Decision Support System for Admission of Regional Government Scholarships in Merauke Regency Using the TOPSIS Method

Selfina Pare, Tatik M. Tallulembang, and Agustan Latif

Abstract — Scholarship is a government program given to high school graduates to be able to continue their studies at the tertiary level. This is as stipulated in the Regent Regulation (PERBUP) No 25 of 2019 concerning "Providing Scholarships and Educational Assistance to students of Merauke Regency". In the scholarship acceptance selection activities in 2019, approximately 103 applicants were recorded, and 74 were successfully accepted. The process of selecting prospective scholarship recipients is currently being carried out, namely checking and comparing one by one with the applicant's data. Based on data in 2019, where there are applicants whose report card value data is incomplete but is accepted for a scholarship. This is considered to have an impact on the decision-making results of prospective scholarship recipients in subsequent years.

In order to assist KESRA in selecting scholarship recipients, these obstacles can be overcome by using a decision support system. The design of this decision support system is carried out using the TOPSIS method, namely selecting the alternative that is the shortest distance from the positive ideal solution and the furthest distance from the negative ideal solution. The results obtained in this study are a system that can assist the People's Welfare in determining the selection of scholarship recipients based on the three predetermined criteria. Testing the accuracy of the system obtained is 67% and for testing the questionnaire to obtain a percentage of 66.67% which is in the "Agree" category.

Keywords — Decision Support System, Scholarship, Merauke Regency, TOPSIS.

I. INTRODUCTION

Scholarship is a government program given to high school graduates to be able to continue their studies at the tertiary level. To achieve the objectives of the program, Merauke Regency through the Local Government (PEMDA) provides convenience for the younger generation to continue their education to higher tertiary institutions, where the Merauke Regency government directly finances the scholarship recipients. As stipulated in Regent Regulation (PERBUP) No 25 of 2019 concerning "Providing Scholarships and Educational Assistance for Merauke Regency Students and Students" [1], the types of scholarships offered are Educational Assistance and Achievement Scholarships. Educational Assistance is the cost of education given to indigenous Papuan students as a whole and non-Papuan students whose parents or guardians cannot afford to pay for their education, while scholarships are more specific to native Papuan and non-Papuan students who excel in academics, as well as passed the university entrance selection.

Scholarships are awarded directly by the Merauke Regency Government's People's Welfare Section. In the 2019 scholarship recipient selection activity, there were approximately 103 prospective applicants, and 74 people were successfully accepted during the selection period of approximately 7 working days. The number of applicants for regional government scholarships received varies each year, this is adjusted to the amount of the available budget. The procedure for awarding scholarships is that the applicant submits an application to the Regent by filling out the form provided in the People's Welfare section, registering as a scholarship recipient candidate, and sending the application file addressed to the Regent and a copy is submitted to the head of the People's Welfare section, then the applicant's data is recapitulated into Microsoft Excel.

The process of selecting prospective scholarship recipients is currently carried out by using several criteria including the average report card score, ethnic origin, and passing the university entrance selection. The assessment of each criterion is checked and compared one by one with the applicant's data, where the first criterion seen is ethnic origin. Then if acceptance based on ethnic origin has been carried out, the next determination is seen from the average value of report cards and passing the university entrance selection. After that the data was brought together again by KESRA to determine the scholarship recipients who would receive the scholarship. But in the current determination, the welfare party does not involve the 3 criteria directly. This is based on data on scholarship recipients in 2019, where there are applicants whose report card value data is incomplete but is accepted for a scholarship. This is considered to have an impact on the decision-making results of prospective scholarship recipients in subsequent years. Therefore, these problems can be overcome using a method calculation system that can assist in selecting prospective scholarship recipients.

The system to be built is a Decision Support System using a method, namely the TOPSIS method. By using the TOPSIS method the system can provide the most ideal alternative from a number of alternatives. The best alternative is the shortest distance from the positive ideal solution and the farthest from the negative ideal solution.
Therefore, the author wants to take a research topic entitled "Decision Support System for Merauke District Government Scholarship Acceptance Using the TOPSIS Method".

