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Decision Support System for Best Teacher Selection using the Multi-Objective Optimization on the Basic of Ratio Analysis (MOORA)

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Abstract−Teachers are one of the most important assets owned by companies in their efforts to maintain survival, develop, ability to compete and earn profits. The selection of the best teachers will produce valid and useful information for employee administrative decisions such as promotions, training, transfers including reward systems and other decisions. Decision Support System is a computerized system and is designed to increase the effectiveness in decision making to solve semi-structured and unstructured problems so that the decision making process can be of higher quality. This application that will be made is an application that is guided by the MOORA method. The calculation results using the MOORA method revealed that alternative A5 shows the best performance with a score of 1.246, while alternative A9 occupies the lowest position with a score of 0.546.

Keywords: Decision Support System; Best Teacher Selection; MOORA

1. INTRODUCTION

A teacher is someone who works for an institution, office, company, and so on with a salary (wage)[1]. Teachers are one of the most important assets owned by the company in maintaining the continuity of the company, developing, the ability to compete and earn profits[2]. Competition in the business world that is increasingly competitive spurs companies to work harder in improving the quality of their resources. One of the efforts for companies is to improve the quality of human resources because the quality of good human resources will be able to increase productivity and profit achievement in a company.

The selection of the Best Teacher can aim at generating valid and useful information for teacher administrative decisions such as promotion, training, transfer including reward systems and other decisions[3]. The current selection of the best teacher in the company under study is by random means because of the limited time and the large number of teachers, each department represents one teacher to participate in the selection of the best teacher so that this method is considered not objective because it does not match the teacher data[4]. Overall, companies that carry out the process of selecting the best teachers are only based on individual leadership research, allowing for errors. In a decision support system, a method can be applied that can produce the best decision from several alternatives that are inputted.

In many schools, the selection process for the best teacher is based solely on the individual research of the leadership, allowing for errors to occur. So sometimes there are teachers who feel entitled to the best teacher selection but are not selected in the best teacher selection. This will result in less confidence in the results of the assessment conducted by the leadership. To solve this problem, a decision support system is used that is able to assist decision making to produce decisions objectively according to the values possessed by each teacher based on the criteria set.

Decision Support System (DSS) is a collection of data processing procedures to assist decision makers in dealing with semi-structured problems[5][6]. SPK is intended to assist decision makers in solving problems and not replace human decision makers[7][8]. In a decision support system, methods can be applied that are able to produce the best decision from several alternatives inputted, for example the Promethee, Electre, Topsis, VIKOR, MOORA, OCRA methods[9].

Ardi Kusuma According to research on the Decision Support System for Selection of Exemplary Students using MOORA, it can be concluded that the weight determined in each assessment is very influential on the alternatives that will be calculated and in helping the selection of exemplary students by applying the MOORA method for fairly effective results[10]. Samuel Manurung According to the research of the Decision Support System for the Selection of the Best Teacher and the Best Employee Using the MOORA Method, it can be concluded that using the MOORA method is faster and more precise in a selection of teachers and teachers to get the expected results[11].

Based on these problems, it is necessary to build a Decision Support System (SPK) to support the process of selecting the best employees, by applying the MOORA method. The application of the MOORA method will be able to provide the best solution to the company in selecting the best teacher based on predetermined criteria.

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2. RESEARCH METHODS

2.1 Decision Support System

A decision support system is the result of decisively solving the problem it faces. A decision is a definitive answer to a question [12][13]. A decision can also be an action against an implementation that deviates significantly from the original plan. A decision support system is a procedure-based model or computer-based tool or system that retrieves and displays information to assist decision makers to obtain quality decisions[14][15].

2.2 The Best Teacher

The best teachers are employees who really have the will to work, have the education and intelligence of each teacher they have that can be emulated or imitated by each employee with each other. the best teachers are also able to take responsibility in every job given so that they can create and have a positive impact on the school such as; progress at school, well-known in the community and develop from time to time[16][17].

