Selection of Recipients of Excellent Scholarship Educational Assistance using Simple Addictive Weighting Method

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Abstract*— The selection of educational assistance recipients is an important process that determines the effectiveness of aid distribution. However, inconsistencies in assessment criteria and less systematic data management often become obstacles in determining the right recipient candidates. This problem results in subjectivity and lack of transparency in the selection process. This study proposes a solution in the form of implementing the Simple Additive Weighting (SAW) method as a multi-criteria-based decision support system. This method is used to process data on prospective recipients with criteria including economic conditions, number of family dependents, written test results, and interviews. The approach used is quantitative descriptive with stages of data collection, criteria weighting, SAW score calculation, and evaluation of results. The results of the study show that the SAW method is able to provide objective and consistent rankings of prospective recipients. Evaluation of real data on scholarship recipients shows an accuracy level of 84.62%, indicating the effectiveness of this method in the selection process. These results indicate that the SAW method can be an effective solution to increase transparency, consistency, and fairness in the educational assistance selection process.

Keywords — Scholarship Selection, Simple Additive Weighting, Decision Support System, Accuracy, Educational Assistance

I. INTRODUCTION

The selection process of beneficiaries of educational assistance is a crucial aspect to ensure the effectiveness of aid distribution in amil zakat institutions that manage Zakat, Infaq, Sadaqah, and Waqf (ZISWA) funds to support the improvement of people's quality of life through better access to education [1], [2]. However, the selection process that has been running still faces challenges in the form of inconsistent criteria and unsystematic data management, which has the potential to cause the distribution of assistance that is less targeted and reduce stakeholder trust [3].

The gap encourages the need for a more structured, objective, and data-based selection system. Decision Support System (DSS) with Simple Additive Weighting (SAW) method is a relevant solution due to its ease of implementation, computational efficiency, and ability to process multicriteria assessments consistently and transparently [4].

Several previous studies have shown the advantages of SAW in the context of criteria-based selection, such as parental income, number of dependents, written tests, and interviews, which are able to produce decisions with high accuracy without excessive algorithm complexity [5][6]. Compared to other methods such as MOORA and FANP, SAW is also more stable against variations in criteria weights, so the selection results are more consistent [7].

This research aims to develop an objective and structured scholarship recipient selection process by integrating the SAW method in SPK, especially for social institutions such as DT Peduli Kuningan. In addition, the proposed system is expected to be applied in other institutions that face similar challenges in managing educational assistance.

II. METODE PENELITIAN

Previous studies have proven the important role of Decision Support Systems (SPK) in optimizing the selection process of scholarship recipients. The Simple Additive Weighting (SAW) method is one of the methods widely used in SPK because of its superiority in simplifying the calculation process and producing objective decisions. Studies by Issn, Liang, and Muhtarom show that SAW is able to provide accurate and consistent results compared to traditional methods because of its ability to combine weight values from various criteria comprehensively [8]. In addition, research by Achmad, Mu, and Saputro (2023) revealed that SAW has higher time efficiency than other methods such as Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA) and Weighted Product (WP), especially in the context of handling large data on the selection of scholarship beneficiaries [5], [9].

However, most of the existing research focuses on the application of SPK in the corporate sector or government agencies with more stable management structures and better resource availability. In the context of social institutions, such as DT Peduli Kuningan, the challenges faced are different. For example, frequent changes in management staff and manual data documentation are significant obstacles in the selection process [10]. Afrina's (2018) study on the application of the FANP method in social institutions shows that although the method is effective, the long processing time and complexity of calculations are often an obstacle when faced with limited

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human resources in small institutions [11]. In addition, research by Wicaksono, Bachri, and Irawan (2024) using MOORA in web-based SPK also showed that the method is effective for handling various criteria, but requires a more in-depth trade-off analysis than SAW, which can be a challenge in implementation in institutions with limited resources [6], [12].

Another shortcoming in the literature is the lack of research evaluating the long-term impact of PRSP implementation on beneficiary success. Most studies focus more on initial selection outcomes, without assessing how the implementation of CBMS affects the sustainability of benefits received by individuals. In addition, not many studies have explored how SDM can be customized to address the unique challenges faced by social institutions with dynamic resource conditions.

