Decision support system for selection of the best teacher at SD Muhammadiyah 18 Medan using the analytical hierarchy process method

Josua Nainggolan[1], Johanes Apriadi Parlinggoman Sirait[1], Muhammad Fadlan Ikromi[1], Putri Ameliya Lubis[1], Debi Yandra Niska[1]

[1*] Computer Science Study Program, Faculty of Mathematics and Natural Sciences, Medan State University (Universitas Negeri Medan), Indonesia, Jl. Willem Iskandar Pasar V Medan, Sumatera Utara, Indonesia, 20221

*✉ josuanainggolan991@gmail.com

ABSTRACT

A Decision Support System can be interpreted as a system that can and can provide solutions or capabilities both the ability to provide solutions or solve problems and the ability to communicate on semi-structured problemsHierarchy is a complex problem in a multi-level structure where the first level is the goal, followed by the level of problem factors, criteria, sub-criteria, alternatives, and so on down to the last level of alternatives. With a hierarchy, a complex problem can be translated into a collection of groups which are then organized into a hierarchical form so that the problem will appear more structured and systematicDecision Support System designed can be an alternative for SD Muhammadiyah 18 Medan and other schools in determining the best teacher. And with the establishment of a computerized system with the Analytical Hierarchy Process (AHP) method, the data processing process is faster and greatly minimizes errors and shortcomings in the calculation of values and also obtains maximum results. Obtained teacher data and the results of the value will be stored in the database so that if an error is found in the data entry and calculation results, the wrong data can be replaced through the database used. The final result can be concluded that the AHP method has given the best value recommendation to the teacher Syamsul Hidayat S, Pd with a value of 0.4473 with a percentage of 45%.

Keywords: Decision support system; AHP; hierarchy; criteria.

1. INTRODUCTION

Decision support systems can be understood as a system with the capacity to solve problems and the ability to do so, as well as the capacity to communicate about semi-structured difficulties [1].

Every year, SD Muhammadiyah 18 Medan chooses the top instructors as a way to show teachers how much the school values them and to inspire them to raise the bar for instruction in the classroom. While a teacher who can carry out, and accomplish each assignment is the ideal teacher. They can shape their personalities to be compatible with the teaching profession and educational knowledge, which can greatly enhance the effectiveness of learning processes and results. Teachers are obliged to continuously inspire pupils by examining their abilities so that they can grow into a generation that is helpful and valuable to others [2].

The advancement of the times has made educators and the general public more aware of the fact that education is a dynamic field where instructors, who serve as the frontline, are needed to never stop learning. The finest instructors are required because teachers are human learners, i.e., people who are constantly learning, thinking, acting, producing, and innovating to motivate their students to become dynamic people [3][4].

Parties from the SD Muhammadiyah 18 Medan school sometimes struggle to obtain calculations and assessments of these teachers since they take a long time and may contain inaccuracies. When placing instructors who do well so that other teachers might model them, SD Muhammadiyah 18

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Medan encountered several issues due to inaccuracies that occurred when deciding the teacher's assessment. A review method was created based on the issues to address the issues SD Muhammadiyah 18 Medan encountered so that there would be no errors in evaluating the instructor and selecting the best teacher.

At SD Muhammadiyah 18 Medan, choosing the best teacher is still an opinion-based approach. One of them is by raising the standard of educators and rewarding the finest ones with accolades and goals. Every teacher should be driven and passionate about what they do to improve as an educator. There have been several studies done, including. An evaluation of teacher performance is necessary to determine whether teachers have improved competency [5]. Additionally, there is research that looks at how the SAW and AHP approaches and others are used to choose the greatest teachers [6][7].

As a result, a system for selecting the best teacher was developed to aid in the selection of the best teacher to solve the issue of choosing the best teacher at SD Muhammadiyah 18 Medan. To help information users make better judgments, SPK aims to direct, advise, predict, and guide them. However, SPK may not be accepted [8].

The objectives and requirements of decision support systems for educational institutions include enhancing decision quality and analyst productivity, saving time, incorporating decision-makers insights and judgments into analysis, and reducing expenses. This system needs to be backed by one of the decision-making techniques, specifically the Analytical Hierarchy Process (AHP) technique, to achieve its objectives [9].

2. METHOD

Thomas L. Saaty, a scientist, created AHP. According to Saaty (1993), this decision assistance technique will categorize difficult multi-factor or multi-criteria problems. criterion, sub-criteria, alternatives, and so forth to the bottom level of the alternative. A complex problem can be broken down into some sections and then organized in a hierarchy using a hierarchy to make the problem appear more organized and systematic [10].

2.1 Methods of data collection and samples

Questionnaire By distributing surveys to respondents, specifically instructors at SD Muhammadiyah 18 Medan, data is gathered. Teachers, staff members, and employees at SD Muhammadiyah 18 Medan participated in the survey. A questionnaire was given to 50 responders in total for this study [11].

