Comparison Analysis of the SAW Method and TOPSIS Method in the Decision Support System for Determining Permanent Teachers in SMK Pasundan 2 Banjaran

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Abstract. The decision-making process is quite burdensome because it is necessary to issue the right decisions so many people do it carefully. Nowadays with the development of decision making system can help in the decision making process because it is done with measurable stages and with methods that have a high level of accuracy. By using the Decision Making System, the process of assigning teachers remains in SMK Pasundan 2 Banjaran can be done quickly, precisely and accurately so that it is expected that the results obtained can be accounted for. But here will be tried to do the decision-making process by using SAW method and TOPSIS method by doing comparison or comparison with the two methods with the aim of getting the right results who can be submitted as a permanent teacher of SMK Pasundan 2 Banjaran but also get advantages and disadvantages and which method is appropriately used for the determination of permanent teachers in SMK Pasundan 2 Banjaran from each method by conducting process trials. Each method certainly has stages in the process of determining results to assist in decision making and this can be a reference in looking at the accountable calculation process. Based on the results of comparison or comparison of SAW method and TOPSIS method which then carried out sensitivity test resulted in a method that is similar to this case study namely SAW method. With saw change value of 10.03168% and TOPSIS by 0.62590%.

1. Introduction
Not all teachers of SMK Pasundan 2 Banjaran have been appointed as Civil Servants (Civil Servants) and Permanent Teachers Foundation (GTY), but there are still teachers who are permanent teachers or honorary teachers. To become a Permanent Teacher of Yayasan (GTY), it must be done assessment and evaluation activities in advance. This assessment and evaluation activity of honor teachers is useful to know the results of teaching honor teachers to their students. Assessment, evaluation, and awarding can be done aimed at spurring the performance of teachers in the teaching learning process. Assessments are carried out to obtain honorary teachers who will then be appointed as Permanent Teachers Foundation (GTY) [1]. Teachers recruited to become permanent teachers by foundations or schools must demonstrate good performance.
SMK Pasundan 2 Banjaran in the appointment of The Permanent Teacher Foundation (GTY) still has constraints that are done manually and the appointment must be in accordance with the approval of the principal. To facilitate the appointment of permanent teachers, a system known as the decision support system is needed (DSS). DSS aims to assist decision makers in producing a decision on the appointment of permanent teachers at SMK Pasundan 2 Banjaran.

The use of decision support systems has many methods that can be used. For the appointment of Yayasan Permanent Teacher at SMK Pasundan 2 Banjaran will use Simple Additive Weighting (SAW) Method which will be compensated with Technique For Order Preference by Similarity to Ideal Solution (TOPSIS) method in the hope that it will be presented which method is appropriate in decision making.

The comparison of the two methods mentioned above has also been used but in different cases such as the selection of exemplary teachers [2], the selection of residential destinations [3], the selection of tourist destinations in West Java [4], the selection of tourist destinations in Indonesia [5], then based on the reference is expected to be the basis of this research reference although certainly the criteria will be different.

2. Background Theory

2.1. Decision Support System

The concept of a decision support system was first introduced by Michael S. Scott Morton in the early 1970s as the Management Decision System. It is a computer-based system aimed at assisting decision-making by utilizing certain data and models to solve unstructured problems.

System is an interconnected set of elements responsible for processing inputs resulting in output. Decision is the activity of choosing a strategy or action in solving the problem [6]. The criteria of the decision are many options/alternatives, there are constraints/conditions, following a pattern/model of behavior, many inputs/variables, there are risk factors, it takes speed and accuracy.

Decision Support System (DSS) is an interactive information system that provides information, modeling, and manipulation of data [7]. The system is used to assist decision-making in semi-structured situations and unstructured situations, where no one knows exactly how the decision should be.

DSS serves as an add-on or advocate for decision makers, can expand knowledge and possibilities, but does not replace judgment. The system is intended for decisions that require assessment and decisions that can be processed with algorithms or technically.

2.2 Simple Additive Weighting (SAW) Method

The SAW method is the simplest and most widely used MADM method [8]. This method is also the easiest method to apply, because it has an algorithm that is not very complicated. SAW methods are often also known as weighted summation methods. The basic concept of the SAW method is to look for weighted summation of performance ratings on each alternate on all attributes. The SAW method requires the process of normalizing the decision matrix (X) to a scale that can be compared to all existing alternative rating.

