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Decision Support System of Bonus for Honorary Teachers through the TOPSIS Algorithm

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Abstract

The proliferation of algorithms facilitates various tasks by allowing for specialization in specific fields. Among these, algorithms designed for calculation and decision-making are particularly useful. Decision Support Systems (DSS) have undergone numerous changes and advancements, leading to the development of new algorithms in this area. The TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) algorithm enables the determination of criteria and weights to assist in decision-making by calculating solution distances and weight values. This system allows for the adjustment of points, criteria, and weight values based on specific needs. At SMPN 1 Pajangan, the implementation of this system enhances the accuracy and efficiency of supervisors in managing bonuses for non-permanent teachers, mitigating social jealousy through a predefined, system-based distribution of criteria and weights.

Keywords: performance, decision support system, TOPSIS.

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1. Introduction

The TOPSIS algorithm can solve the problem by calculating according to the performance of each honorarium teacher by paying attention to the aspects of discipline, order, accuracy, and responsibility of each honorarium teacher (Setiawan, 2021; Xie & Ma, 2021). This algorithm can calculate according to the dose given by the supervisor so that the supervisor only needs to input the performance figures according to what the honorarium teacher gets through the previously calculated aspects (Baky, 2014; Belouaar et al., 2022; Coronado-Hernández et al., 2020; Ellyzabeth Sukmawati et al., 2022; Fu & Fu, 2023). With this system, all calculations are carried out by the TOPSIS algorithm so as to produce valid data, and in this system, it is not so complicated because it uses criteria indicators and alternative variables in supporting the decision-making system (Forouzandeh et al., 2022; Setyaningrum et al., 2023; Wang et al., 2023). This algorithm has a fast and efficient calculation in deciding the eligibility of honorarium teachers in the distribution of bonuses, so it can be used as a decision-making system with fast computation (Alshammari et al., 2022; Mariyani & Putri, 2022; Setiawan, 2021; Shukla et al., 2017).

With the TOPSIS algorithm, the system will be more efficient because it uses simple computation, and does not use complex computational calculations like other decision support algorithms (Abdal, 2020; Li et al., 2023; Zhang & Liang, 2023). The Topsis algorithm considers the existence of positive and negative ideal solutions so that multi-objective problems can produce different values for each object and the existence of weight preferences that consider the best and worst solutions of a criterion (CAN et al., 2022).

With the above problems, the authors are interested in creating an application program through a combination of technological developments and bonus granting activities for honorarium teachers carried out by the SMP Negeri 1 Pajangan agency in the hope that this research can be used to select bonuses for honorarium teachers with a decent portion based on the weighted values determined by the relevant agencies (Fitriana et al., 2015).

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The purpose of this research is to implement the TOPSIS algorithm to decide bonus for honour teachers by considering the aspects provided.

2. Research methods

The research method used development research. The research site was SMPN 1 Pajangan. The equipment used hardware and software. The test method utilized BlackBox testing, where the test program was run with the same function and does not need to pay attention to the overall details of the software and only checks the output value based on the input data entered. With the Equivalence Partitioning (EP) method, it can be used by the author to test inputs into groups based on their functions so that accurate test cases were obtained. In this research, several stages were carried out. In the initial stage, it determined the Test Case software tested with the Equivalent Partitions method then initialized the standard grade partition input and output. This aims to get a dataset that displays test documentation and the value of the effectiveness of the Equivalence Partitions method (Arwaz et al., 2019).

3. Results and Discussion

3.1. Fuzzy Form

The data entered at the beginning of the honorary teacher employment was converted into a criteria table in fuzzy form in the Table 1.

Table 1. Employee Data Table

No	Name	Criteria				
		C1	C2	C3	C4	C5
1	Rudi	80	85	18	90	90
2	Budi	85	80	18	90	85
3	Nora	85	85	20	90	80
4	Retno	85	90	20	80	90
5	Anji	80	90	20	80	80
6	Ali	85	90	18	85	90
7	Eko	80	80	20	90	85
8	Ela	90	80	18	90	85
9	Riska	80	85	19	90	90
10	Atik	90	85	19	85	90

Next, find the value of X_n with the following formula:

$$|Xn| - \sqrt{\sum_{i=1}^{m} x_{ij}^2}$$

Here is the calculation:

$X_1 = \sqrt{(80)^2 + (85)^2 + (85)^2 + (85)^2 + (80)^2 + (85)^2 + (80)^2 + (90)^2 + (80)^2 + (90)^2} = 256.89$
$X_2 = \sqrt{(85)^2 + (80)^2 + (85)^2 + (90)^2 + (90)^2 + (90)^2 + (80)^2 + (80)^2 + (85)^2 + (85)^2} = 269.072$
$X_3 = \sqrt{(18)^2 + (18)^2 + (20)^2 + (20)^2 + (20)^2 + (18)^2 + (20)^2 + (18)^2 + (19)^2 + (19)^2} = 60{,}149$
$X_4 = \sqrt{(90)^2 + (90)^2 + (90)^2 + (80)^2 + (80)^2 + (85)^2 + (90)^2 + (90)^2 + (90)^2 + (85)^2} = 177{,}552$
$X_5 = \sqrt{(90)^2 + (85)^2 + (80)^2 + (90)^2 + (80)^2 + (90)^2 + (85)^2 + (85)^2 + (90)^2 + (90)^2} = 275{,}870$

If the value of X_n had been obtained, then the next step was to calculate the normalized value of the matrix using the following formula:

$$rij = \frac{x_{ij}}{\sqrt{\sum_{i}^{m} x_{ij}^2}}$$

then, the following normalization matrix was produced after several stages of normalization.

Table 2. Criteria Table

No	Name	Criteria				
		C1	C2	C3	C4	C5
1	Rudi	0.2881	0.3012	0.2867	0.3106	0.3105
2	Budi	0.3061	0.2835	0.2867	0.3106	0.2933
3	Nora	0.3061	0.3012	0.3185	0.3106	0.276
4	Retno	0.3061	0.3189	0.3185	0.2761	0.3105
5	Anji	0.2881	0.3189	0.3185	0.2761	0.276
6	Ali	0.3061	0.3189	0.2867	0.2934	0.3105
7	Eko	0.2881	0.2835	0.3185	0.3106	0.2933
8	Ela	0.3041	0.2835	0.2867	0.3106	0.2933
9	Riska	0.2281	0.3012	0.3026	0.3106	0.3105
10	Atik	0.3041	0.3012	0.3026	0.2934	0.3105

After the matrix normalization step, the next step is to calculate the weighted normalization matrix (Y), for the predetermined weights (W) used the formula $y_{ij} = w_i \times r_{ij.}$ Then, the normalized weight values were produced as follows.

Table 3. Normalization Criteria Table

No	Name	Criteria				
		C1	C2	C3	C4	C5
1	Rudi	1.1525	0.9037	0.5734	1.2425	1.5526
2	Budi	1.2245	0.8505	0.5734	1.2425	1.4664
3	Nora	1.2245	0.9037	0.6371	1.2425	1.3801
4	Retno	1.2245	0.9568	0.6371	1.1044	1.5526
5	Anji	1.1525	0.9568	0.6371	1.1044	1.3801
6	Ali	1.2245	0.9568	0.5734	1.1735	1.5526
7	Eko	1.1525	0.8505	0.6371	1.2425	1.4664
8	Ela	1.2965	0.8505	0.5734	1.2425	1.4664
9	Riska	1.1525	0.9037	0.6052	1.2425	1.5526
10	Atik	1.2965	0.9037	0.6052	1.1735	1.5526

If the weight value has been normalized, the next step is to calculate the positive (A^{+}) and negative (A^{-}) ideal matrix values.

Table 4. Positive Ideal Matrix (A+)

Criteria				
Absence	Communication	Work Period	Loyalty	Discipline
y_1^+	y_2^+	y_3^+	y_4^+	y_5^+
1.2965	0.9568	0.6371	1.2425	1.6389

Table 5. Negative Ideal Matrix (A-)

Criteria				
Absence	Communication	Work Period	Loyalty	Discipline
y_1^-	y_2^-	y_3^-	y_4^-	y_5^-
1.152	0.851	0.573	1.104	1.38

If the ideal positive and negative matrices have been obtained, the next step is that the program calculated the distance between positive and negative solutions using the following formula.

Positive ideal distance:

$$D_i^+ = \sqrt{\sum_{j=1}^{n} (y_i^+ - y_{ij})^2}$$

and the following results were obtained.

Table 6. Positive Ideal Solution Distance (D+)

Number	Name	D^+
1	Rudi	0.1880
2	Budi	0.2249
3	Nora	0.2743
4	Retno	0.1782
5	Anji	0.3273
6	Ali	0.1469
7	Eko	0.2494
8	Ela	0.2127
9	Riska	0.1796
10	Atik	0.1265

Negative ideal distance:

$$D_i^- = \sqrt{\sum_{j=1}^{n} (y_i^- - y_{ij})^2}$$

and the following results were obtained.