II. LITERATURE REVIEW

A. Decision Support System

Decision support systems as computer-based systems consisting of three interacting components, language systems (a mechanism for providing communication between users and other decision support system components), knowledge systems (repositories of problem domain knowledge that exist in decision support systems or as data or as procedures), and problem processing systems (the relationship between the other two components, consisting of one or more general problem manipulation capabilities required for decision making) [3].

B. Scholarship

Scholarships can be said to be financing that does not come from self-funding or parents, but is provided by the government, private companies, embassies, universities, cooperatives, educational or research institutions, or also from the office where one works because of the achievements of an employee and can be given the opportunity to increase the capacity of its human resources through education. The fee is given to those who are entitled to receive it, especially based on the classification, quality and competence of the scholarship recipient [4].

C. Technique for Order Performance by Similarity to Ideal Solution (TOPSIS)

Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) is a method in decision making, which in making a decision will choose an alternative that is not only closest to the positive ideal solution, but also farthest from the negative ideal solution [5].

TOPSIS method steps:
1. Determine the normalized decision matrix (R), as in (1).
\[
r_{ij} = \frac{x_{ij}}{\sqrt{\sum_j x_{ij}^2}}, \quad (i = 1, 2, \ldots, n; j = 1, 2, \ldots, m)
\] (1)

2. Determine the weighted decision matrix (y), as in (2).
\[
y = \begin{bmatrix} y_{11} & y_{12} & \cdots & y_{1j} \\ y_{21} & y_{22} & \cdots & y_{2j} \\ \vdots & \vdots & \ddots & \vdots \\ y_{11} & y_{12} & \cdots & y_{1j} \end{bmatrix}
\] (2)

where, 
- \( y_{ij} = w_j r_{ij} \)

Information:
- \( w_j \) is the weight of the j-criterion,
- \( y_{ij} \) is an element of a weighted normalized decision matrix.

Determine the positive ideal solution matrix (A+) and negative ideal solution matrix (A-), such as (3) and (4).
\[
A^+ = (y^1_1, y^2_1, \ldots, y^n_1)
\] (3)
\[
A^- = (y^1_1, y^2_1, \ldots, y^n_1)
\] (4)

where,
- \( y^*_j \) is \( \max y_{ij}, \) if j is the profit attribute,
- \( y^-_j \) is \( \min y_{ij}, \) if j is the cost attribute.
- Determine the distance of alternative values from the positive ideal solution matrix (di+) and the negative ideal solution matrix (di-), the distance of the positive ideal solution (di+) as in (5).
\[
D^+_i = \sqrt{\sum_{j=1}^{n} (y^*_j - y_{ij})^2} \quad i = 1, 2, \ldots, m
\] (5)

Negative ideal solution distance (di-) as (6).
\[
D^-_i = \sqrt{\sum_{j=1}^{n} (y^-_j - y_{ij})^2} \quad i = 1, 2, \ldots, m
\] (6)

Determining the preference value for each alternative. The preference value for each alternative \( V_i \) is given by (7).
\[
V_i = \frac{D^+_i}{D^+_i + D^-_i} \quad i = 1, 2, \ldots, m
\] (7)

D. Accuracy Testing

Accuracy testing is the closeness of the test results to the actual results in the field. Accuracy testing is useful to determine the ability of the system to make decisions. This level of accuracy can be obtained by using the following equation [10].
\[
\text{Level of accuracy} = \frac{\text{True positive} + \text{True negative}}{\text{Number of samples tested}} \times 100\%
\] (8)

where True negative is:
- (Number of samples - (True positive + False positive + False negative))

Information:
- True Positive, is a candidate for assistance that is predicted to be feasible (pass), indeed feasible (pass).
- True Negative is a potential beneficiary who is predicted to be unfit (failed) and actually is not eligible (failed).
- False Positive, is a candidate for assistance that is predicted to be feasible, but it turns out to be not feasible.
- False Negative is a candidate for assistance recipients who is predicted to be unfit, turns out to be feasible.

III. RESEARCH METHODOLOGY

A. System Analysis

The proposed system analysis can be seen in Fig. 1 and Fig. 2.