This SAW method requires decision makers to determine the weight for each attribute. The total score for an alternative is obtained by summing up the entire multiplication between the rating (which can be compared across attributes) and the weight of each attribute. The rating of each attribute must be dimension-free in the sense that it has gone through the normalization process of the previous matrix.
2.3 Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) Method
The TOPSIS completion method is based on a concept in which the best selected alternative not only has the shortest distance from the positive ideal solution, but also has the longest distance from the negative ideal solution [9]-[10].

3. Methodology
Research methodology is essentially a scientific way to obtain information with specific purposes and uses. Research methods are a way used by researchers in collecting their research data. In the preparation of this research will go through several stages that form a systematic flow in Figure 1.

Figure 1. Research Methods
The stage of problem identification aims to know the problem that is being experienced in the research. At this stage spelled out what problems were raised for research. The issues raised will then be reviewed and obtained information related to the issue.

Furthermore, the authors conducted a literature study to look for references to existing problems and support the research conducted. By looking for some good materials from books, scientific journals, and research results related to the application of fuzzy logic using the Mamdani method [11]-[14].

The Third Stage is to perform the data collection stage is the author's activity of collecting the data needed for application development. The data collection technique performed by the author is an observation on the website of pikobar. The purpose of this observation is to obtain data used for application development, namely in the form of data on the number of ODP, the number of PDP, and the positive amount of Covid-19.

The Fourth phase is the analysis and planning phase is the beginning of the implementation of the system development method rapid application development (RAD) in this study. Activities to plan needs include system planning and analysis. At this stage the author analyzes all the needs that have been collected before to understand the nature of the program to be built. Then the author defines the needs of the application to be built in the form of user characteristics, data needs, and functional and non-functional needs. After the needs of the system have been defined, the authors created a fuzzy logic model of the Mamdani method on predicting an increase in the number of positive cases of Covid-19 14 days later. Based on prior studies on prediction using the fuzzy logic of the Mamdani method and the limitations of the author's ability, the study used linear representation for membership functions, the MAX (Maximum) method for the method of rule composition, and the centroid (Composite Moment) method for the defuzzification method. The design architecture used to design the applications used in this study was Object Oriented Analysis and Design (OOAD), so the authors used Unified Modelling Language (UML) to create a software design object model. The UML diagrams to be created are use case diagrams, class diagrams, sequence charts, and state diagrams. The author only created the four diagrams because they are the main diagrams that are quite used for applications that are not very large. At this stage also the author creates a prototype in the form of an application mockup to be built. After the fuzzy logic was created, the authors then tested the results of the Mamdani method in predicting covid-19 cases with field sample data.

The last stage of this research is the implementation and testing phase is the advanced stage of rad implementation, namely construction and cut over. Construction is the author's activity of implementing the user model into an application. Applications are built using java programming languages with Netbeans and MySQL tools for database management. If during the application development stage there is a discrepancy with the needs of the application that has been defined in the stage of planning the needs then a model and prototype improvement is carried out at the user model stage. If the application built at the construction stage is in accordance with the needs of the application that has been defined at the stage of planning the need, then the next step is to test the application or cut over. The testing method that the authors did on this study was the black-box method. At this stage, a comparison of the calculation of prediction results using the application built on this study with data on the number of covid-19 positive cases that have occurred to look for the error rate.

4. Results and Discussions

4.1 Data Assumptions

The decision-making process in the appointment of Yayasan Permanent Teacher at SMK Pasundan 2 Banjaran still has constraints that are done manually and the appointment must be in accordance with the approval of the principal. To facilitate the appointment of permanent teachers, a system known as
the decision support system (DSS) is required. SPK aims to assist decision makers in producing a decision on the appointment of permanent teachers at SMK Pasundan 2 Banjaran.

4.2 Model Validation

One of the steps in the creation of a decision support system is to validate the model which means entering the necessary facts. In the form of criteria, weight values, and honorary teacher data that will be used as an alternative.

