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Implementation Of The Simple Additive Weighting (SAW) Method On The Determination Of Scholarship Recipients

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ABSTRACT

In recent years, technology and science have developed quite drastically. With advances in technology and science, we can create a system to help solve a problem such as granting scholarships. The purpose of this research is to build a decision support system to help and make it easier to determine who is entitled to get a scholarship. The method we use here is Simple Additive Weighting (SAW) which simplifies the process of awarding scholarships which is then carried out by a process of ranking and determining the weight values for each criterion attribute to get the best alternative and who is entitled to get the scholarship. The data used to determine scholarship recipients includes GPA data (Grade Point Average), parents income data, and parents dependents data. The results obtained in this study indicate that a decision support system can make it easier to determine who is entitled to get the scholarship without requiring more time than the manual method which will also make it easier for humans to make decisions.

Keywords: Scholarship; Decision Support System; SAW;

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1. INTRODUCTION

Good universities generally have assistance programs in the form of scholarships for students who have a lack of funds in getting a proper education. Scholarships are a form of financial assistance provided to individuals with the aim of being used in obtaining education. Scholarship recipients are generally underprivileged people but have achievements in academic and non-academic activities held during their studies. With the existence of scholarships, it is hoped that all students can complete their studies on time without funding obstacles. The government has attempted to provide scholarships, especially in the field of education, based on the achievements and financial inability of the students' parents. Data reported by the Central Bureau of Statistics (BPS) shows that over the past decade, there has been an increasing trend in scholarship or education assistance recipients, from 3.89% in 2009 to 20.14% in 2021.

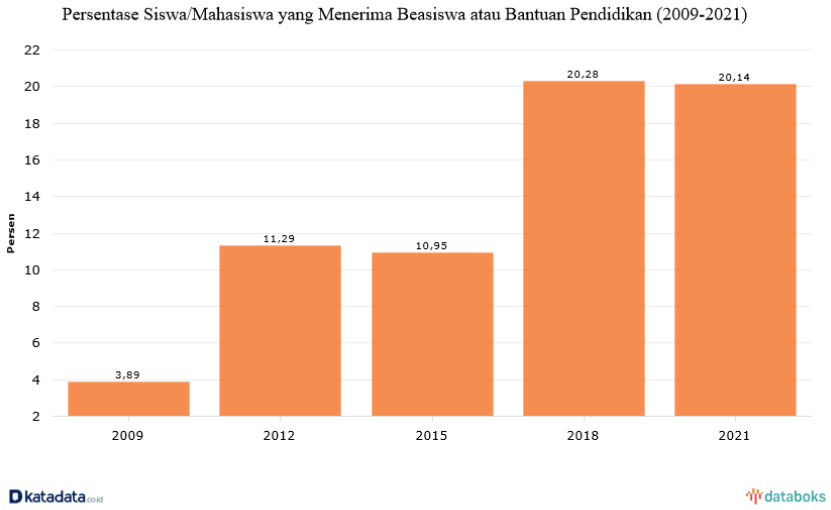

Figure 1. Data on Scholarship or Education Assistance Recipients from 2009 - 2021
Source: katadata.co.id

Figure 1 illustrates that the largest increase occurred from 2015 to 2018, with the percentage of students receiving scholarships in 2018 reaching 20.28%, doubling from 10.95% in 2015. These scholarships include the Indonesia Smart Program (PIP), scholarships from the central government, scholarships from local governments, scholarships or assistance from nongovernmental organizations, and others.

Scholarships must be given to the right people by measuring various criteria that must be met by each prospective scholarship recipient. The problem that then arises is that determining which students deserve a scholarship is not easy. This is due to the large number of applicants and the specific criteria set by the institution. On the other hand, the funds provided to support the scholarship program are usually limited according to the provisions of the funder. Slow data collection because it must be input manually by the institution is also an obstacle in measuring scholarship criteria. A scholarship is funding provided to a student that does not come from the parents' income or their own income. There are many scholarships for students in every educational institution offered. There are scholarships that are sourced from the government and some are sourced from the college itself or other private institutions. Scholarships are usually awarded if the recipient meets predetermined criteria such as grades, achievements, parents' income, number of dependents.

