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Analysis of the Decision Support System for the Selection of the Best Teaching Staff Using the AHP and Topsis Methods

Fajar Agung Nugroho [a,1,*]

[a] *University of Pamulang, Jl. Raya Puspitek, Kec. Pamulang, Kota Tangerang Selatan, Banten 15310, Indonesia*
[1] *fajaragungnugroho@unpam.ac.id**
** corresponding author*

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ABSTRACT

The selection of the best teaching staff is very important to improve the quality of education at SMK Al - Amanah. However, the selection process carried out by SMK Al – Amanah is still subjective and less structured, so this can cause difficulties in determining the best teaching staff because of the many criteria that must be considered. In addition, the existing selection methods are not systematic and measurable, so they have the potential to cause bias and inconsistency in decision-making. This research aims to analyze and develop a decision support system that can help in the selection of the best teaching staff objectively and efficiently. The proposed solution is the development of a system that integrates the Analytical Hierarchy Process (AHP) method to determine the weight of the assessment criteria, as well as the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method to rank teaching staff based on this weight. The method used for collecting data on assessment criteria for the selection of the best teachers is through interviews and applying the AHP method in determining the weight of the criteria, as well as the application of the TOPSIS method for ranking in the selection of the best teaching staff. From the results of the research, it was obtained that the creation of a Decision Support System can simplify and accelerate the assessment process carried out by the leadership of each teaching staff and also the assessment of each teaching staff to be more accurate and minimize errors in making decisions.

I. Introduction

Teaching staff is an important component in the world of education, because the quality of teachers directly affects the quality of learning and student achievement. SMK Al-Amanah as one of the vocational secondary education institutions is committed to improving the quality of learning by conducting routine evaluations of the performance of teaching staff [1]. One form of appreciation and evaluation is the selection of the best teaching staff on a regular basis. However, the process of selecting the best teaching staff is often done subjectively, only based on general assessments without structured methods. This can lead to dissatisfaction and a lack of transparency in the decision-making process. Therefore, a decision support system (DSS) is needed that can help the selection process objectively and systematically [2]. One approach that can be used is to combine the Analytical Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) [3]. AHP is used to determine the weights of each criterion based on paired comparisons, while TOPSIS is used to perform alternative rankings based on the distance from positive and negative ideal solutions [4]. The combination of these methods allows for a more accurate and accountable decision-making process. This system can later provide objective, transparent, and measurable results based on relevant criteria, such as discipline, pedagogic competence, learning innovation, interpersonal relationships, and academic and non-academic achievements [5][6][7].

Several previous studies have proven the effectiveness of the AHP and TOPSIS methods in multi-criteria decision-making. As a study conducted by [8] in his research entitled "Decision Support System for the Selection of Outstanding Teachers Using the AHP and TOPSIS Methods" concluded that the combination of the two methods produces more accurate recommendations than manual assessments. Then the research conducted by [9] in the study "Evaluation of Lecturer Performance Using AHP and TOPSIS" stated that this method can be widely applied in the field of education because of its flexibility and thoroughness. The selection of the AHP and TOPSIS methods is based on their respective advantages in dealing with multi-criteria problems. AHP has the advantage of compiling a hierarchy of problems and conducting pairwise comparisons to logically determine the priority weight between criteria [10]. Meanwhile, TOPSIS is very effective in assessing alternatives based on their proximity to the ideal solution, so that it is able to produce an objective ranking. The combination of these two methods provides a comprehensive approach: AHP is used to consistently determine the weights of criteria, while TOPSIS is used to provide a ranking order of the existing alternatives [11]. Thus, the selection of the best teaching staff can be done by considering many aspects that affect each other and produce fair and accountable decisions.

II. Method

The research methods used in the development of this decision support system are as follows [12][13]:

A. Data Collection Methods

The methods used by the author to collect the data needed in this study are as follows:

1. Observation
   Observation in this study is a data collection method carried out by directly observing the activities, behavior, and performance of teaching staff at SMK Al-Amanah as the object of research. The goal is to obtain factual data regarding the implementation of teachers' duties, such as discipline, teaching methods, involvement in school activities, and interaction with students and colleagues. The results of this observation are the basis for assessing the relevant criteria for the selection of the best teaching staff, as well as supporting the analysis process with the AHP method in determining the weight of the criteria and TOPSIS in providing an objective ranking of each teacher.

