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DECISION SUPPORT SYSTEM FOR ASSESSING SCHOLARSHIP RECIPIENTS USING THE TOPSIS METHOD AT SMPN 1 PULAU PANGGUNG

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Abstract

The institution is constantly pushing its pupils to do better. Scholarships are a great incentive for students to strive for excellence. Grants are financial awards given to students based on their academic performance or demonstrated financial need, and are therefore not limited to those who are merely pursuing further education. Scholarships are available to pupils each year at Pulau Pangkalan 1 Middle School. Currently, these institutions rely on human judgment to choose which students merit scholarship money. There are still issues with the decision-making procedure for determining who is eligible for scholarships at SMP N 1 Pulau Panggung. All stakeholders must be happy with the outcome, and the decision-making process can involve competing priorities. The TOPSIS algorithm is a type of decision-support algorithm predicated on the notion that the optimal choice minimizes both the positive and negative distances to the optimal solution. An important goal of this study is to determine whether or not a decision support system can facilitate the picking of scholarship winners at SMP N 1 Pulau Panggung. The TOPSIS method was used to decide scholarship awards at SMP N 1 Pulau Panggung, and the results showed that alternative C, with a value of 0.819, was the best choice overall. At SMP N 1 Pulau Panggung, the decision support system is able to help with scholarship approval, it is claimed.

INTRODUCTION

An integral part of any educational institution is its student body. The institution constantly encourages its students to do better. Scholarships are a great incentive for students to strive for excellence. [1] Grants provide financial aid to students who demonstrate academic excellence and to those who may not be able to continue their education. [2] Scholarship applications were on the rise, so we needed methods to help us select deserving students. [3] Scholarships are awarded as a token of gratitude to finance part of the financial

stress imposed on families by their children pursuing higher education. In order to help finance the tuition fees, Pangkalan Island Junior High School 1 annually provides financial assistance to some students. About 30 of their classmates attended the annual ceremony to honor the outstanding students at N 1 Stage Island Middle School. The top students in these schools currently receive scholarships individually. Scholarship recipients at SMP N 1 Pulau Panggung were still chosen inappropriately due to delays in the decision-making process. This is due to the lack of a simple and impartial method of determination, based on current information, who deserves the scholarship.The decision-making system is a useful resource for managers, but decisions can be opposed by a number of factors, including the fact that some decisions depend and satisfy only one party, others are competitive and need to be accepted by all parties. [4]

The TOPSIS technique is used in this SPK to help people choose the solution that is most preferred by those around them. The TOPSIS algorithm was chosen because it is a decision-making aid that takes into account the concept that the optimal choice lies at the point of the greatest distance from the positive and negative ideal solution. This guarantees that the scientific advice made by the algorithm will be accurate. [5] The author's academic training and professional expertise will be detailed here so that others can benefit from their work creating a TOPSIS-based decision support system. This study aims to find out whether a decision support system can improve the selection process for scholarship recipients at SMP N 1 Pulau Panggung, and if so, how successful the system is.

LITERATURE REVIEW

Grant Acceptance Decision Support System at SMKN 2 Sojol: Research Results, published in a journal by Ilham and colleagues. Input, data processing, and delivery of information related to assets at the Ampana Tete Subdistrict Office, Tojol Una-Una Regency, Central Sulawesi Province have been completed using the AHP Method in 2018. To ensure that the software created is working properly, system testing is carried out. to be anticipated. The researchers used a Black Box approach to evaluate this software, which emphasizes the program's intended functionality rather than its outward appearance. The functionality of the software is the main emphasis of the Black Box testing approach. [6] Nova Noor, Kalama Sari, and colleagues reported in 2018 that the Economics High School plans to streamline the selection process by only considering GPA as a criterion for awarding BBP-PPA scholarships; As a result, Kalama Sari and Nova Noor used a web-based TOPSIS engineering decision support system to award scholarships. [7] It is stated that in 2019 a scholarship acceptance decision support system has been created using the SAW method and has been functioning properly based on the results of the test scenario on the functionality test based on previous research by Muqorobin and colleagues. The desired effect is already noticeable. To assist the Scholarship Selection Team in deliberations and produce the most useful suggestions for prospective scholarship winners, the SAW methodology can be utilized. Both BP and BKM scholarship programs, each with their own criteria and weight, can be used in conjunction with the SAW methodology. Because identical results are obtained from both manual and program calculations, the decision support system of the SAW method is considered valid which is indicated by the final test with a validity test. [8] Hadhy Ranuwinata and Lis Suryadi, 2022, in a study of the application of the TOPSIS method in awarding scholarships to SD IT stabit keis, explained that the system design determines the final weighting of alternative scores, which is then used