This research aims to fill the void by developing and implementing a SAW-based CBMS that is tailored to the needs and conditions of DT Peduli Kuningan. The main focus of this research is to ensure that the system is not only able to produce transparent and accurate selection decisions, but also can be operated easily by staff who do not have a strong technical background. The research will also evaluate the long-term impact of the CBMS implementation on the success of the education program, including how beneficiaries can maintain their motivation to learn and complete the program successfully.

By addressing the limitations in previous research, this study is expected to contribute not only to improving the quality of beneficiary selection at DT Peduli Kuningan but also provide practical recommendations for other social institutions facing similar issues. This research also broadens insights into how the SAW method can be adapted in the context of dynamic social institutions, so that it can be a relevant model to be applied more widely.

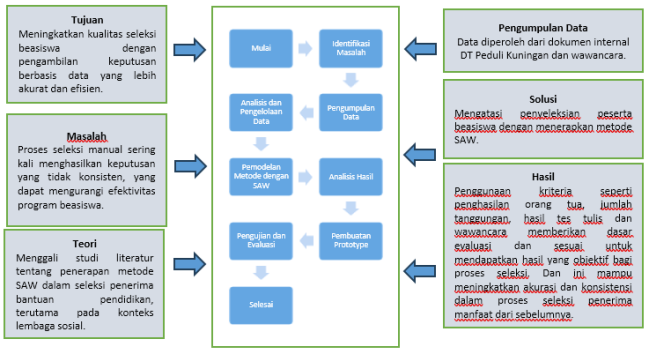

Fig. 1. Research Conceptual Framework

In the visualization of the conceptual framework of the chart above, before a decision is obtained, there is a data processing process through the SAW method, including: Criteria Input, Weighting and Scoring, Final Score Summation (Selection Decision), Scholarship Recipient Recommendation (Selected Recipient with Highest Score) and Continuous Evaluation (Monitoring Recipient Success). Thus this research focuses on how the application of SAW can improve consistency in the selection of scholarship recipients at DT Peduli Kuningan. Thus, this final result will be used as the basis for selecting scholarship recipients [13].

A. Research Approach

This research uses a descriptive quantitative approach, which aims to analyze the selection data of scholarship beneficiaries at DT Peduli Kuningan by applying the Simple Additive Weighting (SAW) method. The SAW method was chosen because of its ability to integrate various selection criteria with different weights to produce consistent and accurate decisions [13], [14].

B. Research Data

This research data was obtained from the internal archives of DT Peduli, which is located in Kuningan Regency. This research aims to develop a SAW-based decision support system, designed to increase the transparency, accuracy and efficiency of beneficiary selection [15]. The information on scholarship candidates is based on four main criteria [16]:

a. Parents' income
   Used to evaluate the economic condition of prospective recipients. The lower the income, the more eligible the candidate is to receive the scholarship.
b. Number of family dependents
   Indicates the number of financial burdens in the family. The more dependents, the more deserving.
c. Written test
   Measures the academic ability or basic knowledge of prospective scholarship recipients.
d. Interview
   Interview Assesses the motivation, commitment, and potential of the scholarship recipient

C. Determination of Criteria Weight

The weight is given based on the level of importance of each criterion in the selection process as follows:

a. Parents' income: 40%
b. Number of family dependents: 30%
c. Written test: 20%
d. Interview [17]: 10%
   Weights were determined based on literature and discussions with DT Peduli Kuningan [13], [16].

D. Data Conversion and Normalization

The original data on each criterion was converted into a numerical rating scale of 1-5 according to the institution's standard score table. This scale is used to equalize units between diverse data. The following is the normalization formula used in the SAW method, in equations (1) dan (2):

1 For benefit criteria, where higher values are better

$$\frac{x_{ij}}{Max_i\, x_{ij}} \quad \text{if j is a benefit attribute} \tag{1}$$

2 For the cost criterion, where the lower value is better.

$$\frac{Min_{ij}\, x_{ij}}{x_{ij}} \quad \text{"if j is a cost attribute"} \tag{2}$$

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where:
rij = normalized performance rating
max xij = maximum value of each row & column
mix xij = manimum value of each row & column'
xij = rows and columns of the matrix

E. Calculating the final score

After all values are normalized, the final score of each alternative is calculated by summing the results of multiplying the weights Wj of each criterion and the normalized value r_{ij}

$$S_i = \sum_{j=1}^{n} W_j \, x \, r_{ij} \quad (3)$$

where:
S_i is the total score of the i-th alternative
S_i is the weight of the j-th criterion
IS s the number of criteria Alternative with S_i values

The alternative with the highest S_i value is then selected as the recommended beneficiary [18].