2. Interview
   The author carried out a data collection technique with interviews, namely a direct question-and-answer activity with the leader and owner of SMK Al - Amanah to obtain information related to the assessment process carried out to each teaching staff

3. Literature Study
   In this case, the author conducted a literature study of several references such as books, journals, and scientific papers related to related issues in the development of web-based decision support systems using the AHP and TOPSIS methods

B. System Development

In this study, the analysis method used by the author is the waterfall method. The pictures of the stages of the waterfall method are as follows [14]:

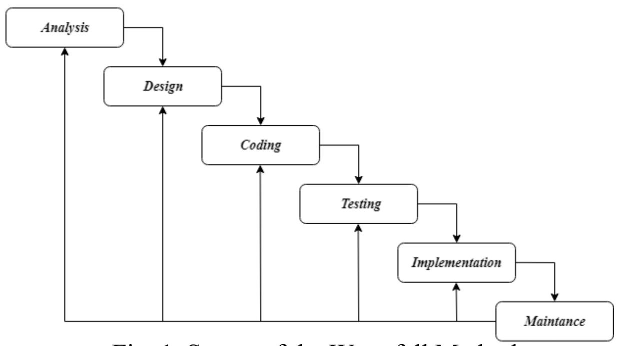

Fig. 1. Stages of the Waterfall Method

The following is an explanation of the stages of the waterfall method above [15][16]:

1. Analysis

   Requirement Analysis is the initial stage in the Waterfall method that serves to identify, collect, and document all the system needs to be developed, both functional and non-functional. At this stage, the developer interacts with users or stakeholders to understand in detail what is expected of the system, what features are needed, and any limitations or obstacles that must be considered. The results of this process are usually outlined in the Software Requirements Specification (SRS) document which becomes the official reference for all subsequent stages of development. The success of the needs analysis stage is crucial, as errors or shortcomings here can lead to mismatches in the system built with the user's expectations.

2. Design

   System Design is a stage in the Waterfall method that is carried out after the needs analysis is completed, with the aim of designing the structure and components of the system based on the requirements specifications that have been collected beforehand. At this stage, the developer creates a technical and architectural overview of the system to be built, including the design of the user interface, database structure, process flows, system diagrams, as well as the division of modules and their functions.

3. Coding

   Implementation is a stage in the Waterfall method where a pre-designed system design is translated into a form of program code using a specific programming language. At this stage, the development team begins to build all the components of the system according to the technical specifications that have been specified in the design document.

4. Testing

   Testing is a stage in the Waterfall method that is carried out after the implementation process is completed, with the aim of ensuring that the software that has been built runs according to the needs and specifications that have been predetermined. At this stage, the system is thoroughly tested to find faults, ensure each function is working correctly, and evaluate the system's performance and security.

5. Implementation

   The implementation and unit testing stage is the programming stage. The creation of the software is divided into small modules that will later be combined in the next stage. In addition, in this phase, tests and checks are also carried out on the functionality of the modules that have been made, whether they have met the desired criteria or not.

6. Maintenance

   In the final stage in the Waterfall Method, the finished software is user-operated and maintained is performed. Maintenance allows developers to make corrections for errors that were not detected in previous stages. Maintenance includes fixing faults, improving the implementation of system units, and upgrading and adjusting the system according to needs.

III. Results and Discussion

A. Decision Calculation with AHP and TOPSIS Methods

The AHP method is used to calculate the weighting of the criteria which will later be the priority weight of the criteria used for calculation in the ranking process using the TOPSIS method. Then the ranking process produces an alternative ranking based on preference value where the alternative with the highest preference value becomes the best teaching staff. The alternative in question is the teaching staff at SMK Al - Amanah. The data used in the following calculation process is assessment data by the leadership objectively through an assessment questionnaire.