4.3 Determining the Criteria and Weight of Permanent Teacher Appointment

In the process of appointment of permanent teachers carried out using saw method and TOPSIS method, criteria are required, weight of interest of each criterion and alternative match rating to the criteria to perform the calculation so that the best alternative will be obtained (See Table 1). There are 7 benefit criteria used in conducting assessment, namely as follows:
1. C1 = The length of work, in the appointment of the teacher still takes 4 years of work.
2. C2 = The level of education, higher education includes bachelor's or master's. If his education is vocational school then appointed as a permanent teacher to guide the extracurricular.
3. C3 = Attendance, teacher attendance in teaching is at least 75%, so it is seen the teacher's dedication to the world of education.
4. C4 = Evaluation of learning results, evaluation of learning results is done to know the quality of the teacher's performance in conducting teaching and learning activities.
5. C5 = Competency, a teacher must be able to master the science to the teacher and be able to apply it in learning strategies.
6. C6 = Discipline, a teacher must be disciplined, so as to be an example for his protégé.
7. C7 = Responsible, responsible in devising interesting learning strategies that are loved by students.

Table 1. Criteria

| No | Criteria | Description               | Type  |
|----|----------|---------------------------|-------|
| 1  | C1       | Length of Work            | Benefit|
| 2  | C2       | Education Level           | Benefit|
| 3  | C3       | Presence                  | Benefit|
| 4  | C4       | Evaluation of Learning    | Benefit|
|    |          | Outcomes                  |       |
| 5  | C5       | Competence                | Benefit|
| 6  | C6       | Discipline                | Benefit|
| 7  | C7       | Responsible               | Benefit|

4.4 Rank Order Centroid (ROC) Method

The ROC algorithm is based on the level of importance or priority of the criteria [15]. The ROC techniques give weight to each criterion according to the rankings assessed based on priority level. It is usually formed with the statement "Criterion 1 is more important than criteria 2, which is more important than criteria 3" and so on until the nth criterion.

Based on the above criteria, it will then be given to the weight value by applying the Rank Order Centroid (ROC) method, using the equation (1) as follows:
\[ W_k = \frac{1}{k} \sum_{i=1}^{k} (i) \]  

Description:
\( W_j \) = \( j \) attribute weighting value
\( K \) = number of attributes
\( i \) = attribute priority sequence value

After going through the process of calculating the weight value by applying the Rank Order Centroid (ROC) method obtained the results displayed in the form of a table of weight values for each criterion on the decision support system for the SAW and TOPSIS methods can be seen in Table 2.

| No | Criteria | Description               | Type  | Weights |
|----|----------|---------------------------|-------|---------|
| 1. | C1       | Length of Work            | Benefit | 0.37    |
| 2. | C2       | Education Level           | Benefit | 0.23    |
| 3. | C3       | Presence                  | Benefit | 0.16    |
| 4. | C4       | Evaluation of Learning Outcomes | Benefit | 0.11    |
| 5. | C5       | Competence                | Benefit | 0.07    |
| 6. | C6       | Discipline                | Benefit | 0.04    |
| 7. | C7       | Responsible               | Benefit | 0.02    |

4.5 Teacher Honorer Data That Becomes An Alternative

The teacher honourer data that will be used as an alternative to be assigned as a teacher can still be seen in Table 3.

| No | Alternative | Teacher’s Name          |
|----|-------------|-------------------------|
| 1. | A1          | Sunaeni Haryati, S.Si   |
| 2. | A2          | David Ramadhan Pratama  |
| 3. | A3          | Drs. Undang Hidayat     |
| 4. | A4          | Heri Kiswanto, S.Sn     |
| 5. | A5          | Muhamad Ridwan, S.Pd    |
| 6. | A6          | Sena Dwi Septoaji Suherman, S.Pd |
| 7. | A7          | Dewi Kartika, S.Pd      |
| 8. | A8          | Mohamad Gelar Cipta, S.Pd |
| 9. | A9          | Ilham Halimi Akbar, S.Pd |
| 10.| A10         | Nurdin, S.Pd            |
| 11.| A11         | Riki Agus Setiawan      |

4.6 Determining Each Alternate Match Rating

From the specified criteria, a level of criteria interest is created based on the alternative stipulated based on the match rating of each alternate on each criterion converted to the crip number: \( VL = 0; \ L = 0.25; \ E = 0.5; \ H = 0.75; \ VH = 1. \)

a. Working Length Criteria

The old working variable is converted with a fuzzy number like Table 4.
Table 4. Crips Value Of Old Working Criteria

| Criteria (C1)     | Crips Value |
|-------------------|-------------|
| Length of Work    |             |
| 6 Months          | 0           |
| 1 Years           | 0.25        |
| 2 Years           | 0.5         |
| 3 Years           | 0.75        |
| 4 Years           | 1           |

b. Education Level Criteria
Educational level variables are converted with fuzzy numbers such as Table 5.