to round the selection of scholarship winners. . With the help of this decision support system, principals can more easily award merit-based scholarships to deserving students, with the largest score being 0.782 and the lowest score being 0.0. (0,241). [9] Previous research by Heriawan and Subawa with the title "Decision support system for awarding Bidikmisi scholarships with the Topsis-saw method at Stah mpu Kuturan Singaraja in 2019", By using a hybrid decision support system based on SAW and TOPSIS techniques, it was determined that administrators at the Mpu Kuturan Hindu Religious College (STAH) can more accurately provide Bidikmisi scholarships (90% of the time). [10]

From the results of the five researchers above, determining scholarship acceptance by several methods that have been carried out such as the AHP, TOPSIS, and SAW methods, which have shortcomings in the five researchers. For example, the merger of the SAW-TOPSIS method in determining scholarship recipients in determining the weighting of criteria must go through many steps, so that a lot of time is needed to obtain it and it is not effective if a merger is carried out between the two methods. Therefore, researchers only use one method, namely the TOPSIS method which is more effective and does not take much time in the process of determining the provision of family hope, so as to obtain better results.

RESEARCH METHODS

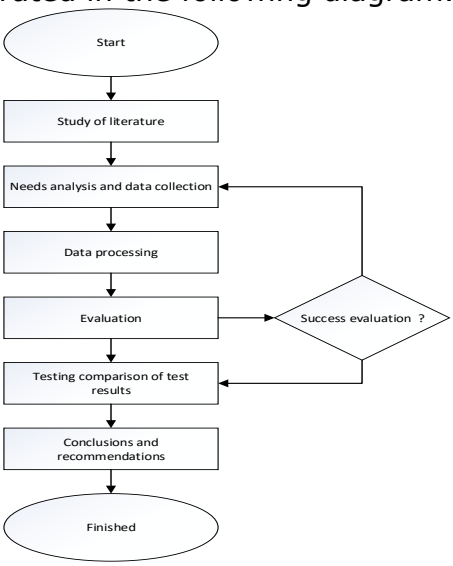
The scholarship acceptance at SMP N 1 Pulau Panggung was carried out once a year and researchers took this research data starting from 2021 to 2023.

Table 1. Scholarship recipients

No	Year	Number of Registrants	Escape	Did not qualify
1	2021	53	31	22
2	2022	67	33	34
3	2023	55	32	23

Source : Acceptance of SMP N 1 Pulau panggung scholarship

Follow the logic presented here to learn how the TOPSIS technique can be used to decide who will receive the grant. The authors go through a number of iterations of the study process to ensure that the final product will be useful. The author process is illustrated in the following diagram.



An important part of any investigation is determining the approach to be taken to the problem at hand, and this is where research techniques come in. The Topsis method was used for analysis in this study. The best option is one that is close to the positive ideal solution and as far as possible from the negative ideal solution, so that the sum of the two is maximum, then the TOPSIS method is a method for finding a MEDM solution. Some MADM models use this idea to address real-world decision-making challenges. Reasons include simplicity of concept, computational efficiency, and the ability to quantitatively compare the benefits of different options for making choices. [11].

Here are the stages of the TOPSIS procedure for solving a problem:

1. At first, Topsis built a matrix of options. M possible options are represented by the X choice matrix.

$$X = \begin{vmatrix} A_1 & X_{11} & X_{12} & X_{13} & \ldots X_{1n} \\ A_2 & X_{11} & X_{22} & X_{23} & \ldots X_{2n} \\ A_3 & X_{31} & X_{32} & X_{33} & \ldots X_{3n} \\ A_m & X_{m1} & X_{m2} & X_{m3} & \ldots X_{mn} \end{vmatrix}$$

Ai (i=1, 2, 3,.... m) represents an alternative set, Xj (j=1, 2, 3,.... n) declares a set of properties used to assess its performance, and Xij (with respect to Xj) represents the performance of the Ai.

