

DECISION SUPPORT SYSTEM FOR SCHOLARSHIP ADMISSION USING SIMPLE ADDITIVE WEIGHTING (SAW) METHOD

Afrizal Martin*

Bakti Nusantara Institute Lampung,
Pringsewu
Sub-district, Pringsewu, Lampung,
INDONESIA

Andreas Andoyo

Bakti Nusantara Institute Lampung,
Pringsewu
Sub-district, Pringsewu, Lampung,
INDONESIA

Widiyanto

Bakti Nusantara Institute
Lampung, Pringsewu
Sub-district, Pringsewu,
Lampung, INDONESIA

Article Info

Article history:

Received: Feb 17th, 2024
Revised: Mar 20th, 2024
Accepted: May 9th, 2024

Keywords:

Decision Support Systems,
Scholarship Acceptance,
SAW Method.

Abstract

Implementing the scholarship recipient selection process funded by the government is aimed at ensuring students receive adequate education and avoid dropping out of school. This scholarship serves as assistance to help students complete their educational tasks in seeking knowledge until the scholarship period ends, in the form of financial aid to support the expenses incurred by students during their educational journey. However, the selection process requires a long time to ensure that the aid recipients are truly deserving students. To assist in determining eligible scholarship recipients, a Decision Support System (DSS) using the Simple Additive Weighting (SAW) method is needed. SAW is a simple ranking method that calculates weighted values based on criteria. With the implementation of the SAW-based decision support system for scholarship selection, the final result obtained from the summation yields A1 as the best alternative for scholarship recipients.

To cite this article:

INTRODUCTION

With the rapid development of technology, technology plays a crucial role in assisting human tasks. Computers, as one of the advanced technological devices, enable task completion and handle large volumes of information while aiding in optimal decision-making[1]. To determine who truly deserves scholarships, a good decision support system is needed to determine the selection team in the scholarship recipient selection process based on specified criteria[2]. Due to the large number of scholarship applicants, a decision support system is required to assist in the selection process, making it easier, faster, and reducing errors in determining scholarship recipients[3].

A Decision Support System (DSS) is an information system that has been widely implemented to facilitate decision-making, both in the long and short term[4]. Scholarship admission is assistance provided to students from financially disadvantaged families, sourced from the government[5]. Every private and public school offers scholarships, and one such primary school is SD Negeri 1 Kamilin Pagelaran Utara, which admits new students totaling 246 annually. The school conducts scholarship selection twice a year, overseen by as the principal and Mr. Murod as the class teacher or data officer for scholarship candidates [6]. Criteria such as proof of financial need, family card, and parents' identity card are required to determine who qualifies for the scholarship, ensuring that

• **Corresponding author:**

Afrizal Martin, Information System, Bakti Nusantara Institute Lampung, Pringsewu Sub-district, Pringsewu, Lampung, INDONESIA. ✉ afrizalmartin.mti@gmail.com

© 2024 The Author(s). **Open Access.** This article is under the CC BY SA license (<https://creativecommons.org/licenses/by-sa/4.0/>)

students receive the scholarship and financial assistance accurately and avoiding misallocation. Hence, a decision support system for scholarship admission using the Simple Additive Weighting (SAW) method is necessary[7]. This involves evaluating scholarship candidates and assigning weights to each criterion, followed by ranking to determine the best alternatives for scholarship recipients[8].

The research conducted on scholarship admission selection at SD Negeri 1 Kamilin Pagelaran Utara using the SAW method or decision support system for scholarship admission is conducted twice a year. The aim is to improve the accuracy of predicting scholarship distribution to mitigate the impacts of economic crises on impoverished communities and ensure that deserving students are selected.

I. Definition of Decision Support System

Decision support system (DSS) is one way to organize information intended for use in decision-making[9]. A decision support system is a computer-based system designed as a decision-making system utilizing specific data and models to solve unstructured problems [10].