Table 5. Crips Value Criteria For Education Level

| Criteria (C2)      | Crips Value |
|--------------------|-------------|
| Education Level    |             |
| Elementary School  | 0           |
| Junior High School | 0.25        |
| Vocational High School | 0.5     |
| Strata 1           | 0.75        |
| Strata 2           | 1           |

c. Attendance Criteria
Presence variables are converted with fuzzy numbers such as Table 6.

Table 6. Crips Attendance Criteria Values

| Criteria (C3)    | Crips Value |
|------------------|-------------|
| Presence         |             |
| Presence < 25%   | 0           |
| Presence > 25%   | 0.25        |
| Presence = 50%   | 0.5         |
| Presence = 75%   | 0.75        |
| Presence = 100%  | 1           |

d. Study Results Evaluation Criteria
The evaluation variables of the study results are converted with fuzzy numbers such as Table 7.

Table 7. Crips Value Evaluation Criteria For Study Results

| Criteria (C4)     | Crips Value |
|-------------------|-------------|
| Evaluation of Learning Outcomes |             |
| Very Low          | 0           |
| Low               | 0.25        |
| Enough            | 0.5         |
| High              | 0.75        |
| Very High         | 1           |
e. Competency Criteria
Competency variables are converted with fuzzy numbers such as Table 8.

Table 8. Competency Crips Values

| Criteria (C5) | Crips Value |
|---------------|-------------|
| Competence    |             |
| Very Low      | 0           |
| Low           | 0.25        |
| Enough        | 0.5         |
| High          | 0.75        |
| Very High     | 1           |

f. Disciplinary Criteria
Discipline variables are converted with fuzzy numbers such as Table 9.

Table 9. Crips Disciplinary Criteria Values

| Criteria (C6) | Crips Value |
|---------------|-------------|
| Discipline    |             |
| Very Low      | 0           |
| Low           | 0.25        |
| Enough        | 0.5         |
| High          | 0.75        |
| Very High     | 1           |

g. Responsible Criteria
The variables responsible are converted with fuzzy numbers such as Table 10.

Table 10. Crips Values Of Responsible Criteria

| Criteria (C7) | Crips Value |
|---------------|-------------|
| Responsible   |             |
| Very Low      | 0           |
| Low           | 0.25        |
| Enough        | 0.5         |
| High          | 0.75        |
| Very High     | 1           |

Based on the criteria and rating of each alternate match on each specified criteria, then the alternate description of each criterion has been converted with a crisp value. Based on the data of the teacher name above can be formed matrix of decision X that has been converted with crisp value, such as Table 11.
Table 11. Match Ratings of Each Alternate on Each Criteria

| Alternative Name | Criteria   | C1 | C2 | C3 | C4 | C5 | C6 | C7 |
|------------------|------------|----|----|----|----|----|----|----|
| A1               | 1          | 0.75 | 0.75 | 0.75 | 0.75 | 0.5 | 0.75 |
| A2               | 1          | 0.5 | 0.75 | 0.75 | 0.5 | 0.5 | 0.5 |
| A3               | 0.25       | 0.75 | 1 | 0.75 | 0.75 | 0.75 | 0.75 |
| A4               | 1          | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| A5               | 0.25       | 0.75 | 0.75 | 1 | 0.75 | 0.5 | 0.5 |
| A6               | 0.5        | 0.75 | 0.5 | 0.75 | 0.5 | 0.5 | 0.5 |
| A7               | 1          | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.5 |
| A8               | 0.25       | 0.75 | 0.5 | 0.5 | 0.5 | 0.5 | 0.75 |
| A9               | 0.5        | 0.75 | 0.5 | 0.75 | 0.5 | 0.5 | 0.75 |
| A10              | 1          | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.5 |
| A11              | 0.75       | 0.5 | 0.75 | 0.5 | 0.5 | 0.5 | 0.5 |

4.7 Verification Testing Proposed Solutions

Verification testing the proposed solution is the implementation of the decision solution to get the best alternative decision. Where in this case to get the best alternative decision is done by comparatively simple additive weighting (SAW) method and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method.