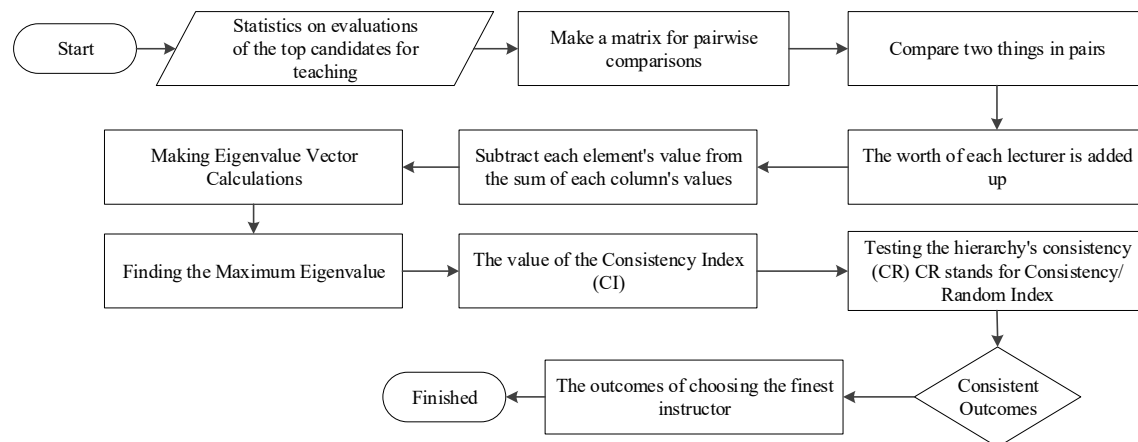### 2.2. The stages of the AHP method
2.3.1 Create a flowchart.

Figure 1. AHP process flowchart

The stages of the research are depicted in **Figure 1** starting with the acquisition of the best teacher candidate assessment data, followed by the construction of a comparison matrix, the addition of column values, pairwise comparisons, distribution of the values obtained, computation of the eigenvector values, computation of the Consistency Index (CI) values, computation of the values of

the maximum eigen, testing of the value, and finally the acquisition of the results of the determination of the best teacher at SD Muhammadiyah 18 Medan

Table 1. Matrix of comparison of criteria-criteria

	Criteria-1	Criteria-2	Criteria-3	Criteria-4
Criteria-1	K11	K12	K13	K1
Criteria-2	K21	K22	K23	K2n
Criteria-3	K31	K32	K33	K3n
Criteria-4	Kn1	Kn2	Kn3	Kmn

The relative contribution criteria or the influence of each element on the goals or criteria at the level above it is shown in **Table 1**'s pairwise comparison matrix [12].

Table 2. Comparison table

No.	Value	Information
1	1	Both criteria and alternative A are equally significant (important)
2	3	A is somewhat more crucial than B (very crucial / one degree more crucial than the other requirements)
3	5	A is unquestionably more crucial than B (more crucial / two tiers more crucial than other criteria)
4	7	A is unquestionably more significant than B (very significant / three levels more significant than other criteria).
5	9	Unquestionably more significant than B (unquestionably more significant / four levels more significant than any other criterion)
	2,4,6,8	Between two nearby values, if in doubt

In **Table 2**, where n is the number of components being compared, the pairwise comparison table is created with a total value of n x [(n-1)/2] pieces [13].

- Calculate the eigenvalues that are obtained and check their consistency. The data retrieval process is restarted from the beginning if it is inconsistent or does not meet [14].
- For every criterion, repeat steps 3, 4, and 5 for all levels of the hierarchy.
- To identify the importance of the elements at the lowest hierarchical level and to get the desired outcome, it is necessary to calculate the results of each pairwise comparison matrix's eigenvectors, which are the result of each x element's weight [15]. The weight vector derived from pairwise comparison matrix A if A is one of those is;

$$(A)(w^T) = (n)(w^T) \tag{1}$$

Can be calculated by:

a. Each column j in matrix A should be normalized so that it may be determined:

$$\Sigma_i a(i,j) = 1 \tag{2}$$

afterward known as A'.

b. calculates the matrix column A"s average value for each row i:

$$w_i = \frac{1}{n}\Sigma_i a(i,j) \tag{3}$$

where w_i is the weight of the ith destination data in the weight vector [16].

c. Verify the data's hierarchical consistency.
Assuming that w is a weight vector value and that A is a pairwise comparison matrix, the consistency computation of the weight vector w can be performed as follows:

a. Calculations are possible using $(A)(w^T)$;

$$t = \frac{1}{n}\Sigma_{i=1}^{n}\left(\frac{element\ to-i\ on\ (A)(w^T)}{element\ to-i\ on\ w^T}\right) \tag{4}$$

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2.4 Calculating the consistency index value:

$$CI = \frac{t-n}{n-1} \tag{5}$$

Table 3. Matrix orders and ratios

Criteria (n)	matrix order	1	2	3	4	5	6	7	8	9
RI n	index ratio	0	0	0,58	0,9	1,12	1,24	1,32	1,41	1,46

Table 3 displays the results of the random index value RI_n which was generated by a random system at A.