Table 7. Negative Ideal Solution Distance (D-)

Number	Name	D^-
1	Rudi	0.2276
2	Budi	0.1778
3	Nora	0.1764
4	Retno	0.2246
5	Anji	0.1238
6	Ali	0.2261
7	Eko	0.1747
8	Ela	0.2179
9	Riska	0.2298
10	Atik	0.244

The next step is to find the preference value and determine those entitled to receive the bonus according to the threshold value determined by the following formula.

$$V_i = \frac{D_i^-}{D_i^- + D_i^+}$$

The preference values, rankings, and information were obtained as follows.

Table 8. Preference Value

Number	Name	V_i	Threshold Value	Information
1	Atik	0.6586	0.6539	Accept
2	Ali	0.6062	0.6539	Do not accept
3	Riska	0.5613	0.6539	Do not accept
4	Retno	0.5576	0.6539	Do not accept
5	Rudi	0.5476	0.6539	Do not accept
6	Ela	0.506	0.6539	Do not accept
7	Budi	0.4415	0.6539	Do not accept
8	Eko	0.4119	0.6539	Do not accept
9	Nora	0.3914	0.6539	Do not accept
10	Anji	0.2744	0.6539	Do not accept

3.2. System Testing

3.2.1. Test Cases

This testing system was carried out to test the software to ensure that the results obtained are in accordance with predetermined requirements. When the requirements for a software system have been prepared, there should be a test plan (Salamah & Khasanah, 2017).

This testing technique used Equivalence Partioning and the first step that must be taken aimed to create a test case based on existing software functions. Then proceed with creating test limits, then created a test model and tried to produce what was expected from the software that had been created. After everything had been implemented, the final step was to carry out testing based on the model that had been designed (Arwaz et al., 2019).

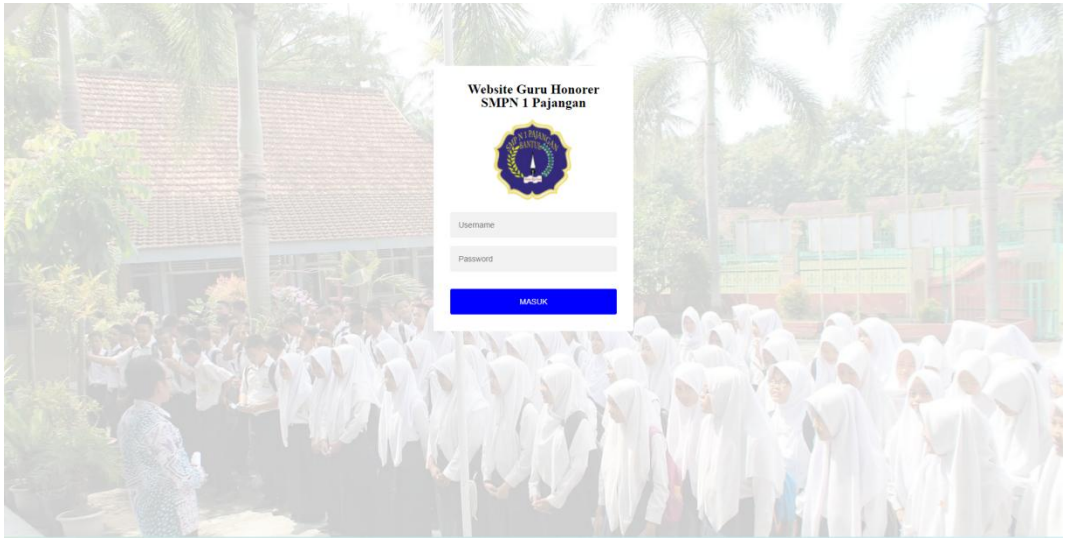

Figure 1. Login Form

Based on the Figure 1, there is a login form containing the Username and Password. In this test plan, if user enters a username, it must be filled in with the username that was created previously *(for example admin)* with a password *(admin).* After entering it, then go to the main page. If the username and password are incorrect, there will be a notification *("The username/password you entered is incorrect").*

3.2.2. Login Form Test Case Design

Table 9. Login Form Test Case Design

Id	Description	Expected results
A001	Fill in the Username with "admin" and password "admin" then press the "Login" button	The system accepts and goes to the main page.
A002	Fill in the Username with "admin" and password "admin123" then press the "Login" button	The system will refuse and display "The Username/Password you entered is incorrect").

Figure 2. Criteria Page

Figure 3. Change Criteria Page

Based on the Figure 2 and 3, there is a criteria page design, which contains data and delete buttons and change buttons. If the admin presses the delete button, the data listed on the system will be deleted and the notification of *"Data successfully deleted"* will be displayed and returned to the criteria page. If click the change button, it will go to the change criteria page, which contains a form for changing the values for the selected data. After pressing the change button, the notification of *"Data successfully saved"* will be displayed.