1. Assessment Criteria

The following are the criteria used as a reference for making decisions on the evaluation of teaching staff at SMK Al – Amanah:

Table 1. Criteria

Code	*Criteria Name*	*Attribution*
K01	Quality of Work	Benefit
K02	Time Discipline	Benefit
K03	Motivation	Benefit
K04	Behaviour	Benefit

2. Weighting of Criteria with the AHP Method

The process of weighting criteria begins by comparing between the assessment criteria of teaching staff to determine the priority weight of the criteria as follows:

a. Creating a paired comparison marix

The value of each criterion in the table above is obtained by analyzing the paired comparison of the row criteria compared to the column criteria and summing the values of each column in the matrix to obtain the total value of the column as follows:

Table 2. Paired Comparison Matrix

Criteria	*Quality of Work*	*Time Discipline*	*Motivation*	*Behaviour*
Quality of Work	1	1	3	5
Time Discipline	1	1	3	4
Motivation	0.333	0.333	1	3
Behaviour	0.2	0.25	0.333	1
Total	2.533	2.583	7.333	13

b. Calculating matrix normalization

Divide each value of the column by the total of the corresponding column to obtain the matrix normalization as follows:

$a_{11} = 1/2.533 = 0.395$ $a_{21} = 1/2.533 = 0.395$ $a_{31} = 0.333/2.533 = 0.132$

$a_{12} = 1/2.583 = 0.387$ $a_{22} = 1/2.583 = 0.385$ $a_{32} = 0.333/2.583 = 0.129$

$a_{13} = 3/7.333 = 0.409$ $a_{23} = 3/7.333 = 0.409$ $a_{33} = 1/7.333 = 0.136$

$a_{14} = 5/13 = 0.385$ $a_{24} = 4/13 = 0.308$ $a_{34} = 3/13 = 0.231$

$a_{41} = 0.2/2.533 = 0.079$ $a_{42} = 0.25/2.583 = 0.097$ $a_{43} = 0.333/7.333 = 0.045$

Table 3. Normalization Matrix

Criteria	*Quality of Work*	*Time Discipline*	*Motivation*	*Behavior*
Quality of Work	0.395	0.387	0.409	0.385
Time Discipline	0.395	0.387	0.409	0.308
Motivation	0.132	0.129	0.136	0.231
Behaviour	0.079	0.097	0.045	0.077

c. Determining priority weights

Summing the values of a row and dividing the sum by the number of elements to get the priority weight value as follows:

$W_1 = \frac{0.395+0.387+0.409+0.385}{4} = 0.394$ $W_3 = \frac{0.132+0.129+0.136+0.231}{4} = 0.157$

$W_2 = \frac{0.395+0.387+0.409+0.308}{4} = 0.375$ $W_4 = \frac{0.079+0.097+0.045+0.077}{4} = 0.075$

Table 4. Priority Weights

Criteria	*Quality of Work*	*Time Discipline*	*Motivation*	*Behavior*	*Priority Weights*
Quality of Work	0.395	0.387	0.409	0.385	0.394
Time Discipline	0.395	0.387	0.409	0.308	0.375
Motivation	0.132	0.129	0.136	0.231	0.157
Behaviour	0.079	0.097	0.045	0.077	0.075

d. Calculating maximum eigens

Table 5. Maximum Eigens

Criteria	*Quality of Work*	*Time Discipline*	*Motivation*	*Behavior*	*Weights*
Quality of Work	0.394	0.375	0.471	0.375	4.092
Time Discipline	0.394	0.375	0.471	0.3	4.104
Motivation	0.131	0.125	0.157	0.225	4.057
Behaviour	0.079	0.097	0.052	0.075	4.016
Max					4.067

e. Calculating consistency indeks (CI)

$CI = \frac{4.067-4}{4-1} = 0.022$

f. Calculating concistency rasio (CR)

If the CR value > 0.1 then the data calculation is inconsistent and must be recalculated. If the CR value < 0.1 then the data calculation is consistent and correct.

$CR = \frac{0.022}{0.9} = 0.025$

So CR = 0.025 where 0.025 < 0.1 then the calculation is consistent and correct

3. Alternative Ranking with the TOPSIS Method

The priority weights of the criteria obtained from the AHP weighting process will be used in the calculation stage with TOPSIS in calculating the weighted normalized decision matrix as follows:

a. Creating a Normalized Decision Matrix

Table 6. Normalized Matrix

	Quality of Work	*Time Discipline*	*Motivation*	*Behavior*
Ibu Siti Rahmawati, S.Pd.	0.29814	0.40825	0.38014	0.30589
Bapak Ahmad Fauzan, M.Pd.	0.37268	0.3266	0.30411	0.30589