In this digital era, to overcome the problems that occur, a system is needed that can help prospective scholarship recipients who can process the inputted data accurately and quickly and make it easier for institutions to make decisions. Therefore, a decision support system is needed that can recommend scholarships to be directed correctly and consider according to predetermined criteria [2]. The development of decision support systems can be done with various methods to measure the specified criteria. Methods that are often used in the development of decision support systems such as Simple Additive Weighting (SAW), TOPSIS, Fuzzy Logic, and many other methods. The method used in this research is Simple Additive Weighting (SAW). This SAW method was chosen because it can provide weights for each attribute based on predetermined criteria to get precise and accurate results.

Based on the above problems, this research develops a Decision Support System (SPK) in determining prospective scholarship recipients using the Simple Additive Weighting (SAW) method. The results of this study will support similar studies that implement the SAW method for scholarship recipients.

2. RESEARCH METHOD

The system developed in this research is a decision support system with the SAW method. The flow of developing a decision support system in this study can be addressed in the chart below.

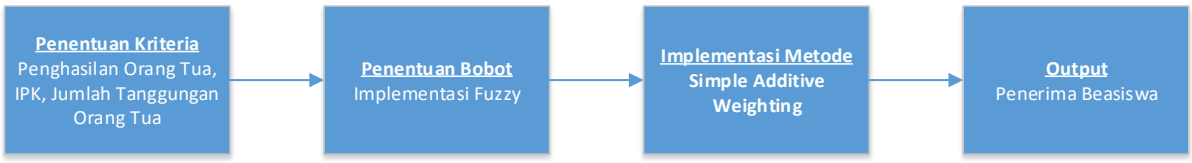

Figure 2. Flow of Scholarship Determination Using SAW Method

Source: Researcher processed results

The development of the system, as shown in Figure 2, begins with determining the criteria used in awarding scholarships. After the criteria have been determined, then the weighting will be done with Fuzzy implementation. Calculation of the results of scholarship recipients is used SAW method in accordance with the formula that will be described in this chapter. After that, the output will be given by sorting based on the acquisition of the largest final result.

2.1 Criteria Determination

The stage of making this application, first is to determine and plan the criteria for receiving scholarships, namely the amount of parent income, achievement index and number of parent dependents.

Table 1. Criteria Codes and Conditions

Criteria Code	Criteria Requirements
C1	Total Parent Income
C2	Achievement Index
C3	Number of Parental Dependents

Source: Researcher processed results

Table 1 illustrates each of the criteria for determining scholarships. The criteria used in this study are the amount of parents' income, achievement index and the number of dependents. The criteria are given a code or label and then the weight is determined.

2.2 Weight Determination

In this research, there are weights and criteria needed to determine who will be selected as a scholarship recipient. (Muslihudin & Hartini, 2015) [3]. The weights used consist of six fuzzy numbers, namely very low (SR), low (R), medium (S), middle (T1), high (T2), and very high (ST) as shown in Figure 1.

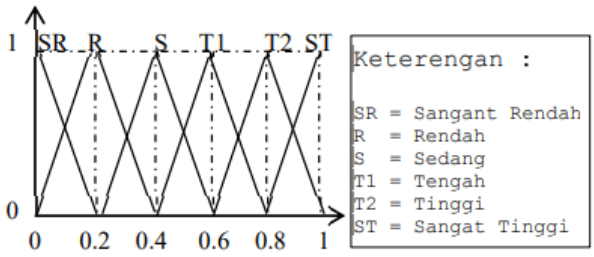

Figure 3. Fuzzy numbers for weights

Fuzzy implementation provides division for classification and weighting as shown in Figure 1. There are 6 (six) classifications determined with their respective weight values outlined in table 2 below.

Table 2. Variables and Weights (Values)

Variables	Value Weight
Very Low (SR)	0th variable / (6-1) = 0
Low(R)	1st variable / (6-1) = 1/5 = 0.2
Medium(S)	2nd variable / (6-1) = 2/5 = 0.4
Center (T1)	3rd variable / (6-1) = 3/5 = 0.6
High(T2)	4th variable / (6-1) = 4/5 = 0.8
Very High (ST)	5th variable / (6-1) = 5/5 = 1

Source: Researcher processed results

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2. Parent Income Criteria

The second criterion described is parents' income. Students' parents' income is very diverse, this needs to be classified so that it can be grouped into several variables according to the implementation of fuzzy numbers.