2.3 Metode Multi-Objective Optimization On The Basic of Ratio Analysis (MOORA)

MOORA is a multiobjective system optimizing two or more conflicting attributes simultaneously. This method is applied to solve problems with complex mathematical calculations.[18][19]. The steps of the MOORA method can be seen as follows [20][21]:

1. Determination of decision matrix values
   Define objectives to identify pertinent evaluation attributes.

$$X = \begin{pmatrix} x_{11} & x_{12} & x_{1n} \\ x_{21} & x_{22} & x_{2n} \\ x_{31} & x_{23} & x3_n \end{pmatrix} \quad (1)$$

2. Matrix Normalization
   Breaures (2008) concluded that for the denominator, the best choice is the square root of the sum of the squares and each alternative per attribute.

$$X_{ij}^{*} = Xij \sqrt{\left[\sum_{i=1}^{m} X_{ij}^{2}\right]} \quad (2)$$

3. Optimizing Attributes
   For multiobjective optimization, the normalized measure is increased in the maximization case (for favorable attributes) and decreased in the minimization case (for unfavorable attributes).

$$Yi = \sum_{j=1}^{m} - \sum_{j=g+1}^{n} X_{ij}^{*} \quad (3)$$

   Where G is the number of attributes to be maximized, (n - g) is the number of attributes to be minimized, yi is the normalized assessment value of alternative 1 against all attributes. When the weight attribute is considered, equation 4 becomes as follows:

$$Yi = \sum_{j=1}^{g} WjX_{ij}^{*} - \sum_{j=g+1}^{g} Wj\, X_{ij}^{*} \quad (4)$$

   Where Wj is the weight of the J^th attribute, which can be determined by applying AHP or entrophy method.
4. Ranking Yi Values
   The Yi value can be positive or negative depending on the maximum and minimum totals in the decision matrix. It is a rank order and Yi indicates the final choice. Thus the best alternative has the highest Yi value, while the worst alternative has a low value.

2.4 Research Stages

The following are the research steps taken to achieve the research objectives in determining the best employee. Thus, the research framework can be organized as follows:

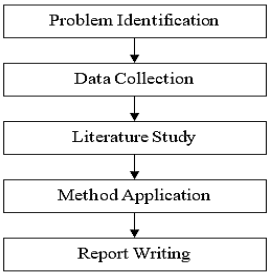

Figure 1. Research Stages

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The research stages in determining the best employee by applying the MOORA method can be explained as follows:

1. Problem Identification
   At this stage, researchers identify problems or needs that need to be resolved. In the context of selecting the best teacher, researchers determine the criteria or factors that will be used in selecting the best teacher.
2. Data Collection
   Once the problem or need has been identified, researchers collect teacher data based on predetermined criteria. It is important for researchers to ensure that the data collected is valid, actual and accurate.
3. Literature Study
   Literature study is a process where researchers search and review literature on the method to be used, namely the MOORA method, as well as its application in determining the best employee. Through literature studies, researchers deepen their understanding of the method, study relevant previous studies, and gain insights and information that support research.
4. Analysis of Method Application
   The stage where researchers apply the MOORA method to process the data that has been collected in the selection of the best teacher. In this stage, determining the weight for each criterion is very important. Using the MOORA formula, the relative performance score of each teacher can be calculated. This formula allows an objective and systematic assessment by considering the maximum and minimum values of each criterion.
5. Preparation of Research Report
   After analyzing the application of the MOORA method, the researcher compiled a research report containing the results of the analysis, interpretation, and recommendations or suggestions based on the research findings. This report is organized clearly and systematically, with the aim of making a meaningful contribution in supporting decision making in determining the best teacher accurately and objectively.

3. RESULTS AND DISCUSSION

In selecting the best employee, the company must calculate and determine who will be the best teacher and sometimes the company has difficulty in making decisions. Based on the above problems, a system was formed to solve the teacher in the calculation using the process in MOORA as follows:

Table 1. Alternative Data

Teacher Name	Alternative Code
Putri Naura	A_1
M. Dany	A_2
Ilham Panjaitan	A_3
Cintya Fitri	A_4
Muhammad Rahul	A_5

Table 1 serves as a reference for the evaluated alternative teacher data, displaying the names of the teachers along with the alternative codes given for each teacher, namely Putri Naura (A1), M. Dany (A2), Ilham Panjaitan (A3), Cintya Fitri (A4), and Muhammad Rahul (A5).