B. System Design

The system design was made using UML modeling, this can be seen in Fig. 3 use case diagram.

Fig. 3 illustrates how the program is used. Admin logs in first before running the program, then carries out activities to manage applicant data, criteria data, sub-criteria data, sub-criteria details and applicant scores to perform calculations and rank scholarship applicant data. Then the ranking results are made in the form of a report.
C. **TOPSIS Method Calculation**

There are three criteria used to determine PEMDA scholarships:

- **C1 = Average Report Value (Benefit)**, which has a criterion weight of 30%.
- **C2 = Ethnic Origin (Benefit)**, which has a criterion weight of 40%.
- **C3 = Graduated from the University of Choice (Benefit)**, which has a criterion weight of 30%.

Sub-criteria and values of the importance level of each predetermined criterion is shown in Table I.

<table>
<thead>
<tr>
<th>Mark</th>
<th>The average value of report</th>
<th>Tribal origin</th>
<th>Graduated from the university of choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Non Papua</td>
<td>State University or Private University MoU number</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Papuans</td>
<td>Private university MoU number</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Marind</td>
<td>State University MoU number</td>
<td></td>
</tr>
</tbody>
</table>

The value of the level of importance can be based on the following preferences:

- **Very Low** = 1
- **Low** = 2
- **Intermediate** = 3
- **Height** = 4
- **Very High** = 5

Formation of preference weights and decision matrices based on alternative suitability rating data against criteria. Alternative data obtained from the results of the initial selection in Table II below.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>The average value of report</th>
<th>Tribal origin</th>
<th>Graduated from the university of choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>87,83</td>
<td>Non. Papua</td>
<td>Univ. Maranatha</td>
</tr>
<tr>
<td>A2</td>
<td>83,61</td>
<td>Marind</td>
<td>Univ. Respati Yogyakarta</td>
</tr>
<tr>
<td>A3</td>
<td>65,83</td>
<td>other Papuans</td>
<td>UKSW Salatiga</td>
</tr>
<tr>
<td>A4</td>
<td>84,83</td>
<td>Non. Papua</td>
<td>Univ. Sanata Dharma Yogyakarta</td>
</tr>
<tr>
<td>A5</td>
<td>83,17</td>
<td>Non. Papua</td>
<td>ITENAS Bandung</td>
</tr>
</tbody>
</table>

Based on Table I and Table II data, the conversion value of each alternative for each criterion can be obtained as shown in Table III below.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>87,83</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>A2</td>
<td>83,61</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>A3</td>
<td>65,83</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>A4</td>
<td>84,83</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>A5</td>
<td>83,17</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Matrix normalization, each matrix element in Table III is normalized to get the generalized matrix R. Each normalization of the $r_{ij}$ value can be done with the following calculation:

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{j=1}^{n} a_{ij}^2}}$$

$$r_{11} = \frac{87,83}{\sqrt{820,761,041}} = 0.482380708$$

$$r_{21} = \frac{83,61}{\sqrt{820,761,041}} = 0.459203586$$
Determining positive ideal solutions and negative ideal solutions. Positive ideal solutions are denoted by \( A^+ \), and negative ideal solutions are denoted by \( A^- \). The results of calculating the positive ideal solution \( A^+ \):

\[
y_{i}^+ = \max \{ \frac{14,47142124 ; 13,77610759}{10,84656336 ; 13,70361043} \} = 14,47142124
\]

The results of calculating the negative ideal solution \( A^- \):

\[
y_{i}^- = \min \{ \frac{14,47142124 ; 13,77610759}{10,84656336 ; 13,70361043} \} = 10,84656336
\]

Determining the distance of alternative values from the positive ideal solution matrix (\( D^+ \)) and the negative ideal solution matrix (\( D^- \)).

\[
D_i^+ = \sqrt{(14,47142124 - 14,47142124)^2 + (32,87979746 - 6,575959492)^2 + (19,63961012 - 6,546536707)^2}
= 29,38231549
\]

\[
D_i^- = \sqrt{(14,47142124 - 10,84656336)^2 + (6,575959492 - 6,575959492)^2 + (19,63961012 - 6,546536707)^2}
= 3,624857875
\]

Calculating preference value (\( V_i \)) and ranking (rank):

\[
V_i = \frac{3,624857875}{3,624857875 + 29,38231549} = 0,109820306
\]

From the results of calculations using the TOPSIS method, the alternative with the highest value is A2.