2. Create a matrix of choices that have been normalized.

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad \textbf{..... (1)}$$

With i=1,2,...,m
j= 1,2,...,n

3. Build a normalized matrix of options in which the weights reflect relative importance.

$$\mathbf{V_{ij} = w_i\, r_{ij}\ ; \ldots\ldots\ldots\ldots\ldots\ (2)}$$

With i=1,2,...,m; and j=1,2,...,n.

4. Using the normalized weight rating (yij as), we can identify a positive ideal solution A+ and a negative ideal solution A-:

$$\mathbf{A^+ = (y_1^+, y_2^+, \ldots, y_n^+)\ ; \ldots\ldots\ldots\ldots\ldots\ (3)}$$
$$\mathbf{A- = (y_1^-, y_2^-, \ldots, y_n^-)\ ; \ldots\ldots\ldots\ldots\ldots\ (4)}$$

Where:
V_j^+ = revenue, or if the Cost Attribute j is zero, Yij Minimal.
V j^- = The attribute$_j$ is a moneymaker when yij is small, and a burden when yij is large.

5. It measures how far the alternative Ai is from the optimal answer in the positive:

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

..... (5)

Where:
D_i^+ different separation Ai that gives the best answer
Y_j^+ = positive ideal solution [i]
Y_{ij} = normalization matrix [i]

6. The separation between Ai and the worst-case scenario answer.

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

..... (6)

I = 1,2,...m
Where:
D_i^- = alternative distance Ai with negative ideal solution
Y_j^- = negative ideal solution [i]
Y_{ij} = normalization matrix [i][j]

7. The preferred value of each option (Vi) is listed below:

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

..... (7)

I = 1,2,....m
Vi = proximity to the optimal answer of each option
D_i^+ different separation AI that finds the best answer
D_i^- = replacement distance Ai negative optimal solution

RESULTS AND DISCUSSION

Criteria and weights

The first step in creating a ranking is to set parameters that will be used to evaluate candidates. Solutions that meet the scholarship requirements are provided below:

Tabel 2. Data and weight of criteria

No	Information	Criterion	Attribute type
1	Parents' income	C1	Cost
2	Number of dependents	C2	Benefit
3	Status of residence	C3	Cost
4	School achievements	C4	Benefit
5	File completeness	C5	Benefit

The weights given to each of the factors in the ranking table are as follows:

Table 3. presents possible answers to each condition.

No	Information	Criterion	Value
1	Parents' income	C1	15%
2	Number of dependents	C2	15%
3	Status of residence	C3	15%
4	School achievements	C4	35%

5	File completeness	C5	20%
	Total		100%

The weights given to each of the factors in the ranking table are as follows.

Tabel 4. Value weights

Information	Value
Not good enough	1
Enough	2
Good	3
Excellent	4

The chart below shows the various sub-criteria that must be established to meet each criterion:

Tabel 5. Subcriteria of parental income

Parents' income	Weight
1.000.000	1
1.500.000	2
2.000.000	3
3.000.000	4

There are sub-criteria for the total number of children who depend on their parents below.

Table 6. subcriteria of the number of dependents

Number of dependents	Weight
1 person	1
2-3 people	2
4-5 people	3
>5 people	4

The requirements for status of residence are broken down into sub-categories below.

Table 7. Status of residence subcriteria

Status of residence	Weight
Housing	1
Privately owned	2
Rent	3
Boarding house	4

Detailed factors for academic success are provided below.

Table 8. School Achievement Subcriteria

School achievements	Weight
1nd place	1
2nd Place	2
3rd Place	3

The completeness of the file is evaluated according to the factors listed below.

Table 9. subcriteria for completeness of the file

File completeness	Weight
Complete	1
Incomplete	2

Scholarship winners are determined using a weighted sample with a matrix and some of the above factors.