2.5 Calculating the results of the consistency value

$$CR = \frac{CI}{RI_n} \tag{6}$$

   – If CI=0, is a consistent hierarchical value
   – If CR < 0,1, is a fairly consistent hierarchical result
   – If CR > 0,1, is a very inconsistent value hierarchy [17].

3. RESULTS AND DISCUSSION

3.1 Establishing criteria

Table 4. The criteria used

Criteria	Code
Achievement in Teaching	C1
Teaching Quality	C2
Discipline	C3
Years of service	C4
Dedication	C5

The criteria that will be utilized as a standard for issue resolution are listed in Table 4 along with the relative relevance of each criterion. Here, the author employs five factors that lead to better outcomes [18].

3.2 The value in the comparison matrix table is calculated.

Table 5. Comparison table on teaching achievement criteria

RESPONDENT 1																		
Which choice is more crucial than the following alternatives for choosing excellent teachers according to the "TEACHING ACHIEVEMENT" criteria:																		
Criteria A	**Scoring scale**																	**Criteria B**
Syamsul Hidayat, S. Pd	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Yulfita Sari Nasution, S. Pd
Syamsul Hidayat, S. Pd	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Yunismar, S. Pd
Syamsul Hidayat, S. Pd	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Witry Ismana. S. Pd
Yulfita Sari Nasution, S. Pd	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Yunismar, S. Pd
Yulfita Sari Nasution, S. Pd	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Witry Ismana, S. Pd
Yunismar, S. Pd	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Witry Ismana, S. Pd

In **Table 5**, one of the criteria—the criteria for teaching achievement—is chosen as an example to show comparisons based on the questionnaire results and data collection from SD Muhammadiyah 18 Medan. Based on which is more important, criteria A and criteria B are compared.

Table 6. Comparison results of teaching achievement criteria

	Respondent 1			
Criteria	Syamsul Hidayat, S. Pd	Yulfita Sari Nasution, S. Pd	Yunismar, S. Pd	Witry Ismana, S. Pd
Syamsul Hidayat, S. Pd	1.00	**9.00**	**7.00**	**3.00**
Yulfita Sari Nasution, S. Pd	0.11	1.00	**3.00**	**3.00**
Yunismar, S. Pd	0.14	0.33	1.00	**5.00**
Witry Ismana S. Pd	0.33	0.33	0.20	1.00

The results of each criterion's comparison are shown in **Table 6**, where criterion A receives a value of 1 when compared to other criteria of the same type, but receives a different value when compared to other criteria of the same type.

3.3 Calculating the criterion weight value (Wj).

Table 7. The weight value of the teaching achievement criteria

	Addition of Columns in the Matrix Based on Teaching Success			
Criteria	Syamsul Hidayat, S. Pd	Yulfita Sari Nasution, S. Pd	Yunismar, S. Pd	Witry Ismana, S, Pd
Syamsul Hidayat, S. Pd	1.00	2.61	2.22	2.34
Yulfita Sari Nasution, S. Pd	0.38	1.00	1.26	1.44
Yunismar, S. Pd	0.45	0.83	1.00	1.15
Witry Ismana, S. Pd	0.43	0.70	0.87	1.00
TOTAL	**2.26**	**5.14**	**5.35**	**5.93**

The weight value of the teaching criteria is shown in **Table 7** and was calculated by multiplying all 50 respondents' inputs for each criterion A by criterion B. After that, add up each criterion's values. Next, normalize the data so that the outcomes of the normalization are as follows:

Table 8. Data normalization results

	Addition of Matrix Columns Based on Teaching Achievements				
Criteria	Syamsul Hidayat, S. Pd	Yulfita Sari Nasution, S. Pd	Yunisma, S. Pd	Witry Ismana, S. Pd	Rata-rata
Syamsul Hidayat, S. Pd	0.44	0.51	0.41	0.39	0.44
Yulfita Sari Nasution, S. Pd	0.17	0.19	0.24	0.24	0.21
Yunismar, S. Pd	0.20	0.16	0.19	0.19	0.19
Witry Ismana, S. Pd	0.19	0.14	0.16	0.17	0.16
				Eigen Vector	1.00

Table 8 is created using the criteria's values, which are then divided by the sum of all the criteria in the comparison table to produce the eigenvector values.