	Quality of Work	*Time Discipline*	*Motivation*	*Behavior*
Ibu Lestari Wulandari, S.Pd	0.29814	0.24495	0.30411	0.22942
Bapak Dedi Kurniawan, S.Pd.I.	0.29814	0.3266	0.22809	0.30589
Ibu Rina Kartikasari, M.Pd.	0.37268	0.24495	0.30411	0.30589
Bapak Heri Santoso, S.Pd.	0.29814	0/3266	0.38014	0.30589
Ibu Dewi Anggraini, S.Pd.	0.37268	0.24495	0.38014	0.30589
Bapak Arif Nugroho, M.Pd	0.22361	0.3266	0.22809	0.38236
Ibu Melani Puspita, S.Pd.	0.29814	0.40825	0.30411	0.38236
Bapak Bambang Subekti, S.Pd	0.29814	0.24495	0.30411	0.30589

b. Creating a Weighted Normalized Decision Matrix

Multiply the normalization value by the priority weight obtained from the AHP process as follows:

y_{11} = (0.394) (0.29814) = 0.11743 y_{12} = (0.375) (0.40825) = 0.15295
y_{21} = (0.394) (0.37268) = 0.14679 y_{22} = (0.375) (0.3266) = 0.12236
y_{31} = (0.394) (0.29814) = 0.11743 y_{32} = (0.375) (0.24495) = 0.09177
y_{41} = (0.394) (0.29814) = 0.11743 y_{42} = (0.375) (0.3266) = 0.12236
y_{51} = (0.394) (0.37268) = 0.14679 y_{52} = (0.375) (0.24495) = 0.09177
y_{61} = (0.394) (0.29814) = 0.11743 y_{62} = (0.375) (0.3266) = 0.12236
y_{71} = (0.394) (0.37268) = 0.14679 y_{72} = (0.375) (0.24495) = 0.09177
y_{81} = (0.394) (0.22361) = 0.08808 y_{82} = (0.375) (0.3266) = 0.12236
y_{91} = (0.394) (0.29814) = 0.11743 y_{92} = (0.375) (0.40825) = 0.15295
$y_{10.1}$ = (0.394) (0.29814) = 0.11743 $y_{10.2}$ = (0.375) (0.24495) = 0.09177

y_{13} = (0.157) (0.38014) = 0.05966 y_{14} = (0.075) (0.30589) = 0.0228
y_{23} = (0.157) (0.30411) = 0.04773 y_{24} = (0.075) (0.30589) = 0.0228
y_{33} = (0.157) (0.30411) = 0.04773 y_{34} = (0.075) (0.22942) = 0.0171
y_{43} = (0.157) (0.22809) = 0.03579 y_{44} = (0.075) (0.30589) = 0.0228
y_{53} = (0.157) (0.30411) = 0.04773 y_{54} = (0.075) (0.30589) = 0.0228
y_{63} = (0.157) (0.38014) = 0.05966 y_{64} = (0.075) (0.30589) = 0.0228
y_{73} = (0.157) (0.38014) = 0.05966 y_{74} = (0.075) (0.30589) = 0.0228
y_{83} = (0.157) (0.22809) = 0.03579 y_{84} = (0.075) (0.38236) = 0.0285
y_{93} = (0.157) (0.30411) = 0.04773 y_{94} = (0.075) (0.38236) = 0.0285
$y_{10.3}$ = (0.157) (0.30411) = 0.04773 $y_{10.4}$ = (0.075) (0.30589) = 0.0228

Table 7. Weighted Normalized Decision Matrix

	Quality of Work	*Time Discipline*	*Motivation*	*Behavior*
Ibu Siti Rahmawati, S.Pd.	0.11743	0.15295	0.05966	0.0228
Bapak Ahmad Fauzan, M.Pd.	0.14679	0.12236	0.04733	0.0228
Ibu Lestari Wulandari, S.Pd	0.11743	0.09177	0.04733	0.0171

	Quality of Work	***Time Discipline***	***Motivation***	***Behavior***
Bapak Dedi Kurniawan, S.Pd.I.	0.11743	0.12236	0.03579	0.0228
Ibu Rina Kartikasari, M.Pd.	0.14679	0.09177	0.04733	0.0228
Bapak Heri Santoso, S.Pd.	0.11743	0.12236	0.05966	0.0228
Ibu Dewi Anggraini, S.Pd.	0.14679	0.09177	0.05966	0.0228
Bapak Arif Nugroho, M.Pd	0.08808	0.12236	0.03579	0.0285
Ibu Melani Puspita, S.Pd.	0.11743	0.15295	0.04733	0.0285
Bapak Bambang Subekti, S.Pd	0.11743	0.09177	0.04733	0.0228

c. Determining the ideal matrix of positive and negative solutions.