Decision Support Systems are information systems Flexible, interactive and adaptable computers, developed for structured, data-driven decision systems, provide easy interfaces and can incorporate decision-making thinking [11].

II. Definition of Scholarship

Scholarship is assistance provided, especially to those still in school, to help them complete their educational tasks in seeking knowledge until completion. This aid usually takes the form of financial support to cover expenses incurred by students or scholars during their education at their desired learning institution. Scholarships also constitute financial assistance given to individuals, intended to be used for the continuation of their

education. Scholarships can be granted by government institutions as well.

The provision of scholarships can be categorized into two types: unconditional and conditional scholarships, and there are various types of scholarships:

- a) Merit-Based Scholarships: These scholarships are awarded based on academic excellence. Scholarships are given based on overall academic achievements.
- b) Need-Based Scholarships: These scholarships are intended to fund academic activities for less fortunate students who still exhibit academic excellence. Scholarship committees typically assess various factors such as parental income, the number of siblings currently studying, living expenses, etc., to determine eligibility for this type of scholarship.
- c) Full Scholarships: These scholarships are usually awarded to cover all academic needs of the recipient. If you are truly fortunate, you may receive a scholarship like this. Scholarships are provided to cover living expenses, books, and educational costs, although many scholarships are available.

Scholarships are defined as a form of recognition given to individuals to continue their education to a higher level. This recognition can take the form of specific access to an institution or an award in the form of financial assistance [12].

III. SAW Method

The Simple Additive Weighting (SAW) method, also known as the weighted sum method, is a technique that involves finding the weighted sum of performance scores for each alternative across all attributes[13]. The basic concept of the SAW method, is to determine the weighted sum of performance scores for each alternative across all attributes [14].

Simple Additive Weighting (SAW) Method The term method is often also known

weighted summation[15]. Basic concepts of the method SAW is a weighted sum search from the performance rating on each alternative on all attributes. The SAW method requires process of normalizing the decision matrix (X) to a scale that can be compared with all existing alternative ratings [16].

The SAW method requires the normalization process of decision matrices (X) to a scale that can be compared across all alternative branches[17]. This method is widely recognized and extensively used, requiring decision-makers to determine weights for each attribute. The total score for each alternative is obtained by summing the multiplication results between the branches (comparable across attributes) and the weights of each attribute value[18]. Each attribute branch must be dimensionless, indicating that it has undergone a previous normalization process [19].

The SAW method is a multi-criteria decision-making approach that involves assigning weights to various criteria, normalizing the criteria scores, and calculating the weighted sum to rank alternatives. Here's a step-by-step framework:

1. Define the Criteria for Scholarship Admission

Identify and define the criteria that will be used to evaluate scholarship applicants. Common criteria might include:

- Academic performance (e.g., GPA)
- Extracurricular activities
- Leadership experience
- Personal statement quality
- Financial need
- Letters of recommendation

2. Assign Weights to Each Criterion

Determine the importance of each criterion by assigning weights. The weights should sum up to 1. For example:

- Academic performance: 0.4
- Extracurricular activities: 0.2
- Leadership experience: 0.1
- Personal statement quality: 0.1

Financial need: 0.15

Letters of recommendation: 0.05

3. Collect Data and Normalize Scores

Gather data for each criterion for all scholarship applicants. Normalize these scores to ensure they are comparable. Normalization can be done using the following formula:

4. Calculate Weighted Scores

For each applicant, calculate the weighted score for each criterion by multiplying the normalized score by the weight of the criterion:

5. Calculate the Final Score

Sum the weighted scores for each applicant to get the final score:

6. Rank the Applicants

Rank the applicants based on their final scores. The applicant with the highest final score will be ranked first, and so on.