3.2.3. Design Test Case Criteria and Change Criteria

Table 10. Design Test Case Criteria and Change Criteria

Id	Test Description	Expected results
B001	Press the Delete button	The data listed is deleted by the system and displays a message ("Data deleted successfully")
B002	Pressing the Change button	The page will go to the change criteria section.
B003	Fill in the data according to the requirements on the criteria form, point 1, point 2, point 3, point 4, point 5.	The system saves data into the database and displays a message ("data has been successfully changed") and returns to the criteria page.

Figure 4. Add Criteria page

Based on the image above, there is a test plan. In the add criteria column, an admin must fill in the form of criteria name, weight, point 1, point 2, point 3, point 4 and point 5. After pressing the add button, the system will display the notification of *"Data successfully added"*.

3.2.4. Test Case Design Add Criteria

Table 11. Test Case Design Add Criteria

Id	Test Description	Expected results
C001	Fill in the criteria form, weight, point 1, point 2, point 3, point 4, point 5	The system saves the data into the database and displays a notification of *("Data successfully saved")* then returns to the add criteria page.

Based on the Figure 5 and 6, there are several test plans. If the admin wants to change the threshold, it must press the change button, then it will go to the change threshold page. After that, the admin fills in the column specified by the administrator and presses the change button to display the notification of "*Data has been successfully changed"*.

Figure 5. Criteria Threshold Page

Figure 6. Change Threshold Page

3.2.5. Threshold Test Case Design

Table 12. Threshold Test Case Designs

Id	Test Description	Expected results
D001	Pressing the “Change” button	After pressing the change button, the page will go to the change threshold page
D002	Fill in the weight column, point 1, point 2, point 3, point 4, point 5 and press the Save button	The system changes database data and displays a notification of *("Data successfully saved")* then returns to the threshold change page.

Figure 7. Employee Page

Figure 8. Change Employee Data page

Based on the Figure 7 and 8, there is a design for the employee page, which contains data and delete buttons and change buttons. If the admin presses the delete button, the data listed on the system will be deleted and the message "Data deleted successfully" will be displayed and returned to the employee page. If the admin clicks the change button, it will go to the employee data change page, which contains a form to change the name of the selected data. After pressing the change button, the notification of *"Data successfully saved"* appears.

3.2.6. Employee Data Test Case Design

Table 13. Employee Data Test Case Design

Id	Test Description	Expected results
E001	Pressing the Delete Button	The system deletes the data in the database and displays the message *("Data Has Been Successfully Deleted")*
E002	Pressing the Change Button	Go to the Change Employee Data page
E003	Fill in the employee name form and press the "Change" button	The system changes the database and displays the message (“Data has been successfully changed”)

Figure 9. Add Employee Page

Based on the Figure 9, there is a test design. Admin adds new employee data in the name and ID columns, which are automatically filled in after pressing the change button. Once successful, the system will display a message *("Data Successfully Added").*

3.2.7. Employee Addition Test Plan

Table 14. Employee Addition Test Plan

Id	Test Description	Expected results
F001	Fill in the Employee name column and press the Save button	The system adds employee data to the database and displays the message *("Data Successfully Added ")*