After the initial assessment and selection are completed, ongoing evaluations are conducted to monitor the progress of the beneficiaries [19]. These evaluations are important to measure the success of the scholarship recipients in achieving their educational goals and to identify potential improvements in the selection process in the future [4]

F. Research Stages

The research was conducted in the following stages:

1) Data Collection
   Data was obtained from internal DT Peduli Kuningan documents, written test results, and interviews. The data was validated to ensure its completeness and accuracy.
2) Determination of Weight
   Giving weight to each criterion based on its level of importance [20].
3) Perform Data Conversion and Normalization
   Before calculating using the SAW method, the original data from each criterion is converted into a 1-5 rating scale. This scale is used to homogenize values and avoid inequality between data units (for example, rupiah, number of people, or test scores) [21].
   Furthermore, data normalization is carried out based on the type of criteria:
   a. For benefit criteria (the higher the better), see the formula in equation (1).
   b. For cost criteria (the lower the better), see equation (2).
   In the context of this research, only parental income is categorized as a cost, while the other criteria are classified as benefits.
4) Calculation of Preference Values
   After the normalization process is complete, each normalized value is multiplied by the weight of each criterion [22]. The multiplied values are then summed up to obtain the final preference value for each alternative (scholarship recipient candidate), see equation (3). Semakin tinggi nilai V_i, The higher the value of Vi, the higher the feasibility of alternatives to be selected as scholarship recipients.
5) Result Analysis and Evaluation
   The final score is used to rank the potential beneficiaries. Evaluation is carried out to compare the results with the previous manual process, as well as to assess the improvement of the efficiency and accuracy of the selection process [15]
6) Prototype Development of SPK System
   The SAW-based decision support system prototype was designed and tested to facilitate the implementation of the selection process in the future[23]

G. Research Tools and Instruments

This research uses several main instruments to support the process of collecting, processing, and analyzing data, which include:

1) Software
   a. Microsoft Excel
      Used to perform SAW method calculations, such as data normalization, criteria weighting, and final score calculation [24]. This tool was chosen because of its flexibility in handling numerical data and the ease of creating automatic formulas for SAW method calculations.
   b. Prototype Development Tool
      To support the implementation of decision support systems (SPK), this research uses web-based prototype software, such as Visual Studio Code and PHP front-end/back-end frameworks [25]. The aim is to build a system that can facilitate the selection of beneficiaries digitally.
2) Questionnaire or Interview Guide
   a. Questionnaire for Interview
      This instrument is used to collect motivation and commitment data from potential beneficiaries through interview sessions. Questions are designed to evaluate the level of motivation, such as educational goals and suitability for the scholarship program.
   b. Written Test Assessment Form
      Used to record written test results that measure the academic ability or basic knowledge of prospective beneficiaries
3) Internal Documents of DT Peduli Kuningan
   Internal documents of DT Peduli Kuningan that record the economic condition and number of family dependents of prospective beneficiaries. This document is the main basis for initial assessment according to economic criteria.
4) Data Validation Instrument
   Performed to check the completeness, accuracy and relevance of data prior to analysis. Validation ensures that data from physical and digital documents meet predetermined selection criteria.

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Data analysis is carried out using the SAW method, where each criterion is given a weight based on its level of importance. Prospective recipients are then given a value or score on each criterion, which is multiplied by the weight of the criterion. The results of this multiplication are summed up to get the final score. The final score becomes the basis for the beneficiary selection process.