METHOD

I. Flowchart Method

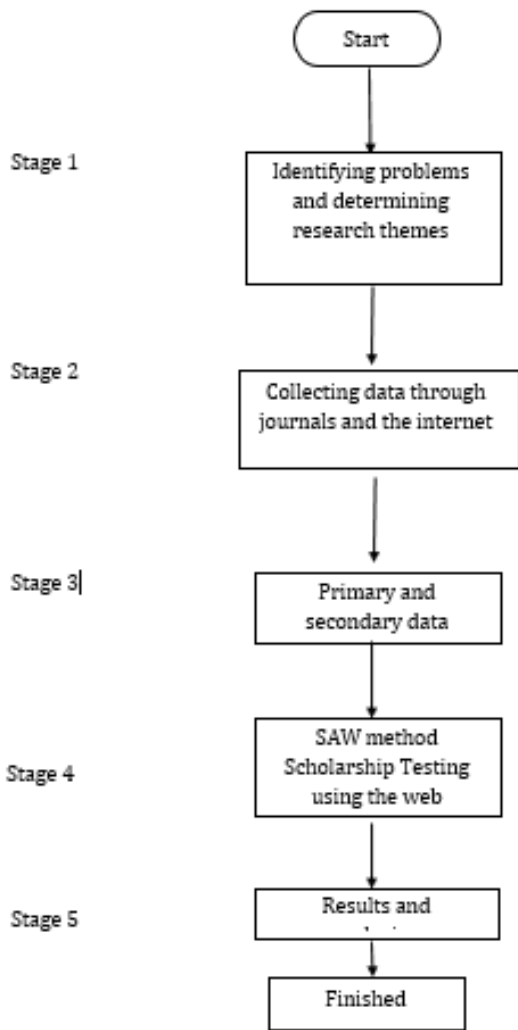


Table 1. Research Flowchart

To design a database structure for a scholarship admission support system that uses the Simple Additive Weighting (SAW) method, you need to store information about applicants, criteria for evaluation, the weights of these criteria, and the scores applicants receive for each criterion. Here’s a suggested schema for such a system:

Database Schema for a scholarship admission support system that uses the Simple Additive Weighting (SAW) method:

Applicants

- applicant_id (Primary Key)
- name
- email
- dob (Date of Birth)
- created_at

Scholarships

- scholarship_id (Primary Key)
- name
- description
- created_at

Criteria

- criteria_id (Primary Key)
- scholarship_id (Foreign Key referencing Scholarships.scholarship_id)
- name (e.g., Academic Performance, Financial Need, Extracurricular Activities)
- weight (A numerical value indicating the importance of the criterion)

Scores

- score_id (Primary Key)
- applicant_id (Foreign Key referencing Applicants.applicant_id)
- criteria_id (Foreign Key referencing Criteria.criteria_id)
- score (A numerical value representing the score of the applicant for the specific criterion)

II. Criterion Value Weight Analysis

1. Table of criteria and weights for determining students who are worthy of a scholarship

Criteria	Information	Value Weight
C1	Performance	30
C2	Parents' income	40
C3	Dependent parents	30
Total Weight		100

Table 2. Criteria and Weights

2. Table of Prospective Scholarship Recipients
Prospective scholarship recipients are taken from their achievements, parents' income and parents' dependents.

A1	Ida Hayati
A2	Ramdhani

A3	Agus Saputra
----	--------------

Table 3. Prospective Scholarship Recipients

a) Value Weighting Table

The value weight is taken from the criteria and weight of prospective scholarship recipients

Very important (VI)	4
Not important (NI)	2
Important (I)	3
Not Required (NR)	1

Table 4. Value Weights

b) Table of Achievement Criteria Values (C1)

Achievements are taken from report cards and academic/non-academic competitions in which they have participated. Like the following table.

Performance	Weight	Mark
Very important	(VI)	2
Not important	(NI)	3
Important	(I)	4
Not Required	(NR)	1

Table 5. Achievements

c) Table of Parental Income Values (C2)

Parental income is obtained from the parent's monthly salary or income which can be seen.