3.6 Calculating the consistency ratio's value as well as the consistency index's value.

$$\begin{pmatrix} 1 & 2.61 & 2.22 & 2.34 \\ 0.38 & 1 & 1.26 & 1.44 \\ 0.45 & 0.83 & 1 & 1.15 \\ 0.43 & 0.7 & 0.87 & 1 \end{pmatrix} \times \begin{pmatrix} 0.44 \\ 0.21 \\ 0.19 \\ 0.16 \end{pmatrix}$$

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Next, the average value acquired is multiplied by the outcome of the sum of the matrix columns to provide the following results:

$$\begin{pmatrix} 0.44 & 0.5481 & 0.4218 & 0.3744 \\ 0.1672 & 0.21 & 0.2394 & 0.2304 \\ 0.198 & 0.1743 & 0.19 & 0.184 \\ 0.1892 & 0.147 & 0.1653 & 0.16 \end{pmatrix} = \dfrac{\begin{pmatrix} 1.7843 \\ 0.847 \\ 0.7463 \\ 0.6615 \end{pmatrix}}{\begin{pmatrix} 0.44 \\ 0.21 \\ 0.19 \\ 0.16 \end{pmatrix}} = \begin{pmatrix} 4.055227 \\ 4.03333 \\ 3.927895 \\ 4.134375 \end{pmatrix}$$

To determine the consistency index value and consistency ratio with value:

$$\square \text{ max} = 4.037708$$
$$CI = 0.012569$$
$$CR = 0.013966$$

This demonstrates that if the consistency ratio is less than 0.1, the aforementioned matrix is consistent. Calculations for the "Teaching Achievement" criteria for the other criteria were done once the CI and CR values for the "Teaching Achievement" criteria were obtained.

The eigenvector results from each alternative are utilized to decide the outcome, and the multiplication operation is then completed using the eigenvector results from the criteria. Next, the value of multiplication is obtained as follows;

$$\begin{pmatrix} 0.1012 & 0.13 & 0.0936 & 0.0473 & 0.0752 \\ 0.0483 & 0.052 & 0.0528 & 0.0198 & 0.0304 \\ 0.0437 & 0.0416 & 0.0504 & 0.0242 & 0.0272 \\ 0.0368 & 0.0364 & 0.0456 & 0.0198 & 0.0272 \end{pmatrix}$$

The sum was then calculated using these results, and the best teacher decision supporters at SD Muhammadiyah 18 Medan provided the following results;

Table 9. Final result value

0.4473	Syamsul Hidayat, S. Pd
0.2033	Yulfita Sari Nasution, S. Pd
0.1871	Yunismar, S. Pd
0.1658	Witry Ismana, S. Pd

According to Table 9, the results for Syamsul Hidayat S, Pd were 0.4473, Yulfita Sari Nasution S, Pd was 0.2033, Yunismar, S. Pd was 0.1871, and Witry Ismana S, Pd was 0.1658. Next, convert the value to percentage form as shown below:
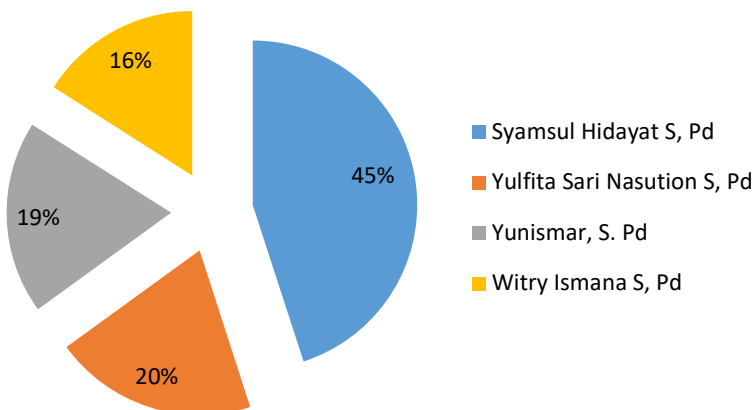

Figure 2. Percentage of final results

According to **Figure 2**, Syamsul Hidayat, S. Pd, has a 45% share, followed by Yulfita Sari Nasution, S. Pd, with 20%, Yunismar, S. Pd, with 19%, and Witry Ismana, S. Pd, with 16%.

4. CONCLUSION

To select the finest teacher, the SD Muhammadiyah 18 Medan school and other schools might use the created Decision Support System as an option. Additionally, the implementation of a computerized system using the Analytical Hierarchy Process (AHP) approach speeds up data processing, significantly reduces errors and flaws in value calculation, and also yields the best possible results. To allow for the replacement of incorrect data if an error is discovered in the data input or the calculation results, the teacher's data is obtained, and the resulting values are recorded in the database. With a value of 0.4473 and a percentage of 45%, the final results show that the AHP technique has given the teacher Syamsul Hidayat S, Pd the best value recommendation.

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