III. RESULT AND DISCUSSION

This research was conducted on scholarship registration taken from Daarut Tauhiid Peduli Kuningan. There are names of prospective scholarship recipients who have registered and have passed the administrative stage totaling thirteen people in the 2022/2023 period. The existing data is then calculated using the Simple Additive Weighting (SAW) method. The following are the names of the participants used:

TABLE I. DATA PARTICIPANT

Code	Gender	Age	Income	Support	Writting Test	Interview
A1	L	22	Rp2.000.000	5	61	77,85
A2	L	20	Rp500.000	3	75	83,905
A3	P	22	Rp2.000.000	3	52	82,2
A4	L	22	Rp1.500.000	3	56	76,5
A5	P	23	Rp1.500.000	2	65	78,24
A6	P	21	Rp750.000	2	47	86
A7	P	22	Rp500.000	5	59	78,475
A8	L	19	Rp1.250.000	3	54	78,85
A9	L	20	Rp500.000	3	73	82,1
A10	P	23	Rp500.000	3	59	79,32
A11	L	22	Rp1.900.000	5	38	77,48
A12	L	23	Rp500.000	3	44	84,2
A13	P	19	Rp500.000	3	63	79,77

(Source: DT Peduli Kuningan internal data)

Table 1 shows the list of potential scholarship recipients along with the value of each criterion used as the basis for assessment. Each criterion such as parents' income, number of dependents, written test results and interviews are given the appropriate weight to describe the relative importance of each aspect in determining the eligibility of scholarship recipients.

The assessment is carried out by determining the criteria and weights that will be used as consideration in the decision. The criteria can be seen in Table 2.

TABLE II. CRITERIA DETERMINATION

No	Code	Criteria	Attribute	Value
1	C1	Parental income	Cost	0,40
2	C2	Number of dependents	Benefit	0,30
3	C3	Written Test	Benefit	0,20
4	C4	Interview	Benefit	0,10
Total				**100%**

DT Peduli Kuningan assessment policy based on research [2]

Tabel 2 shows the details of the weight for each criterion that is taken into consideration in the DT Peduli Kuningan assessment system.

In the initial stage, data on potential scholarship recipients is collected and categorized based on predetermined criteria, such as parents' income, number of dependents, written test results, and interview results. Each of these criteria is given a weight based on its level of importance in determining the eligibility of scholarship recipients. These weights were set proportionally at 0.25 for each criterion, in order to reflect a balanced role in the selection process.

Furthermore, Table 2 to Table 5 show the point assessment for each of the criteria used, namely Parents' Income, Number of Dependents, Written Test Scores and Interviews. Each value point is determined based on policies and agreements that have been designed by the institution as an assessment standard that suits the selection needs. In this case, each alternative (participant) is calculated based on a rating scale of 1-5. This scale gives additional value to the participant with the highest score in the benefit category and vice versa for the cost category. Through this comparison, the system can determine the ranking of the most eligible participants based on the calculation results using the SAW method. And the determination of points in each table is certainly based on quantitative and qualitative evaluations that are adjusted to the purpose of the scholarship program, which is to provide assistance to prospective recipients who are most in need and have a high potential for success.

With the sub criteria of Parents' income, Number of Dependents, Written Test Score, Interview, can be seen in tables 3,4,5 and 6, as follows:

TABLE III. PARENTS INCOME

Code	Parent's Income	Value Points
C1	< 1.000.000	5
	1.000.000 – 1.500.000	4
	1.500.000 – 2.000.000	3
	2.000.000 – 2.500.000	2
	> 2.500.000	1

Source: Income assessment policy adjusted to DT Peduli Kuningan selection needs

Parents' income in table 3 is categorized into 5 groups based on a range of scores. The lower the income, the higher the score.

TABLE IV. NUMBER OF DEPENDENTS

Code	Number of Dependents	Value Points
C2	5 Child	5
	4 Child	4
	3 Child	3
	2 Child	2
	1 Child	1

Source: Dependent assessment policy adjusted to the needs of DT Peduli Kuningan selection

Scores are assigned based on the number of family dependents. The greater the number of dependents, the higher the score given.

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TABLE V. WRITTEN TEST SCORE

Code	Written Test Score	Value Point
C3	80 > 90	5
	75 > 80	4
	70 > 75	3
	60 > 70	2
	< 60	1

Sumber: Kebijakan penilaian tes tulis disesuaikan dengan kebutuhan seleksi DT Peduli Kuningan (2023)

Scores are assigned based on the written test score range, using the institution's policy standards to determine the range.