4.8 The Calculation Process of Simple Additive Weighting (SAW) Method

4.8.1 Matrix Normalization

Normalize the matrix by calculating the normalized performance rating value (rij) of the Ai alternative to the Cj attribute based on an equation adjusted to the attribute type (profit/benefit attribute = MAXIMUM or cost attribute = MINIMUM).

The normalize the matrix given the following equation (2):

\[ r_{ij} = \begin{cases} \frac{x_{ij}}{\text{Max } x_{ij}} & \text{If } j \text{ is an advantage attribute (benefit)} \\ \frac{\text{Min } x_{ij}}{x_{ij}} & \text{If } j \text{ is a cost attribute (cost) } x_{ij} \end{cases} \]

where with rij is the nominee performance rating of the Ai alternative on the Cj: i = 1,2,...,m and j = 1,2,...,n.

Description:
- \( \text{Max } x_{ij} \) = The greatest value of any criteria i
- \( \text{Min } x_{ij} \) = Smallest value of each criteria i
- \( x_{ij} \) = Attribute values held by each criteria
- Benefit = If the greatest value is best
- Cost = If the smallest value is best
After going through the calculation process, the normalized performance matrix is obtained as follows:

\[
\begin{bmatrix}
1 & 1 & 0.75 & 0.75 & 1 & 0.67 & 1 \\
1 & 0.67 & 0.5 & 0.75 & 0.67 & 0.67 & 1 \\
0.25 & 1 & 1 & 0.75 & 1 & 1 & 1 \\
1 & 1 & 0.75 & 0.5 & 1 & 1 & 1 \\
0.25 & 1 & 0.75 & 0.5 & 1 & 0.67 & 0.67 \\
0.5 & 1 & 0.5 & 0.75 & 0.67 & 0.67 & 0.67 \\
1 & 1 & 1 & 0.75 & 1 & 1 & 0.67 \\
0.25 & 1 & 0.5 & 0.5 & 0.67 & 0.67 & 1 \\
0.5 & 1 & 0.5 & 0.75 & 0.67 & 0.67 & 1 \\
1 & 1 & 1 & 0.75 & 1 & 1 & 0.67 \\
0.75 & 0.67 & 0.75 & 0.5 & 0.67 & 0.67 & 0.67
\end{bmatrix}
\]

### 4.8.2 Preference Values for Each Alternative (Vi)

Specifies the reverence value for each alternate (Vi) by summing the result times between the normalized matrix (R) and the weight value (W). So it gets the greatest value chosen as the best alternative (Ai) as a solution.

According to Alonso et al. (2008) states that to calculate the preference weight value for each alternative (Vi) given the following equation [16]:

\[
V_i = \sum_{j=1}^{n} w_j r_{ij}
\]

Description:
- \(V_i\) = Rank for each alternative.
- \(w_j\) = Rank weight value (of each criteria).
- \(r_{ij}\) = Normalized performance rating value.

Based on the calculation of equation (3), the result can be seen in Table 12.

| Alternative Name | Preference Weight Value (Vi) | Ranking |
|------------------|-----------------------------|---------|
| A7               | 0.96583                     | 1       |
| A10              | 0.96583                     | 1       |
| A1               | 0.91917                     | 2       |
| A4               | 0.90500                     | 3       |
| A2               | 0.77250                     | 4       |
| A3               | 0.69500                     | 5       |
| A11              | 0.69250                     | 6       |
| A9               | 0.67083                     | 7       |
| A6               | 0.66417                     | 8       |
| A5               | 0.66250                     | 9       |
| A8               | 0.55083                     | 10      |

Based on the process of SAW method, it can be concluded that the largest value is alternative code A7 and A10 with a value of 0.96583 namely Dewi Kartika, S.Pd and Nurdin, S.Pd is appointed as the
alternative chosen honorary teacher who will be appointed as a permanent teacher in SMK Pasundan 2 Banjaran.