Table 3. Criteria for Parents' Income

Parents' Income (C1)	Variables	Value
C1 <= Rp. 1 million	SR	0
C1 > Rp. 1.1 million < C1 < Rp. 2.5 million	R	0.2
C1 > Rp. 2.6 million < C1 < Rp. 4 million	S	0.4
C1 > Rp. 4.1 million < C1 < Rp. 5 million	T1	0.6
C1 > Rp. 5.1 million < C1 < Rp. 6 million	T2	0.8
C1 > Rp. 6.1 million	ST	1

Source: Researcher processed results

Table 3 above describes the division of people's income based on the classification of Fuzzy numbers. There are 6 nominal income criteria that are divided and sorted from very low to very high income.

3. Achievement Index Criteria

Table 4. Achievement Index Criteria

Achievement Index (C2)	Variables	Value
C2 <= 3.0	SR	0
C2 <= 3.2	R	0.2
C2 <= 3.4	S	0.4
C2 <= 3.6	T1	0.6
C2 <= 3.8	T2	0.8
C2 >= 4.0	ST	1

Source: Researcher processed results

Table 4 above describes the division of the cumulative achievement index (GPA) based on the classification of Fuzzy numbers. There are 6 nominal GPA criteria that are divided and sorted from very low to very high income.

4. Parental Dependents Criteria

Table 5. Criteria for Parental Dependents

Parental Dependents (C3)	Variables	Value
2-3 children	SR	0
4-5 children	R	0.2
6-7 children	S	0.4
8-9 children	T1	0.6
10-11 children	T2	0.8
More than 11 children	ST	1

Source: Researcher processed results

Table 5 above describes the division of parental dependents or the number of children borne based on the classification of Fuzzy numbers. There are 6 criteria for parental dependents that are divided and sorted from very low to very high income.

2.3 SAW Method Implementation

The method needed to produce this decision support system is Simple Additive Weighting (SAW). Simple Additive Weighting (SAW), or weighted summation, is used to find the best alternative from a set of alternatives with certain criteria, or find a weighted sum of the performance ratings on each alternative on all attributes [1]. The advantage of the Simple Additive Weighting (SAW) method lies in a more accurate assessment because it is based on specified criteria and preference weights. The basic concept of the SAW method is to find the weighted sum of the performance ratings on each alternative on all attributes. The SAW method can help in making decisions on a case, but calculations using this SAW method only produce the largest value that will be selected as the best alternative [2]. The total score for an alternative is obtained by summing up all multiplications between ratings (which can be compared across attributes) and the weights of each attribute. This method is the best known and most widely used method in dealing with Multiple Attribute Decision Making (MADM) situations [2]. SAW method is suggested to solve the selection problem in multi-process decision-making system [2]. The SAW method requires normalizing the decision matrix (X) to a scale that can be compared with all ratings [2].

$$R_{ij} = \begin{Bmatrix} \frac{X_{ij}}{Max_i X_{ij}}; & ...a \\ \\ \frac{Min_i X_{ij}}{X_{ij}}; & ...b \end{Bmatrix} \quad (1)$$

a. If j is a benefit attribute.
b. If j is a cost attribute.

Description: rij = normalized performance ranking value xij = attribute value owned by each criterion Max xij = the largest value of each criterion Min xij = the smallest value of each criterion Benefit = if the largest value is best Cost = if the smallest value is best

Where rij is the normalized performance ratio of alternative Ai on attribute Cj; i=1, 2, m and j=1,2,...n. The preference value for each alternative (Vi) is given as:

$$Vi = \sum_{J=1}^{n} w_j r_{ij} \quad (2)$$

Description:
Vi = ranking for each alternative
wj = weight value of each criterion
rij = the value of the normalized performance raiting, the greater value of Vi indicates that alternative Ai is more selected [3].