Parents' Income	Weight	Mark
More than 500.000	(VI)	1
More than 1.000.000	(NI)	2
More than 1.500.000	(I)	3
More than 2.000.000	(NR)	4

Table 6. Parents' Income

d) Table of Values of Dependent Parents (C3)

Parental dependency is determined by how many children the parents support.

Dependent Parents	Weight	Mark
More than 2 child	(VI)	1
More than 3 child	(NI)	2
More than 4 child	(I)	3
More than 5 child	(NR)	4

Tabel 7. Parent's Responsibility

e) Table of Alternative Values for Each Criteria

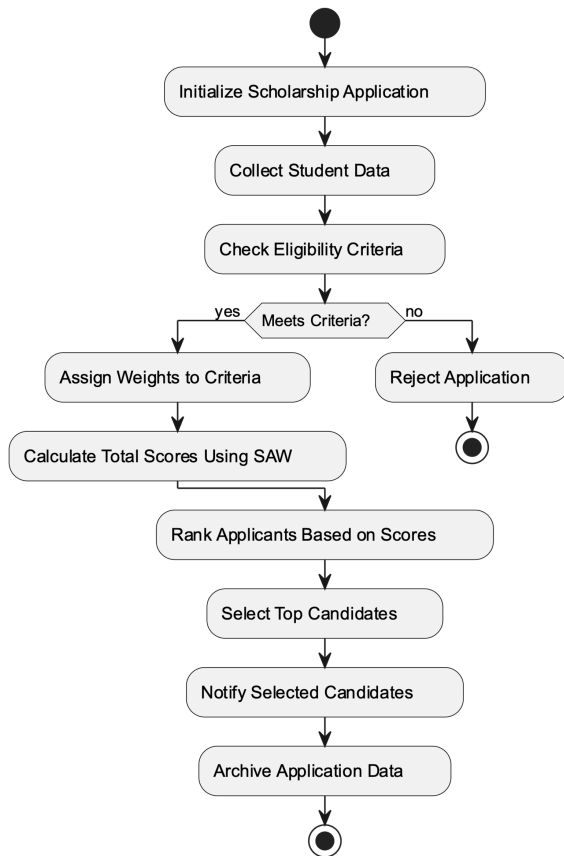
The alternative values used for each criterion will be weighted to determine the best alternative.

Alternative		Criteria		
		C1	C2	C3
A1	Ida Hayati	4	2	3
A2	Ramdhani	3	3	1
A3	Agus Saputra	1	4	1

Tabel 8. Alternative For Each Criterion

RESULTS AND DISCUSSION

To make a system of scholarship admission support system that uses the Simple Additive Weighting (SAW) method, Researcher make every step using flowchart like on figure above:



each step in the flowchart for the scholarship admission support system using the Simple Additive Weighting (SAW) method:

1. **Initialize Scholarship Application:**
Description: The system starts by initializing the scholarship application process. This could involve setting up necessary forms, databases, and other initial configurations required to collect and process applications.
2. **Collect Student Data:**
Description: The system collects data from students who are applying for the scholarship. This data might include personal information, academic records, financial status, extracurricular activities, and any other relevant information required for the scholarship evaluation.
3. **Check Eligibility Criteria:**
Description: The system evaluates the collected data against the predefined eligibility criteria for the scholarship. These criteria might include minimum GPA, income thresholds, citizenship requirements, etc.
4. **Meets Criteria:**
Description: This decision point checks whether the applicant meets the eligibility criteria.
Yes: If the applicant meets the criteria, the system proceeds to the next step.
No: If the applicant does not meet the criteria, the application is rejected.
5. **Assign Weights to Criteria:**
Description: For applicants who meet the eligibility criteria, the system assigns weights to each criterion based on its importance. For example, academic performance might be weighted more heavily than extracurricular activities.
6. **Calculate Total Scores Using SAW:**
Description: The Simple Additive Weighting (SAW) method is used to calculate a total score for each applicant. This involves multiplying each criterion's weight by the applicant's score for that criterion and summing these products to get the total score.
7. **Rank Applicants Based on Scores:**
Description: After calculating the total scores, the system ranks the applicants from highest to lowest score. This helps in identifying the top candidates for the scholarship.
8. **Select Top Candidates:**
Description: Based on the ranking, the system selects the top candidates who will receive the scholarship. The number of selected candidates might be determined by the number of available scholarships or other predefined factors.
9. **Notify Selected Candidates:**
Description: The system sends notifications to the selected candidates, informing them that they have been awarded the scholarship. This could be