Alternative	Criterion				
	C1	C2	C3	C4	C5
A1	4	4	3	3	4
A2	4	3	2	3	3
A3	3	2	1	3	1

The following answer returns a normalized matrix:

$X1 = \sqrt{4^2 + 4^2 + 3^2}$
$= \sqrt{16 + 16 + 9}$
$= \sqrt{41}$
$= 6{,}40$

$R_{11} = \frac{X11}{X1} = \frac{4}{6{,}40} = 0{,}62$

$R_{21} = \frac{X21}{X1} = \frac{4}{6{,}40} = 0{,}62$

$R_{31} = \frac{X31}{X1} = \frac{3}{6{,}40} = 0{,}46$

$X2 = \sqrt{4^2 + 3^2 + 2^2}$
$= \sqrt{16 + 9 + 4}$
$= \sqrt{29}$
$= 5{,}38$

$R_{12} = \frac{X12}{X2} = \frac{4}{5{,}38} = 0{,}74$

$R_{22} = \frac{X22}{X2} = \frac{3}{5{,}38} = 0{,}55$

$R_{32} = \frac{X32}{X2} = \frac{2}{5{,}38} = 0{,}37$

$X3 = \sqrt{3^2 + 2^2 + 1^2}$
$= \sqrt{9 + 4 + 1}$
$= \sqrt{14}$
$= 3{,}74$

$R_{13} = \frac{X13}{X3} = \frac{3}{3{,}74} = 0{,}80$

$R_{23} = \frac{X23}{X3} = \frac{2}{3{,}74} = 0{,}53$

$R_{33} = \frac{X33}{X3} = \frac{1}{3{,}74} = 0{,}26$

$X4 = \sqrt{3^2 + 3^2 + 3^2}$
$= \sqrt{9 + 9 + 9}$
$= \sqrt{27}$
$= 5{,}19$

$R_{14} = \frac{X14}{X4} = \frac{3}{5,19} = 0,57$

$R_{24} = \frac{X24}{X4} = \frac{3}{5,19} = 0,57$

$R_{34} = \frac{X34}{X4} = \frac{3}{5,19} = 0,57$

$X5 = \sqrt{4^2 + 3^2 + 1^2}^2$
$= \sqrt{16 + 9 + 1}$
$= \sqrt{26}$
$= 5,09$

$R_{15} = \frac{X15}{X5} = \frac{4}{5,09} = 0,78$

$R_{25} = \frac{X25}{X5} = \frac{3}{5,09} = 0,58$

$R_{35} = \frac{X35}{X5} = \frac{1}{5,09} = 0,19$

The following answer displays a normalized decision matrix:

	0,62	**0,74**	**0,80**	**0,57**	**0,78**
R =	0,62	0,55	0,53	0,57	0,58
	0,46	0,37	0,26	0,57	0,19

The following solution shows how to find a weighted normalization matrix after obtaining the normalization matrix :

$Y_{11} = (0,15)(0,62) = 0,09$
$Y_{21} = (0,15)(0,74) = 0,11$
$Y_{31} = (0,15)(0,80) = 0,12$
$Y_{41} = (0,35)(0,57) = 0,19$
$Y_{51} = (0,20)(0,78) = 0,15$

$Y_{12} = (0,15)(0,62) = 0,09$
$Y_{22} = (0,15)(0,55) = 0,08$
$Y_{32} = (0,15)(0,53) = 0,07$
$Y_{42} = (0,35)(0,57) = 0,19$
$Y_{52} = (0,20)(0,58) = 0,11$

$Y_{13} = (0,15)(0,46) = 0,06$
$Y_{23} = (0,15)(0,37) = 0,05$
$Y_{33} = (0,15)(0,26) = 0,03$
$Y_{34} = (0,35)(0,57) = 0,19$
$Y_{35} = (0,20)(0,19) = 0,03$

The following are the calculated findings of the normalized decision matrix:

$$Y = \begin{vmatrix} 0,09 & 0,11 & 0,12 & 0,19 & 0,15 \\ 0,09 & 0,08 & 0,07 & 0,19 & 0,11 \\ 0,06 & 0,05 & 0,03 & 0,19 & 0,03 \end{vmatrix}$$

Calculating the matrix of positive ideal solutions (A+)
Y_1^+ =Max{0,09 ; 0,09 ; 0,06} = 0,06
Y_2^+ =Max{0,11 ; 0,08 ; 0,05} = 0,11
Y_3^+ =Max{0,12 ; 0,07 ; 0,03} = 0,03
Y_4^+ =Max{0,19 ; 0,19 ; 0,19} = 0,19
Y_5^+ =Max{0,15 ; 0,11 ; 0,03} = 0,15