IV. DISCUSSION

A. Display of Program Results

The results obtained from this study the authors have created a software, namely the Decision Support System for Merauke PEMDA scholarships using the TOPSIS method which is expected to support people's welfare in determining prospective scholarship recipients.

1) Applicant adds value menu

This page is used to add value data for scholarship applicants. In detail can be seen in Fig. 4 below.

![Tambah Nilai Pemohon](image)

Fig. 3. Applicant value added data form.

2) Report menu

The Report menu serves to present the output generated from the data management process using the website application. The report menu is categorized into 2, namely the TOPSIS calculation report and the ranking report.

a) TOPSIS Calculation Report Form

This page is used to view the results of the TOPSIS calculation. In detail can be seen in Fig. 5.
Laporan Perhitungan Topsis Laporan Peringkat

<table>
<thead>
<tr>
<th>Nilai Alternatif Kriteria</th>
<th>Kriteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Nama Pemohon</td>
</tr>
<tr>
<td>1</td>
<td>Ret Anjarwoat Kusuma Putri</td>
</tr>
<tr>
<td>2</td>
<td>Febri Pambian Iham</td>
</tr>
<tr>
<td>3</td>
<td>Grace Anika Kristianti</td>
</tr>
<tr>
<td>4</td>
<td>Suharlin Abdillah Agra</td>
</tr>
<tr>
<td>5</td>
<td>Dahlia Aisyah</td>
</tr>
<tr>
<td>6</td>
<td>Paskalina Samakal</td>
</tr>
<tr>
<td>7</td>
<td>Ronald Christian Madika</td>
</tr>
<tr>
<td>8</td>
<td>Marysa Enjela Ravaul</td>
</tr>
<tr>
<td>9</td>
<td>Elvawatin Amin Nulisah</td>
</tr>
</tbody>
</table>

Fig. 4. TOPSIS calculation report form.

Fig. 5. Ranking report form.

b) Ranking Report Form

This page is used to view ranking results and can be printed and exported to MS Excel.

<table>
<thead>
<tr>
<th>No</th>
<th>Nama Pemohon</th>
<th>Nilai</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yacob Cemunriwa</td>
<td>997337953</td>
</tr>
<tr>
<td>2</td>
<td>Yuliana Beatris Aurey Waire</td>
<td>997150014</td>
</tr>
<tr>
<td>3</td>
<td>Paskalina Maria Maxo</td>
<td>995507972</td>
</tr>
<tr>
<td>4</td>
<td>Venessa Kristina Afriha Kaise</td>
<td>989772624</td>
</tr>
</tbody>
</table>

| Where the results of the ranking data can be printed in the form of a pdf report and can be exported to Microsoft Excel. In addition, the system is able to work according to the design and design of the system that has been designed previously. This is evidenced by the results of the Black box test.

In addition, testing the accuracy of the system carried out showed that the system created succeeded in selecting scholarship applicants with an accuracy rate of 67%. Meanwhile, for testing the questionnaire conducted on 10 respondents, it showed that 66.67% of respondents "agreed" to the system that was created.

REFERENCES


Selfina Pare, S.Kom., MT., Born in Merauke – Indonesia on September 16, 1981. Currently domiciled in Merauke – Papua Indonesia, she is a lecturer at the Undergraduate Program in Information Systems, Musamus University, Merauke. Completed Bachelor Degree (S.Kom) at the College of Informatics and Computer Management Makassar – Indonesia in 2015, majoring in Accounting Information Systems then continued with Engineering Education (MT) at Hasanuddin University Makassar – Indonesia in 2011. In joining the association professional organization Informatics and Computer Higher Education (APTIKOM) until now, and is an organizational administrator for the Papua Informatics and Computer Higher Education Association (APTIKOM).