done via email, SMS, or any other communication channel.

10. Archive Application Data:

Description: Finally, the system archives all the application data for future reference. This could involve storing the data in a database or any other storage system. This step ensures that the data is preserved for audits, future reference, or further analysis.

Decision Support System Calculations

The SAW calculation process will be carried out by normalization and will form a matrix table.

1. Normalization of Achievement Criteria

To find out the results of adding up the A1 scores for the achievement criteria by determining the calculation of the R1 and R2 scores r3.

A1

$$R1 = 4 / \text{Max}\{4:3:1\} = 4/4 = 1$$

$$R2 = 2 / \text{Max}\{2:3:4\} = 2/4 = 0.5$$

$$R3 = 3 / \text{Max}\{3:1:1\} = 3/3 = 1$$

2. Parents' Income

To find out the results of adding up the A2 value, parents' income determines the calculation of the R1 R2 and R3 values.

A2

$$R1 = 3 / \text{Max}\{4:3:1\} = 3/4 = 0.75$$

$$R2 = 3 / \text{Max}\{2:3:4\} = 3/4 = 0.75$$

$$R3 = 1 / \text{Max}\{3:1:1\} = 1/3 = 0.333$$

3. Dependent Parents

To find out the results of adding up the A3 value of dependent parents by determining the calculation of the R1 R2 and R3 values.

A3

$$R1 = 1 / \text{Max}\{4:3:1\} = 1/4 = 0.25$$

$$R2 = 4 / \text{Max}\{2:3:4\} = 4/4 = 1$$

$$R3 = 1 / \text{Max}\{3:1:1\} = 1/3 = 0.333$$

4. Tabel Matriks Normalisasi

The Pangkingan process will be carried out by adding up the multiplication of each criterion in the normalized alternative with the weight value of the criteria that has been determined.

ALTERNATIVE	C1	C2	C3
Ida Hayati	1	0.5	1
Ramdhani	0.75	0.75	0.333
Agus Saputra	0.25	1	0.333

Table 9. Normalization Matrix

$$A1 = (30 \times 1) + (40 \times 0.5) + (30 \times 1) \\ = 30 + 20 + 30 \\ = 80$$

$$A2 = (30 \times 0.75) + (40 \times 0.75) + (30 \times 0.333) \\ = 22.5 + 30 + 9.99 \\ = 62.49$$

$$A3 = (30 \times 0.25) + (40 \times 1) + (30 \times 0.333) \\ = 7.5 + 40 + 9.99 \\ = 57.49$$

The final result is the value obtained from the sum of the values A1, A2 and A3 which gets the largest value A1.

	Alternative Name	Alternative Value
A1	Ida Hayati	80
A2	Ramdhani	62.49
A3	Agus Saputra	57.49

Table 10. Addition of values

From the calculation above, the largest value is obtained at A1 so that the best alternative, in other words, Ida Hayati, is the best scholarship recipient.

Based on research that has been carried out on the Scholarship Acceptance Decision Support System at SD Negeri 1 Kamilin Pagelaran Utara, it has several advantages, firstly, calculating the decision support system using the SAW method will be easier and faster, secondly, this system has multi-data so that in data management Alternatives and criteria can

be done dynamically. The weakness that still exists in this decision support system is that there is no system for checking data that exceeds the existing value, this will result in errors in the system being run.