Calculating the matrix of negative ideal solutions (A-)
Y_1^- =Min{0,09 ; 0,09 ; 0,06} = 0,09
Y_2^- =Min{0,11 ; 0,08 ; 0,05} = 0,05
Y_3^- =Min{0,12 ; 0,07 ; 0,03} = 0,12
Y_4^- =Min{0,19 ; 0,19 ; 0,19} = 0,19
Y_5^- =Min{0,15 ; 0,11 ; 0,03} = 0,03

Find out how far the weight value of each option is from the positive and negative optimal solution.

Aelas of the following solution that the optimal solution spacing is positive:

$$D_1^+ = \sqrt{\begin{matrix}(0{,}06-0{,}09)^2+(0{,}11-0{,}11)^2+\\(0{,}03-0{,}12)^2+(0{,}19-0{,}19)^2+\\(0{,}15-0{,}15)^2\end{matrix}}$$

$$= 0{,}009$$

$$D_2^+ = \sqrt{\begin{matrix}(0{,}06-0{,}09)^2+(0{,}11-0{,}08)^2+\\(0{,}03-0{,}07)^2+(0{,}19-0{,}19)^2+\\(0{,}15-0{,}11)^2\end{matrix}}$$

$$= 0{,}005$$

$$D_3^+ = \sqrt{\begin{matrix}(0{,}06-0{,}06)^2+(0{,}11-0{,}05)^2+\\(0{,}03-0{,}03)^2+(0{,}19-0{,}19)^2+\\(0{,}15-0{,}03)^2\end{matrix}}$$

$$= 0{,}018$$

Aelas of the following solution that the optimal solution spacing is positive:

$$D_1^- = \sqrt{\begin{matrix}(0{,}09-0{,}09)^2+(0{,}05-0{,}11)^2+\\(0{,}12-0{,}12)^2+(0{,}19-0{,}19)^2+\\(0{,}03-0{,}15)^2\end{matrix}}$$

$$= 0{,}018$$

$$D_2^- = \sqrt{\begin{matrix}(0{,}09-0{,}09)^2+(0{,}05-0{,}08)^2+\\(0{,}12-0{,}07)^2+(0{,}19-0{,}19)^2+\\(0{,}03-0{,}11)^2\end{matrix}}$$

= 0,0098

$$D_3^- = \sqrt{\begin{matrix}(0{,}09-0{,}06)^2+(0{,}05-0{,}05)^2+\\(0{,}12-0{,}03)^2+(0{,}19-0{,}19)^2+\\(0{,}03-0{,}03)^2\end{matrix}}$$

= 0,0819

Find out how much you value each option.

$V_1 = \frac{0{,}018}{0{,}018+0{,}009} = 0{,}666$

$V_2 = \frac{0{,}0098}{0{,}0098+0{,}005} = 0{,}662$

$V_3 = \frac{0{,}0819}{0{,}0819+0{,}018} = 0{,}819$

Proximity to a positive ideal solution (A+) is determined by dividing the distance to a positive ideal solution (A-) by the distance to a proxy negative ideal solution (A-) (A-).

Table 10. Alternate sorting

Alternative	Value
A	0,666
B	0,662
C	0,819

Thus, choice C has a score of 0.819 for students of N 1 Stage Island Middle School who get a scholarship.

CONCLUCION

Calculations and analyses performed with the topsis technique show that this technique is useful for determining which students will be awarded scholarships at SMP N 1 Pulau Panggung. Methods include generating a normalized decision metric and a weighted normalized decision matrix after finding a decision matrix that represents the option under consideration. Finally, By calculating the gap between each option and the ideal solution (both positive and negative), a preference number can be given. More significantly, the Ai option is more favored. Thus, based on the calculated grade, option C for grantees at SMP N 1 Island Stage has a value of 0.819. A web-based or android-based system is needed to further develop a decision support system for the assessment of the acceptance of superior merit scholarships at SMP N 1 Pulau Panggung, as well as the ability to develop various criteria or methods.

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