3. RESULTS AND DISCUSSION

In This research produces a decision support system that implements the Simple Additive Weighting (SAW) method to determine scholarship recipients based on predetermined criteria. The data used for system testing is dummy data or researcher's land data which is used to test whether the methods and calculations used in the system run properly.

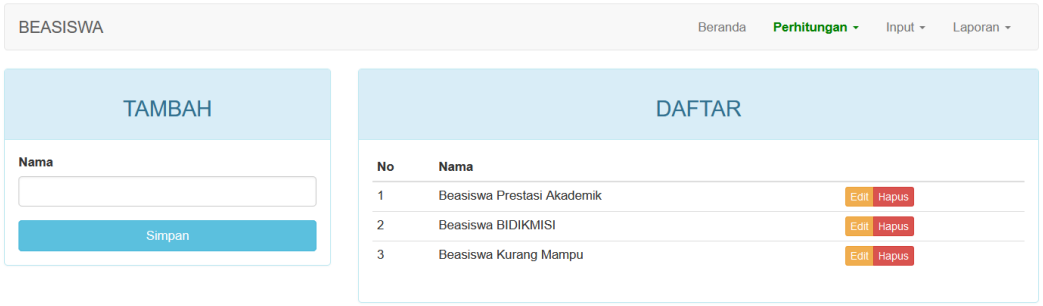

Figure 4. Scholarship Type Input

The scholarship input menu as shown in Figure 3 is used to enter any scholarships that you want to use. The first thing to do is to add student data.

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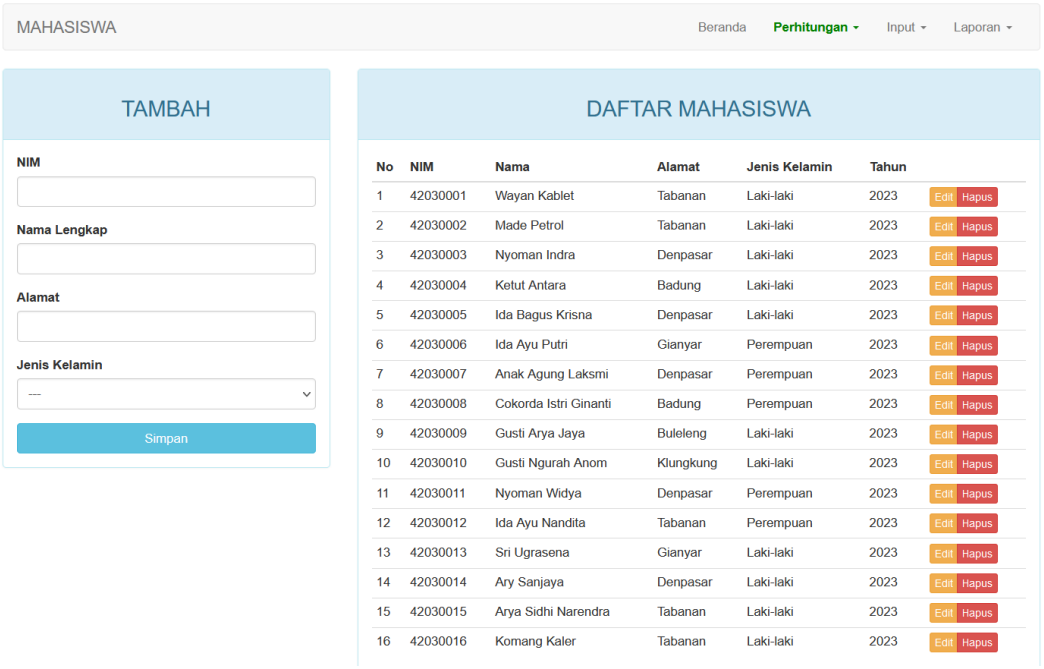

Figure 5. Student input

The student input menu is used to add data from students who register for scholarships.

Figure 6. Registration list

The enrollment list contains the student's name, number, address, gender, and the year they applied for the scholarship.