CONCLUSION

Based on the results of the discussion described in the previous chapters, the author can draw the following conclusions:

1. The Scholarship Acceptance Decision Support System at SD Negeri 1 Kamilin Pagelaran Utara was built with the stages of planning, analysis, design, development, testing, implementation, operation and maintenance.
2. With the existence of a Scholarship Acceptance Decision Support System at SD Negeri 1 Kamilin Pagelaran Utara using the SAW method, this method is used to find the sum of the weighted values for scholarship acceptance, from the performance chain for each alternative for all attributes.
3. With the SAW method scholarship acceptance decision support system, the final result is obtained from the sum of the values A1, A2, A3 which gets the largest value of A1 with the best alternative as a scholarship recipient.

REFERENCES

- [1] D. Wira Trise Putra and A. Agustian Punggara, "Comparison Analysis of Simple Additive Weighting (SAW) and Weighed Product (WP) In Decision Support Systems," *MATEC Web Conf.*, vol. 215, p. 01003, 2018, doi: 10.1051/mateconf/201821501003.
- [2] Y. Kinanti Kumarahadi, E. Aprilianto, D. Yulianto, and Kusriani, "Decision Support System For Determining The Provision Of Single Tuition Relief Using KNN and SAW Methods," in *2020 8th International Conference on Cyber and IT Service Management (CITSM)*, Pangkal Pinang, Indonesia: IEEE, Oct. 2020, pp. 1–6. doi: 10.1109/CITSM50537.2020.9268886.
- [3] Yuda Irawan, "Decision Support System For Employee Bonus Determination With Web-Based Simple Additive Weighting (SAW) Method In PT. Mayatama Solusindo," *JAETS*, vol. 2, no. 1, pp. 7–13, Nov. 2020, doi: 10.37385/jaets.v2i1.162.
- [4] P. I. Ciptayani, N. G. A. P. H. Saptarini, P. A. W. Santiary, and I. N. G. A. Astawa, "Decision Support System for Tourist Destination using the Combination of AHP and SAW," in *2018 2nd East Indonesia Conference on Computer and Information Technology (EIconCIT)*, Makassar, Indonesia: IEEE, Nov. 2018, pp. 271–275. doi: 10.1109/EIconCIT.2018.8878638.
- [5] A. Fitrul Hadi, R. Permana, and H. Syafwan, "Decision Support System in Determining Structural Position Mutations Using Simple Additive Weighting (SAW) Method," *J. Phys.: Conf. Ser.*, vol. 1339, no. 1, p. 012015, Dec. 2019, doi: 10.1088/1742-6596/1339/1/012015.
- [6] M. Ferdadiningsih, "Penerapan Metode Ahp Pada Sistem Pendukungkeputusan Penerimaan Beasiswa Sekolah," *Jurnal Teknologi Terkini*, vol. 2, no. 12, 2022.
- [7] A. Rasadi, B. Hidayat, and T. Ophiyandri, "Decision support system in determining the priority of disaster mitigation infrastructure development in villages level using the Simple Additive Weight (SAW) method," *IOP Conf. Ser.: Earth Environ. Sci.*, vol. 708, no. 1, p. 012065, Apr. 2021, doi: 10.1088/1755-1315/708/1/012065.
- [8] S. V. B. Manurung, F. G. N. Larosa, I. M. S. Simamora, A. Gea, E. R. Simarmata, and A. Situmorang, "Decision Support System of Best Teacher Selection using Method MOORA and SAW," in *2019 International Conference of Computer Science and Information Technology (ICoSNIKOM)*, Medan, Indonesia: IEEE, Nov. 2019, pp. 1–6. doi:

- 10.1109/ICoSNIKOM48755.2019.9111550 .
- [9] H. Kurniawan, A. P. Swondo, E. P. Sari, K. Umami, Yufrizal, and F. Agustin, "Decision Support System To Determine The Student Achievement Scholarship Recipients Using Fuzzy Multiple Attribute Decision Making (FMADM) With SAW," in *2019 7th International Conference on Cyber and IT Service Management (CITSM)*, Jakarta, Indonesia: IEEE, Nov. 2019, pp. 1–6. doi: 10.1109/CITSM47753.2019.8965326.
- [10] Z. Zhai, J. F. Martínez, V. Beltran, and N. L. Martínez, "Decision support systems for agriculture 4.0: Survey and challenges," *Computers and Electronics in Agriculture*, vol. 170. 2020. doi: 10.1016/j.compag.2020.105256.
- [11] H. Pratiwi, "Sistem Pendukung Keputusan," *Sistem Pendukung Keputusan*, vol. 4, no. 1960, 2022.
- [12] Popy Yolita Clara Banamtuan, Alfredo Pasaribu, and Yohanes Ari, "Sistem Pendukung Keputusan Penerimaan Beasiswa Dengan Metode Simple Additive Weighting (SAW)," *Jurnal Sistem Informasi dan Teknologi (SINTEK)*, vol. 1, no. 4, 2024, doi: 10.56995/sintek.v1i4.64.
- [13] A. Diana and A. Solichin, "Decision Support System with Fuzzy Multi-Attribute Decision Making (FMADM) and Simple Additive Weighting (SAW) In Laptop Vendor Selection," in *2020 Fifth International Conference on Informatics and Computing (ICIC)*, Gorontalo, Indonesia: IEEE, Nov. 2020, pp. 1–7. doi: 10.1109/ICIC50835.2020.9288587.
- [14] R. D. Gunawan, F. Ariany, and Novriyadi, "Implementasi Metode SAW Dalam Sistem Pendukung Keputusan Pemilihan Plano Kertas," *Journal of Artificial Intelligence and Technology Information (JAITI)*, vol. 1, no. 1, 2023, doi: 10.58602/jaiti.v1i1.23.
- [15] Ramadiani, R. Kurniawan, A. H. Kridalaksana, and M. L. Jundillah, "Decision Support Systems Selection of Soang Superior Brood Using Weighted Product (WP) and Simple Additive Weighting (SAW) Method," *E3S Web Conf.*, vol. 125, p. 23004, 2019, doi: 10.1051/e3sconf/201912523004.
- [16] R. H. Saputra, J. A. Baba, and G. Y. K. S. Siregar, "Penilaian kinerja dosen menggunakan modifikasi skala likert dengan metode simple additive weighting," *Explore: Jurnal Sistem Informasi dan Telematika (Telekomunikasi, Multimedia dan Informatika)*, vol. 9, no. 1, 2018.
- [17] D. Ramadaniah, K. S. Nurjannah, M. R. Romahdoni, and J. Andrew, "DEVELOPMENT OF DECISION SUPPORT SYSTEM APPLICATION FOR ADMISSION OF NEW STUDENTS AND DETERMINATION OF MAJOR USING SIMPLE ADDITIVE WEIGHTING (SAW)," *AISJ*, vol. 1, no. 2, Jan. 2023, doi: 10.24042/aisj.v1i2.15766.
- [18] E. Daniati and A. Nugroho, "K-Means clustering with Decision Support System using SAW: Determining thesis topic," in *2016 6th IEEE International Conference on Control System, Computing and Engineering (ICCSCE)*, Penang, Malaysia: IEEE, 2016, pp. 326–331. doi: 10.1109/ICCSCE.2016.7893593.
- [19] A. F. Pasaribu, A. Surahman, A. T. Priandika, S. Sintaro, and Y. T. Utami, "Sistem Pendukung Keputusan Seleksi Penerimaan Guru Menggunakan SAW," *Journal of Artificial Intelligence and Technology Information (JAITI)*, vol. 1, no. 1, 2023, doi: 10.58602/jaiti.v1i1.21.