4.9 The Calculation Process of Technique For Order Preference by Similarity to Ideal Solution (TOPSIS) Method

4.9.1 Matrix Normalization

According to Tong et al. (2005) states that to determine the matrix of normalized decisions (R) TOPSIS of each ai alternative and cj criteria given the following equation (4) [17]:

\[
   r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{j=1}^{n} x_{ij}}} 
\]

with i = 1,2,...,m; dan j = 1,2,...,n.

Description:
\( r_{ij} \) = a value that must be normalized to a comparable scale.
\( x_{ij} \) = comparison form pairs each Ai alternative in each Cj criteria

Based on the equation (4), the calculation results of each criterion can be seen in Table 13.

| Alternative | Criteria |
|-------------|----------|
|             | C1       | C2       | C3       | C4       | C5       | C6       | C7       |
| A1          | 0.43644  | 0.318    | 0.3      | 0.31449  | 0.34874  | 0.25     | 0.36116  |
| A2          | 0.43644  | 0.212    | 0.2      | 0.31449  | 0.23250  | 0.25     | 0.24077  |
| A3          | 0.10911  | 0.318    | 0.4      | 0.31449  | 0.34874  | 0.375    | 0.36116  |
| A4          | 0.43644  | 0.318    | 0.3      | 0.20966  | 0.34874  | 0.375    | 0.36116  |
| A5          | 0.10911  | 0.318    | 0.3      | 0.41931  | 0.34874  | 0.25     | 0.24077  |
| A6          | 0.21822  | 0.318    | 0.2      | 0.31449  | 0.23250  | 0.25     | 0.24077  |
| A7          | 0.43644  | 0.318    | 0.4      | 0.31449  | 0.34874  | 0.375    | 0.24077  |
| A8          | 0.10911  | 0.318    | 0.2      | 0.20966  | 0.23250  | 0.25     | 0.36116  |
| A9          | 0.21822  | 0.318    | 0.2      | 0.31449  | 0.23250  | 0.25     | 0.36116  |
| A10         | 0.43644  | 0.318    | 0.4      | 0.31449  | 0.34874  | 0.375    | 0.24077  |
| A11         | 0.32733  | 0.212    | 0.3      | 0.20966  | 0.23250  | 0.25     | 0.24077  |

4.9.2 Weighted Normalized Matrix

According to Tong et al. (2005) states that to determine the matrix of weighted normalized decisions or matrix Y is a multiplication between the matrix of normalized decisions (R) with weight (W) given the following equation (5) [17]:

\[
   y_{ij} = w_{ij} r_{ij} 
\]

with i = 1,2,..., m; j = 1,2,..., n

Based on the equation (5), the calculation result can be seen in Table 14.
Table 14. Normalized Values Y

| Alternative | Y1  | Y2  | Y3  | Y4  | Y5  | Y6  | Y7  |
|-------------|-----|-----|-----|-----|-----|-----|-----|
| A1          | 0.16148 | 0.07314 | 0.048 | 0.03459 | 0.02441 | 0.01 | 0.00722 |
| A2          | 0.16148 | 0.04876 | 0.032 | 0.03459 | 0.01627 | 0.01 | 0.00482 |
| A3          | 0.04037 | 0.07314 | 0.064 | 0.03459 | 0.02441 | 0.015 | 0.00722 |
| A4          | 0.16148 | 0.07314 | 0.048 | 0.02306 | 0.02441 | 0.015 | 0.00722 |
| A5          | 0.04037 | 0.07314 | 0.048 | 0.04612 | 0.02441 | 0.01 | 0.00482 |
| A6          | 0.08074 | 0.07314 | 0.032 | 0.03459 | 0.01627 | 0.01 | 0.00482 |
| A7          | 0.16148 | 0.07314 | 0.064 | 0.03459 | 0.02441 | 0.015 | 0.00482 |
| A8          | 0.04037 | 0.07314 | 0.032 | 0.02306 | 0.01627 | 0.01 | 0.00722 |
| A9          | 0.08074 | 0.07314 | 0.032 | 0.03459 | 0.01627 | 0.01 | 0.00722 |
| A10         | 0.16148 | 0.07314 | 0.064 | 0.03459 | 0.02441 | 0.015 | 0.00482 |
| A11         | 0.12111 | 0.04876 | 0.048 | 0.02306 | 0.01627 | 0.01 | 0.00482 |