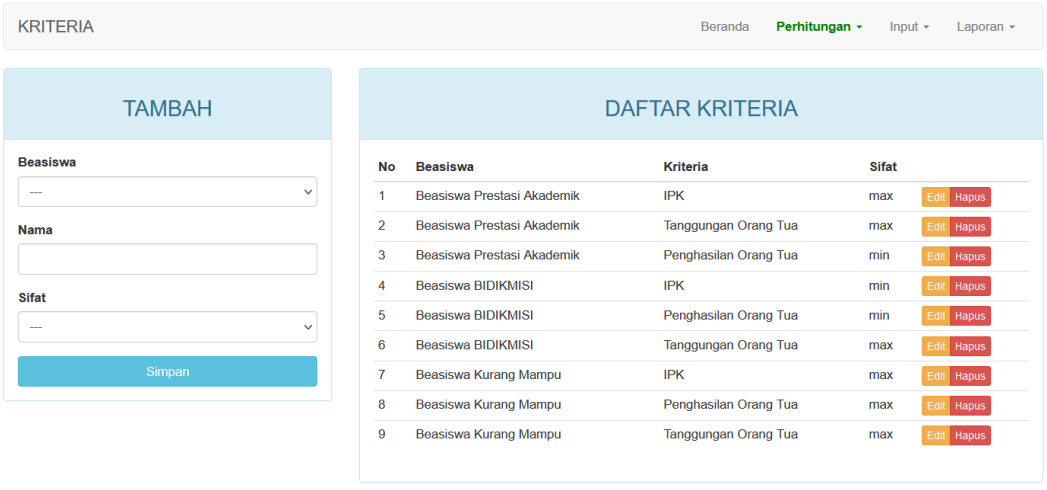

Figure 7. Criteria Input

In this menu, we can input the min value and max value according to the provisions of the scholarship.

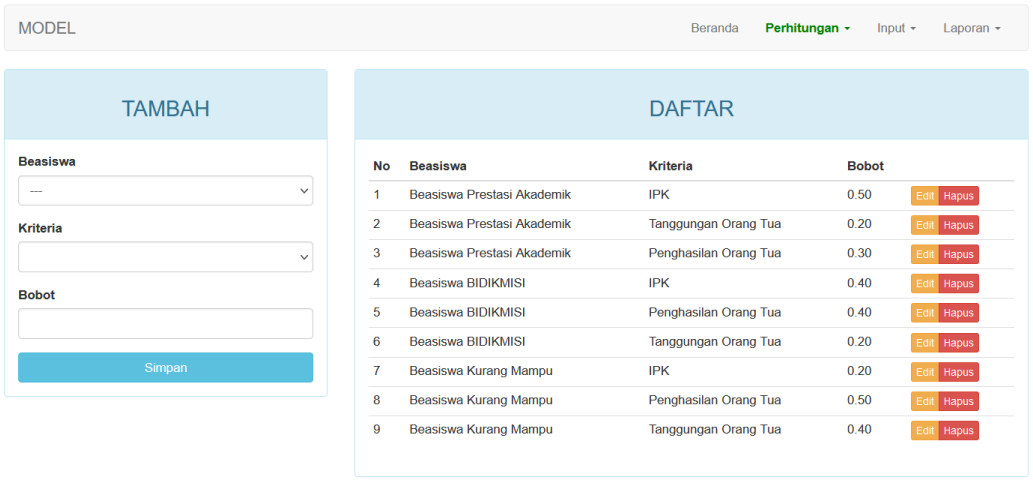

Figure 8. Weight Input

In this menu, we can input the weight of each criterion that has been entered as before.