TABLE VI. INTERVIEW

Code	Interview	Value Points
C4	80 > 90	5
	75 > 80	4
	70 > 75	3
	60 > 70	2
	< 60	1

Sumber: Kebijakan penilaian wawancara disesuaikan dengan kebutuhan seleksi DT Peduli Kuningan

Source: The interview assessment policy is adjusted to the needs of DT Peduli Kuningan selection.

TABLE VII. DATA CONVERSION PROCESS

Code	Income	Dependents	Written Test	Interview
A1	4	5	2	4
A2	1	3	4	5
A3	4	3	1	5
A4	3	3	1	4
A5	3	2	2	4
A6	1	2	1	5
A7	1	5	1	4
A8	2	3	1	4
A9	1	3	3	5
A10	1	3	1	4
A11	3	5	1	4
A12	1	3	1	5
A13	1	3	2	4

Source: Conversion results based on manual scores applied to DT Peduli Kuningan data

Table 7 explains that the raw data from Table 1 is converted to numerical values based on the scale in Tables 3-6. This process uses the following logic:

a. If the participant's income is Rp1,500,000, then according to Table 3, the conversion value is 3.
b. If the family dependents are 5 people, then the conversion value is 5 according to Table 4.

TABLE VIII. NORMALIZATION OF THE DECISION MATRIX

Code	Income	Dependents	Written Test	Interview
A1	0,25	1	0,5	0,8
A2	1	0,6	1	1
A3	0,25	0,6	0,25	1
A4	0,333333333	0,6	0,25	0,8
A5	0,333333333	0,4	0,5	0,8
A6	1	0,4	0,25	1
A7	1	1	0,25	0,8
A8	0,5	0,6	0,25	0,8
A9	1	0,6	0,75	1
A10	1	0,6	0,25	0,8
A11	0,333333333	1	0,25	0,8
A12	1	0,6	0,25	1
A13	1	0,6	0,5	0,8

Source: The calculation of normalization is done by SAW formula adapted from previous research [4]

In table 8, select one or two rows of the table. For example, for income, using equation (2), if the A1 value is 4 and the maximum value is 1 (see table 7), then:

$$r^{ij} = \frac{1}{4} = 0{,}25$$

And do the same for the other criteria.

TABLE IX. PREFERENCE VALUE CALCULATION

KODE	NILAI PREFERENSI SAW
A1	0,58
A2	0,88
A3	0,43
A4	0,443333333
A5	0,433333333
A6	0,67
A7	0,83
A8	0,51
A9	0,83
A10	0,71
A11	0,563333333
A12	0,73
A13	0,76

Source: Preference calculation using SAW method with criteria weights from internal policies

The final stage of this analysis is the calculation of the total preference score based on the SAW method, where the normalized value of each participant is multiplied by the weight

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of each criterion and then summed to obtain the final score. In table 9, to calculate the preference value use the equation (3). For A1, that is:

1 Income: 0,25×0,40 = 0,1
2 Dependents: 1×0,30 = 0,3
3 Written Test: 0,5×0,20 = 0,1
4 Interview: 0,8×0,10 = 0,08

The results were then accumulated between income, dependents, written tests and interviews. So that it becomes 0,1+0,3+0,1+0,08 = 0,58. After calculating all preference values, do the sorting, so that the results can be seen in table 10.

TABLE X. SORTING DATA BY RANK

RANK	CODE	Gender	Age	SAW PREFERENCE VALUE
1	A2	L	20	0,88
2	A7	P	22	0,83
3	A9	L	20	0,83
4	A13	P	19	0,76
5	A12	L	23	0,73
6	A10	P	23	0,71
7	A6	P	21	0,67
8	A1	L	22	0,58
9	A11	L	22	0,563333333
10	A8	L	19	0,51
11	A4	L	22	0,443333333
12	A5	P	23	0,433333333
13	A3	P	22	0,43

Table 10, namely A2 get the highest score, namely 0.88 because it has a very low income, quite a lot of dependents and high test/interview scores. This reference assessment is obtained to determine the determination of the acceptance of educational funding assistance at DT Peduli Kuningan using the Simple Additive Weighting (SAW) method.

The final results of this calculation are then sorted to determine the ranking of beneficiaries. Participants with the highest scores are declared as the most deserving of the scholarship, while participants with lower scores are recommended as candidates who may not meet the eligibility criteria.