To determine the ideal solution, the attributes of each criterion are determined in advance, both benefit and cost attributes.

Table 8. Ideal Solution Matrix

Y	***Elements of the Ideal Solution***	***Positive (A+)***	***Negative (A-)***
Y1	(0.11743); (0.14679); (0.11743); (0.11743); (0.14679); (0.11743); (0.14679); (0.08808); (0.11743); (0.11743)	0.14679	0.08808
Y2	(0.15295); (0.12236); (0.09177); (0.12236); (0.09177); (0.12236); (0.09177); (0.12236); (0.15295); (0.09177)	0.15295	0.09177
Y3	(0.05966); (0.04773); (0.04773); (0.03579); (0.04733); (0.05966); (0.05966); (0.03579); (0.04773); (0.04773)	0.05966	0.03579
Y4	(0.0288); (0.0288); (0.0171); (0.0288); (0.0288); (0.0288); (0.0288); (0.0285); (0.0285); (0.0288);	0.0285	0.0171

d. Determining alternative preference values

The results of the calculation of alternative distances from the positive and negative ideal solutions can be seen in the table below:

Table 9. Alternative Distances to Ideal Solutions

	Positive (Di+)	***Negative Di -)***
Ibu Siti Rahmawati, S.Pd.	0.02291	0.07216
Bapak Ahmad Fauzan, M.Pd.	0.0333	0.06752
Ibu Lestari Wulandari, S.Pd	0.06984	0.03169
Bapak Dedi Kurniawan, S.Pd.I.	0.04899	0.04278
Ibu Rina Kartikasari, M.Pd.	0.06259	0.06019
Bapak Heri Santoso, S.Pd.	0.042778	0.04899
Ibu Dewi Anggraini, S.Pd.	0.06145	0.06364
Bapak Arif Nugroho, M.Pd	0.07038	0.03264
Ibu Melani Puspita, S.Pd.	0.03169	0.06984
Bapak Bambang Subekti, S.Pd	0.06914	0.0322

e. Alternative Preference Values

After the alternative distance of the positive and negative ideal solutions is obtained, it is followed by obtaining the results of the proximity of each alternative to the ideal solution with the following preference values:

Table 10. Alternative Preferences Values

	Preferences
Ibu Siti Rahmawati, S.Pd.	0.70699
Bapak Ahmad Fauzan, M.Pd.	0.66952
Ibu Lestari Wulandari, S.Pd	0.31213
Bapak Dedi Kurniawan, S.Pd.I.	0.46619
Ibu Rina Kartikasari, M.Pd.	0.4902
Bapak Heri Santoso, S.Pd.	0.53381
Ibu Dewi Anggraini, S.Pd.	0.50876
Bapak Arif Nugroho, M.Pd	0.31687
Ibu Melani Puspita, S.Pd.	0.68787
Bapak Bambang Subekti, S.Pd	0.31775

From this preference value, it can be seen that Mrs. Siti Rahmawati, S.Pd has the largest preference value among others so that Mrs. Siti was selected to be the best teaching staff at SMK Al – Amanah.

IV. Conclusion

This study has succeeded in showing that the integration of the Analytical Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods in the decision support system makes a significant contribution to increasing the objectivity and efficiency of the process of selecting the best teaching staff at SMK Al-Amanah. By using AHP, the weight of assessment criteria can be determined systematically and structured based on clear priorities, thereby reducing subjectivity which has been the main obstacle in the selection process. Furthermore, the TOPSIS method is used to rank teaching staff based on the proximity of the solution to ideal conditions, which results in more consistent and measurable decisions. This system is able to accommodate various assessment criteria simultaneously, thus providing a comprehensive and transparent picture in determining the best teaching staff. These findings indicate that the integrated application of the two methods not only improves the quality of decision-making, but also accelerates the selection process with results that can be accounted for academically and practically.

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