Tabel 2. Criteria

Criteria	Description	Weight	Type
C_1	Skills	0,20	Benefit
C_2	Expertise	0,25	Benefit
C_3	Education	0,25	Benefit
C_4	Discipline	0,30	Benefit

Table 2 serves as a guide to the criteria used in the evaluation of selecting the best teachers. This table lists four criteria, namely Skills (C1) with a weight of 0.20, Expertise (C2) with a weight of 0.25, Quality of Education (C3) with a weight of 0.25, and Discipline (C4) with a weight of 0.30. All criteria are of the benefit type, which means that the higher the score, the better the teacher's performance.

Table 3. Alternative Data

Alternative	C_1	C_2	C_3	C_4
A_1	Good	Very Good	Fairly Good	Good
A_2	Fairly Good	Good	Very Good	Good
A_3	Good	Fairly Good	Good	Good
A_4	Good	Good	Very Good	Fairly Good
A_5	Fairly Good	Good	Good	Very Good
A_6	Fairly Good	Very Good	Good	Fairly Good

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Alternative	C_1	C_2	C_3	C_4
A_7	Good	Good	Fairly Good	Fairly Good
A_8	Fairly Good	Very Good	Good	Good
A_9	Good	Good	Not Good	Not Good
A_{10}	Very Good	Not Good	Good	Good enough

Table 3 is alternative data that displays the evaluation of each teacher (A1 to A10) based on four predetermined criteria. The criteria include Skills (C1), Expertise (C2), Quality of Education (C3), and Discipline (C4). From this table, we can see the performance of each teacher in each criterion, ranging from the categories " Poor ", " Fairly Good ", "Good", to "Very Good".

Tabel 4. Criteria Weighting

Description	Weight
Very good	5
Good	4
Fairly Good	3
Not Good	2
Poor	0

Table 4 explains the weighting of the criteria used in the evaluation of the best teacher selection. Weights are given based on performance categories, namely Very Good with a weight of 5, Good with a weight of 4, Fair with a weight of 3, Less Good with a weight of 2, and Poor with a weight of 0.

Tabel 5. Rating The Suitability Of Alternatives And Criteria

Alternatives	C_1	C_2	C_3	C_4
A_1	4	5	3	4
A_2	3	4	5	4
A_3	4	3	4	4
A_4	4	4	5	3
A_5	3	4	4	5
A_6	3	5	4	3
A_7	4	4	3	3
A_8	3	5	4	4
A_9	4	4	2	2
A_{10}	5	2	4	3

Table 5 displays the suitability rating of each alternative teacher (A1 to A10) based on the four predetermined criteria. Ratings are given based on the weights that have been attributed in Table 4. Thus, the numbers in this table represent the extent to which each teacher meets the predetermined criteria. The following are the steps for calculating MOORA.

1. Create an X decision matrix taken from table 8.

$$X = \begin{bmatrix} 4 & 5 & 3 & 4 \\ 3 & 4 & 5 & 4 \\ 4 & 3 & 4 & 4 \\ 4 & 4 & 5 & 3 \\ 3 & 4 & 4 & 5 \\ 3 & 5 & 4 & 3 \\ 4 & 4 & 3 & 3 \\ 3 & 5 & 4 & 4 \\ 4 & 4 & 2 & 2 \\ 5 & 2 & 4 & 3 \end{bmatrix}$$

2. Then normalize the X matrix using the 1st equation.

$$C1 = \sqrt{4^2 + 3^2 + 4^2 + 4^2 + 3^2 + 3^2 + 4^2 + 3^2 + 4^2 + 5^2} = \sqrt{141} = 11{,}874$$

$$A_{11} = \frac{4}{11{,}874} = 0{,}337$$

$$A_{21} = \frac{3}{11{,}874} = 0{,}253$$

$$A_{31} = \frac{4}{11{,}874} = 0{,}337$$

$$A_{41} = \frac{4}{11{,}874} = 0{,}337$$

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$A_{51} = \frac{3}{11,874} = 0,253$