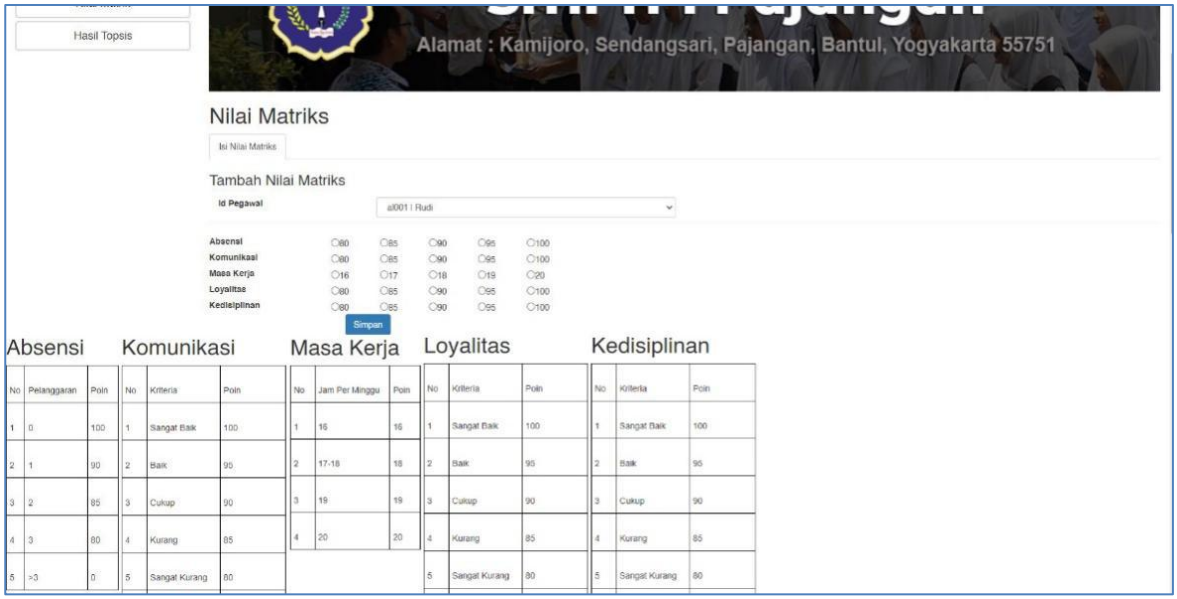

Figure 10. Add Matrix page

Based on the Figure 10, the admin selects the employee ID and employee name then presses the criteria section according to the value. After that, the admin can press the *("Save")* button.

3.3. Accuracy Testing

Testing was carried out in two stages, namely system and manual by comparing the system's original data calculations and manual calculation original data, as well as system random data and manual random data via Excel.

3.3.1. Original Data

a. System

Hasil Topsis

Nilai Matriks | Nilai Preferensi

Nilai Preferensi

Nomor	Nama	V_i	Ambang Batas Nilai	Keterangan
1	Budi	0.54186	0.6539	Tidak Menerima
2	Atik	0.78473	0.6539	Menerima
3	Riska	0.59647	0.6539	Tidak Menerima
4	Rudi	0.58006	0.6539	Tidak Menerima
5	Ali	0.69263	0.6539	Menerima
6	Ela	0.62285	0.6539	Tidak Menerima
7	Retno	0.71047	0.6539	Menerima
8	Eko	0.48472	0.6539	Tidak Menerima
9	Nora	0.59320	0.6539	Tidak Menerima
10	Anji	0.38787	0.6539	Tidak Menerima

Figure 11. Result of Topsis on System using Original Data

b. Microsoft Excel

Nilai Preferensi			
1	Rudi	0.580061	7
2	Budi	0.541866	8
3	Nora	0.59321	6
4	Retno	0.71047	2
5	Anji	0.387877	10
6	Ali	0.692637	3
7	Eko	0.484729	9
8	Ela	0.622859	4
9	Riska	0.596472	5
10	Atik	0.784739	1

Figure 12. Result of Topsis on Microsoft Excel using Original Data

3.3.2. Random Data

a. System

Nilai Preferensi

Nomor	Nama	V_i	Ambang Batas Nilai	Keterangan
1	Budi	0.6935	0.6539	Menerima
2	Atik	0.5114	0.6539	Tidak Menerima
3	Riska	0.5018	0.6539	Tidak Menerima
4	Rudi	0.492	0.6539	Tidak Menerima
5	Ali	0.4795	0.6539	Tidak Menerima
6	Ela	0.4633	0.6539	Tidak Menerima
7	Retno	0.4294	0.6539	Tidak Menerima
8	Eko	0.3802	0.6539	Tidak Menerima
9	Nora	0.3666	0.6539	Tidak Menerima
10	Anji	0.2357	0.6539	Tidak Menerima

Figure 13. Result of Topsis on System using Random Data

b. Microsoft Excel

Nilai Preferensi			
1	Rudi	0.492	4
2	Budi	0.6935	1
3	Nora	0.3666	9
4	Retno	0.4294	7
5	Anji	0.2357	10
6	Ali	0.4795	5
7	Eko	0.3802	8
8	Ela	0.4633	6
9	Riska	0.5018	3
10	Atik	0.5114	2

Figure 14. Result of Topsis on Microsoft Excel using Random Data

Based on calculations determined using both system and manual data as calculation material, the final results obtained that the TOPSIS method have an accuracy level of 99.97%.

4. Conclusion

The TOPSIS method facilitates the equitable distribution of bonuses by implementing the TOPSIS algorithm. This approach effectively addresses the challenge of allocating bonuses for honorary teachers through precise calculations, prioritizing criteria based on pre-established weights, such as Discipline, Loyalty, Attendance, and Communication. The algorithm achieves an accuracy of 99.97%, with a minimal error tolerance of 0.03%, demonstrating its reliability in processing the data.

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