4.9.3 Positive Ideal Solution Matrix ($A^+$) and Matrix of Negative Ideal Solutions ($A^-$)

According to Tong et al. (2005) stated that to find a positive ideal solution ($A^+$) given the following equation (6) [17]:

$$A^+ = (y_1^+ + y_2^+ + ... + y_n^+);$$

with

$$y_j^+ = \begin{cases} \max y_{ij}; & \text{if } j \text{ is an advantage attribute} \\ \min y_{ij}; & \text{if } j \text{ is a cost attribute} \end{cases}$$

with value $j = 1, 2, ..., n$.

Based on equation (6), then the result of the calculation $A^+ = \{0.04037; 0.04876; 0.032; 0.02306; 0.01627; 0.01; 0.00482\}$.

4.9.4 Distance Between Weighted Values of Each Alternative

Determining the distance between the value of each alternative and the matrix of positive ideal solutions and the matrix of negative ideal solutions requires a weighted normalized decision matrix value ($y_{ij}$) and profit attributes ($y_j^+$), and cost attributes ($y_j^-$) in the calculation process.

a. Positive Ideal Solution

According to Tong et al. (2005) states that to calculate the distance between the alternative and the matrix of positive ideal solutions given the following equation (7) [17]:

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

with $i = 1, 2, ..., m$. 

12
Based on equation (7), then the calculation results can be seen in Table 15.

### Table 15. Positive Ideal Solutions

| Alternative | Positive Ideal Solutions | On Behalf of Value |
|-------------|--------------------------|--------------------|
| 1           | $D_1^+$                   | Sunaeni Haryati, S.Si 0.02035 |
| 2           | $D_2^+$                   | David Ramadhan Pratama 0.04299 |
| 3           | $D_3^+$                   | Drs. Undang Hidayat 0.12166 |
| 4           | $D_4^+$                   | Heri Kiswanto, S.Sn 0.02807 |
| 5           | $D_5^+$                   | Muhamad Ridwan, S.Pd 0.12229 |
| 6           | $D_6^+$                   | Sena Dwi Septoaji Suherman, S.Pd 0.08816 |
| 7           | $D_7^+$                   | Dewi Kartika, S.Pd 0.11178 |
| 8           | $D_8^+$                   | Mohamad Gelar Cipta, S.Pd 0.12773 |
| 9           | $D_9^+$                   | Ilham Halimi Akbar, S.Pd 0.08813 |
| 10          | $D_{10}^+$                | Nurdin, S.Pd 0.01178 |
| 11          | $D_{11}^+$                | Riki Agus Setiawan 0.05576 |

b. Negative Ideal Solution

According to Tong et al. (2005) states that to calculate the distance between the alternative and the matrix of negative ideal solutions given the following equation (8) [17]:

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

with : $i = 1,2,....,m$.

Based on equation (8), then the calculation results can be seen in Table 16.

### Table 16 Negative Ideal Solutions

| Alternative | Positive Ideal Solutions | On Behalf of Value |
|-------------|--------------------------|--------------------|
| 1           | $D_1^-$                  | Sunaeni Haryati, S.Si 0.12539 |
| 2           | $D_2^-$                  | David Ramadhan Pratama 0.12166 |
| 3           | $D_3^-$                  | Drs. Undang Hidayat 0.04299 |
| 4           | $D_4^-$                  | Heri Kiswanto, S.Sn 0.12496 |
| 5           | $D_5^-$                  | Muhamad Ridwan, S.Pd 0.03806 |
| 6           | $D_6^-$                  | Sena Dwi Septoaji Suherman, S.Pd 0.18257 |
| 7           | $D_7^-$                  | Dewi Kartika, S.Pd 0.17716 |
| 8           | $D_8^-$                  | Mohamad Gelar Cipta, S.Pd 0.02450 |
| 9           | $D_9^-$                  | Ilham Halimi Akbar, S.Pd 0.04861 |
| 10          | $D_{10}^-$               | Nurdin, S.Pd 0.12849 |
| 11          | $D_{11}^-$               | Riki Agus Setiawan 0.08231 |
4.9.5 Preference Values for Each Alternative (Vi)

According to Tong et al. (2005) states that to determine the preference value for each alternative given the following equation (9) [17]:

\[
V_i = \frac{D_i^-}{D_i^- + D_i^+}
\]  
(9)

with : i = 1,2,...,m.