$A_{61} = \frac{3}{11,8747} = 0,253$

$A_{71} = \frac{4}{11,874} = 0,337$

$A_{81} = \frac{3}{11,874} = 0,253$

$A_{91} = \frac{4}{11,874} = 0,337$

$A_{101} = \frac{5}{11,874} = 0,421$

$C2 = \sqrt{5^2 + 4^2 + 3^2 + 4^2 + 4^2 + 5^2 + 4^2 + 5^2 + 4^2 + 2^2} = \sqrt{168} = 12,961$

$A_{12} = \frac{5}{12,961} = 1,929$

$A_{22} = \frac{4}{12,961} = 1,234$

$A_{32} = \frac{3}{12,961} = 0,694$

$A_{42} = \frac{4}{12,961} = 1,234$

$A_{52} = \frac{4}{12,961} = 1,234$

$A_{62} = \frac{5}{12,961} = 1,929$

$A_{72} = \frac{4}{12,961} = 1,234$

$A_{82} = \frac{5}{12,961} = 1,929$

$A_{92} = \frac{4}{12,961} = 1,234$

$A_{102} = \frac{2}{12,961} = 0,309$

$C3 = \sqrt{3^2 + 5^2 + 4^2 + 5^2 + 4^2 + 4^2 + 3^2 + 4^2 + 2^2 + 4^2} = \sqrt{152} = 12,329$

$A_{13} = \frac{3}{12,329} = 0,694$

$A_{23} = \frac{5}{12,329} = 1,929$

$A_{33} = \frac{4}{12,329} = 1,234$

$A_{43} = \frac{5}{12,329} = 1,929$

$A_{53} = \frac{4}{12,329} = 1,234$

$A_{63} = \frac{4}{12,329} = 1,234$

$A_{73} = \frac{3}{12,329} = 0,694$

$A_{83} = \frac{4}{12,329} = 1,234$

$A_{93} = \frac{2}{12,329} = 0,309$

$A_{103} = \frac{4}{12,329} = 1,234$

$C4 = \sqrt{4^2 + 4^2 + 4^2 + 3^2 + 5^2 + 3^2 + 3^2 + 4^2 + 2^2 + 3^2} = \sqrt{129} = 11,358$

$A_{14} = \frac{4}{11,358} = 1,234$

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$$A_{24} = \frac{4}{11,358} = 1,234$$

$$A_{34} = \frac{4}{11,358} = 1,234$$

$$A_{44} = \frac{3}{11,358} = 0,694$$

$$A_{54} = \frac{5}{11,358} = 1,929$$

$$A_{64} = \frac{3}{11,358} = 0,694$$

$$A_{74} = \frac{3}{11,358} = 0,694$$

$$A_{84} = \frac{4}{11,358} = 1,234$$

$$A_{94} = \frac{2}{11,358} = 0,309$$

$$A_{104} = \frac{3}{11,358} = 0,694$$

The result of normalizing the X matrix is obtained X*ij below:

$$x_{ij}^{*} = \begin{bmatrix} 0,337 & 1,929 & 0,694 & 1,234 \\ 0,253 & 1,234 & 1,929 & 1,234 \\ 0,337 & 0,694 & 1,234 & 1,234 \\ 0,337 & 1,234 & 1,929 & 0,694 \\ 0,253 & 1,234 & 1,234 & 1,929 \\ 0,253 & 1,929 & 1,234 & 0,694 \\ 0,337 & 1,234 & 0,694 & 0,694 \\ 0,253 & 1,929 & 1,234 & 1,234 \\ 0,337 & 1,234 & 0,309 & 0,309 \\ 0,421 & 0,309 & 1,234 & 0,694 \end{bmatrix}$$