The application of the SAW method is proven to provide several advantages for DT Peduli Kuningan, including a more consistent, transparent, and easily accountable selection process. Assessment based on standardized criteria weights allows this institution to provide selection decisions more systematically and data-based. The results of this study are consistent with previous research which states that the SAW method is an effective method in providing objective and accurate multi-criteria decisions [8]. The system also exhibits high flexibility in weight adjustment between criteria, which allows agencies to change priorities based on need without changing the overall structure of the system.

With this system, DT Peduli Kuningan can minimize potential bias in assessment and simplify the beneficiary selection process despite changes in staff or those in charge. In addition, this system also provides an opportunity to conduct continuous evaluation of beneficiaries, so that the institution can monitor their progress and provide more effective support according to the needs of the scholarship recipients. Based on these results, this SAW-based decision support system is expected to be a practical and applicable solution for other institutions that have similar goals in distributing educational assistance.

The existence of different weights between criteria provides fairness in decision-making on which is preferred, but can be adjusted in the future based on changes in program priorities. The normalization and preference assessment shows that participants with lower income and more dependents tend to get higher scores. This shows the consistency of the system in prioritizing participants who are more in need of educational assistance.

Evaluation of the results shows that the SAW method not only produces transparent selection decisions but also simplifies the replication process for the next period. This research reveals that the Simple Additive Weighting (SAW) method provides an effective solution in overcoming the challenges of selecting scholarship beneficiaries at DT Peduli Kuningan. Compared to manual or subjectivity-based selection methods, the use of SAW allows for more objective and consistent decision-making. This method works by standardizing the value of each candidate on certain criteria, which is then processed with proportional weights, thus providing a final result that reflects the level of eligibility quantitatively. This is in line with Suwarno's (2021) findings that SAW is suitable for use in multi-criteria selection to ensure transparency and accuracy in beneficiary selection [8].

Further discussion shows that the SAW method is not only easy to implement but also flexible in setting criteria weights. This flexibility allows DT Peduli Kuningan to adjust the weights based on priorities or applicable policies, without affecting the entire system. This advantage places SAW as an excellent method for scholarship selection cases in social institutions that may often face data management constraints, including inconsistencies due to staff turnover. The use of different criteria weights in this study proved effective in producing objective rankings, although future research could explore the possibility of more specific weights according to the needs of potential recipients.

However, the SAW method also has limitations, particularly in terms of its reliance on data that must be complete and structured. For beneficiary selection that involves incomplete or poorly documented data, SAW may be less than optimal because the normalization process requires complete data for each candidate. Therefore, more systematic data management and digitization are important for this system to be implemented

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optimally. This research suggests that the integration of SAW with cloud-based technology or centralized data could be the next step to improve the effectiveness of the system.

Furthermore, this research has practical implications for similar institutions that want to adopt the SAW method as a decision support system. The findings of this study provide evidence that the SAW method can help improve the quality of scholarship beneficiary selection and reduce the risk of bias in decision-making. In addition, continuous monitoring of beneficiaries is also recommended to measure the success of the program in the long term. The implementation of post-selection evaluation is expected to correct the shortcomings of the previous selection and adjust the support for scholarship beneficiaries. Overall, the SAW method proved to be relevant and contributed significantly to improving the effectiveness of the scholarship program at DT Peduli Kuningan, and has the potential to be applied in other institutions with similar objectives.

IV. Conclusion

The decision support system developed with the Simple Additive Weighting (SAW) method is able to provide solutions to previous obstacles, such as inconsistencies in eligibility criteria and less systematic data processing and has a good accuracy rate of 84.62% and has consistency in the selection process of scholarship beneficiaries at DT Peduli Kuningan. The use of criteria such as parents' income, number of dependents, written test results and interviews provide an objective evaluation basis for the selection process. This SAW method allows each criterion to be processed with a certain weight, resulting in a ranking that helps the institution in determining scholarship recipients more effectively. This process not only reduces subjectivity in decision making but also provides a system that is reliable and easily adaptable to the needs of the institution.

The SAW system can be further developed with the integration of cloud-based technology to improve efficiency and data accessibility. Digitization of processes will ensure consistency despite staff turnover. Further research can explore the variation of weights on the criteria to adjust the selection priorities to the needs of the institution.

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