Based on equation (9), then the calculation results can be seen in Table 17.

Table 17 Topsis Method Warkingan

| Alternative Name | Preference Weight Value (Vi) | Ranking |
|------------------|-----------------------------|---------|
| A7               | 0.93765                     | 1       |
| A10              | 0.91602                     | 2       |
| A1               | 0.86039                     | 3       |
| A4               | 0.81658                     | 4       |
| A2               | 0.73889                     | 5       |
| A6               | 0.67435                     | 6       |
| A11              | 0.59615                     | 7       |
| A9               | 0.35549                     | 8       |
| A3               | 0.26111                     | 9       |
| A5               | 0.23735                     | 10      |
| A8               | 0.16093                     | 11      |

Based on the process of TOPSIS method, it can be concluded that the largest value is the alternative code A7 with a value of 0.93765 namely Dewi Kartika, S.Pd is designated as an alternative chosen honorary teacher who will be appointed as a permanent teacher in SMK Pasundan 2 Banjaran.

4.10 Comparison of SAW Method and TOPSIS Method

Based on the SAW method and TOPSIS method, the results of the comparison of the two methods are obtained in Table 18.

Table 18. Results of Comparison of SAW Methods and TOPSIS Methods

| Alternative Name | SAW Method | TOPSIS Method |
|------------------|------------|---------------|
|                  | Preference Weight Value (Vi) | Ranking | Preference Weight Value (Vi) | Ranking |
| A7               | 0.96583    | 1              | A7           | 0.93765    | 1              |
| A10              | 0.96583    | 1              | A10          | 0.91602    | 2              |
| A1               | 0.91917    | 2              | A1           | 0.86039    | 3              |
| A4               | 0.90500    | 3              | A4           | 0.81658    | 4              |
| A2               | 0.77250    | 4              | A2           | 0.73889    | 5              |
| A3               | 0.69500    | 5              | A6           | 0.67435    | 6              |
| A11              | 0.69250    | 6              | A11          | 0.59615    | 7              |
| A9               | 0.67083    | 7              | A9           | 0.35549    | 8              |
| A6               | 0.66417    | 8              | A3           | 0.26111    | 9              |
| A5               | 0.66250    | 9              | A5           | 0.23735    | 10             |
In the process of SAW method can be concluded that that has the largest value there are two alternative codes A7 and A10 with a value of 0.96583 on behalf of Dewi Kartika, S.Pd and Nurdin, S.Pd. While in the process of topsis method can be concluded that that has the largest value there is only one alternative code A7 with a value of 0.93765 in the name of Dewi Kartika, S.Pd. The final result obtained from the calculation of the two methods can be concluded that there are differences in results, but basically the two methods used in this study play a role in establishing honorary teachers who will be appointed permanent teachers in SMK Pasundan 2 Banjaran.

The result of the comparison of SAW method and TOPSIS method obtained that the name Dewi Kartika, S.Pd emerged as a more chosen alternative as an honorary teacher who will be appointed as a permanent teacher in SMK Pasundan 2 Banjaran.

5. Conclusions

In the process of SAW method can be concluded that that has the largest value there are two alternative codes A7 and A10 with a value of 0.96583 on behalf of Dewi Kartika, S.Pd and Nurdin, S.Pd. Based on the results of comparison or comparison of SAW method and TOPSIS method named Dewi Kartika, S.Pd emerged as a more chosen alternative as honorary teacher to be appointed as a permanent teacher in SMK Pasundan 2 Banjaran. After further comparison or comparison, sensitivity test was conducted which resulted in that saw method is the most appropriate method in the determination of permanent teachers in SMK Pasundan 2 Banjaran because it has the highest percentage of change scores. This is seen in the SAW method sensitivity test result value with a change value of 10.03168%. While in the TOPSIS method the percentage value changes by 0.65290%.

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