3. The next step optimizes the attributes by including the normalized search weights.

$$Xwj = \begin{bmatrix} 0,337(0,20) & 1,929(0,25) & 0,694(0,25) & 1,234(0,30) \\ 0,253(0,20) & 1,234(0,25) & 1,929(0,25) & 1,234(0,30) \\ 0,337(0,20) & 0,694(0,25) & 1,234(0,25) & 1,234(0,30) \\ 0,337(0,20) & 1,234(0,25) & 1,929(0,25) & 0,694(0,30) \\ 0,253(0,20) & 1,234(0,25) & 1,234(0,25) & 1,929(0,30) \\ 0,253(0,20) & 1,929(0,25) & 1,234(0,25) & 0,694(0,30) \\ 0,337(0,20) & 1,234(0,25) & 0,694(0,25) & 0,694(0,30) \\ 0,253(0,20) & 1,929(0,25) & 1,234(0,25) & 1,234(0,30) \\ 0,337(0,20) & 1,234(0,25) & 0,309(0,25) & 0,309(0,30) \\ 0,421(0,20) & 0,309(0,25) & 1,234(0,25) & 0,694(0,30) \end{bmatrix}$$

The result of multiplication with the weight of the criteria, namely :

$$X = \begin{bmatrix} 0,067 & 0,482 & 0,174 & 0,370 \\ 0,051 & 0,309 & 0,482 & 0,370 \\ 0,067 & 0,174 & 0,309 & 0,370 \\ 0,067 & 0,309 & 0,482 & 0,208 \\ 0,051 & 0,309 & 0,309 & 0,579 \\ 0,051 & 0,482 & 0,309 & 0,208 \\ 0,067 & 0,309 & 0,174 & 0,208 \\ 0,051 & 0,482 & 0,309 & 0,370 \\ 0,067 & 0,309 & 0,077 & 0,093 \\ 0,084 & 0,077 & 0,309 & 0,208 \end{bmatrix}$$

Using the 4th equation, the next step can be calculated Yi, which is seen in table 6.

Table 6. Yi List (Preference Value)

Alternative	Maximum (C1+C2+C3+C4)	Y (Max)
A_1	0,067 + 0,482 + 0,172 + 0,370	1,093
A_2	0,051 + 0,309 + 0,482 + 0,370	1,212

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Alternative	Maximum (C1+C2+C3+C4)	Y (Max)
A_3	0,067 + 0,174 + 0,309 + 0,370	0,920
A_4	0,067 + 0,309 + 0,482 + 0,208	1,066
A_5	0,051 + 0,309 + 0,309 + 0,579	1,246
A_6	0,051 + 0,482 + 0,309 + 0,208	1,050
A_7	0,607 + 0,309 + 0,174 + 0,208	0,758
A_8	0,051 + 0,482 + 0,309 + 0,370	1,212
A_9	0,670 + 0,309 + 0,077 + 0,093	0,546
A_{10}	0,084 + 0,077 + 0,309 + 0,208	0,678

From the results above, we can see the ranking of each alternative from the attention of criteria to employees in table 7.

Tabel 7. Ranking Result

Alternative	Results	Ranking
A_1	1,093	4
A_2	1,212	2
A_3	0,920	7
A_4	1,066	5
A_5	1,246	1
A_6	1,050	6
A_7	0,758	8
A_8	1,212	3
A_9	0,546	10
A_{10}	0,678	9

Based on Table 7, alternative A5 is ranked first with a score of 1.246. A2 and A8 share the same score, 1.212, with A2 ranked second and A8 ranked third. Alternative A9 is the lowest with a score of 0.546.

4. CONCLUSIONS

The Best Teacher Selection Decision Support System using the Multi-Objective Optimization On The Basic of Ratio Analysis (MOORA) method has successfully evaluated and ranked ten alternative teachers based on predetermined criteria. The calculation results using the MOORA method show that alternative A5 shows the best performance with a score of 1.246, while alternative A9 occupies the lowest position with a score of 0.546. The scores obtained by each alternative reflect their ranking, with alternatives A2 and A8 having the same score but in a different order. Thus, this data illustrates the priority and relative performance of each alternative in the evaluation. These results can be an important reference in the process of selecting the best teacher to improve the quality of education.

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