	2.00
C3	1.00	1.00	1.00	2.00	1/2	1/2	2.00
C4	2.00	1/2	1/2	1.00	1/2	1/2	2.00
C5	1/3	1/2	2.00	2.00	1.00	1/2	2.00
C6	1/5	2.00	2.00	2.00	2.00	1.00	2.00
C7	1/3	1/2	1/2	1/2	1/2	1/2	1.00

The explanations about values in table 4 are based on level of importance on Table 1. For example, a respondent gives the level of importance of C1 compared to C2 is 2, so the level of importance of C2 compared to C1 is ½ (as reciprocal).
The following table are the results of converting Table 4 to decimal values.

Table 5. The Pairwise Comparison Matrix Conversion Results between Criteria

Criteria	C1	C2	C3	C4	C5	C6	C7
C1	1.00	2.00	1.00	0.50	3.00	2.00	3.00
C2	0.50	1.00	1.00	2.00	2.00	0.50	2.00
C3	1.00	1.00	1.00	2.00	0.50	0.50	2.00
C4	2.00	0.50	0.50	1.00	0.50	0.50	2.00
C5	0.33	0.50	2.00	2.00	1.00	0.50	2.00
C6	0.50	2.00	2.00	2.00	2.00	1.00	2.00
C7	0.33	0.50	0.50	0.50	0.50	0.50	1.00

2) Normalize values for each column of the pairwise comparison matrix is shown in Table 6.
For example, we can calculate the normalization of C1 to C2. Using Table 5, so $\frac{b_{12}}{p_2} = \frac{2}{7.5} = 0.267$.

By the same way, we can normalize for the others criteria. The following table is the results of normalization of pairwise comparison matrix.

Table 6. Normalization Matrix of Pairwise Comparisons

Criteria	C1	C2	C3	C4	C5	C6	C7
C1	0.177	0.267	0.125	0.050	0.316	0.364	0.214
C2	0.088	0.133	0.125	0.200	0.211	0.091	0.143
C3	0.177	0.133	0.125	0.200	0.053	0.091	0.143
C4	0.353	0.067	0.063	0.100	0.053	0.091	0.143
C5	0.058	0.067	0.250	0.200	0.105	0.091	0.143
C6	0.088	0.267	0.250	0.200	0.211	0.182	0.143
C7	0.058	0.067	0.063	0.050	0.053	0.091	0.071

3) Calculate the weight of the criterion.

By dividing the total number of adjusted column values, normalizing the value of each pairwise comparison matrix column, and computing the average value of the sum of each row matrix, you may determine the weight of the criterion. Explaining for the calculate are :

Weight of C1 is $w_1 = \frac{1.512}{7} = 0.216$ where 1.512 is sum of entries in first row of Table 6.
Likewise with other criteria, we have

$$w_2 = \frac{0.991}{7} = 0.142$$
$$w_3 = \frac{0.921}{7} = 0.132$$
$$w_4 = \frac{0.869}{7} = 0.124$$
$$w_5 = \frac{0.914}{7} = 0.131$$
$$w_6 = \frac{1.340}{7} = 0.191$$
$$w_7 = \frac{0.452}{7} = 0.065$$

The results can be shownbelow.

Table 7. The Weight of Criteria

Criteria	Weightof Criteria
C1	0.216
C2	0.142
C3	0.132
C4	0.124
C5	0.131
C6	0.191
C7	0.065

4) Next,we determine ratio concistency with

$$\lambda_{max}$$
$$= 5.66 \times 0.216 + 7.5 \times 0.142 + 8 \times 0.132 + 10 \times 0.124 + 9.5 \times 1.131 + 5.5 \times 0.191 + 14 \times 0.065 = 7.777$$
$$CI = \frac{7.777-7}{7-1} = 0.130$$

Because of ordo matrixis7 x 7, so RI is 1.32. Thus

$$CR = \frac{0.130}{1.32} = 0.098$$

The value of the Consistency Ratio (CR) obtained is less than 0.1 so the calculation results can be declared correct or consistent.
Thus, the ordered of criteria is shown in Table 8.

Table 8. Rank of Criteria

Criteria	**Rank**
Responsibility of providing information related to services	1
Transparency of fee for using the product services	2
Availability of information about product	3

services	
Knowledge and reliability of human resources in product services	4
Easiness of requests the product service	5
Easiness of users getting information about products	6
Responsibility of handling complaints	7

Based on the results in Table 8, the mathematics and science learning center must give more attention for responsibility of providing information related to services such that the satisfaction of consumers can be fulfilled.

IV. CONCLUSIONS

The implementation of AHP can be used for determining priority of criteria suvch that the mathematics and science learning center can full the satisfaction of consumers. The results of ordering in this research is consistent because the Consistency Ratio (CR) is less than 0.1.

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