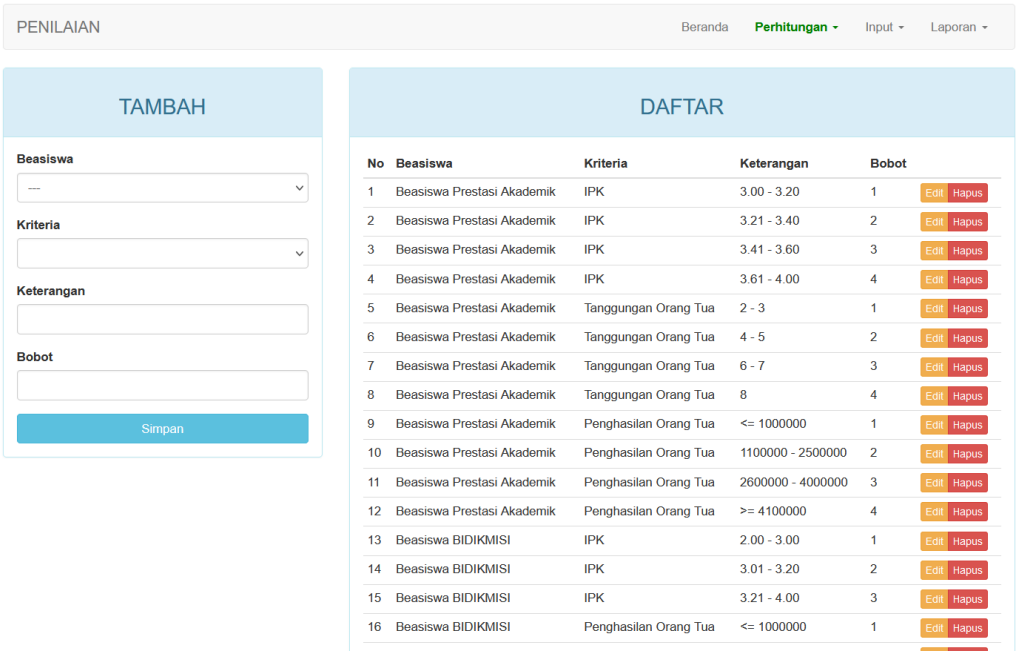

Figure 9. Assessment input

This menu is intended to create the boundaries of these criteria, for example in academic achievement scholarships with GPA criteria with information 3.00 - 3.20 getting weight 1.

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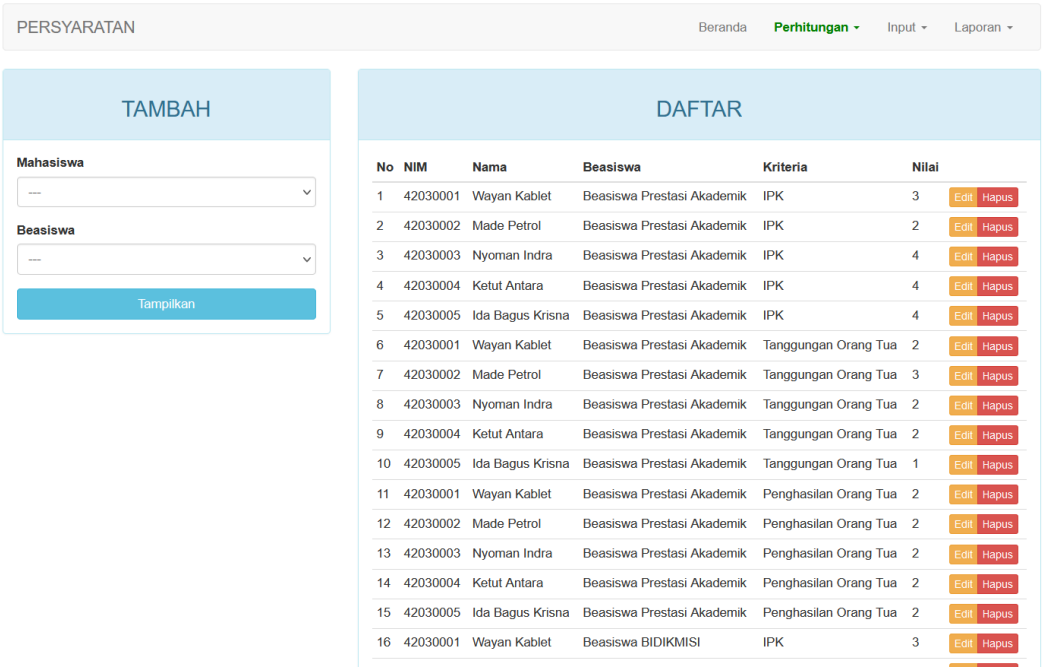

Figure 10. Requirement Input

In this menu, we will determine whether a student is entitled to the scholarship. For example, a student with the name Wayan Kablet in an academic achievement scholarship with GPA as a criterion gets a score of 3. Then for the criteria of parental dependents, get a score of 2, and the last with the criteria of parental income gets a score of 2.

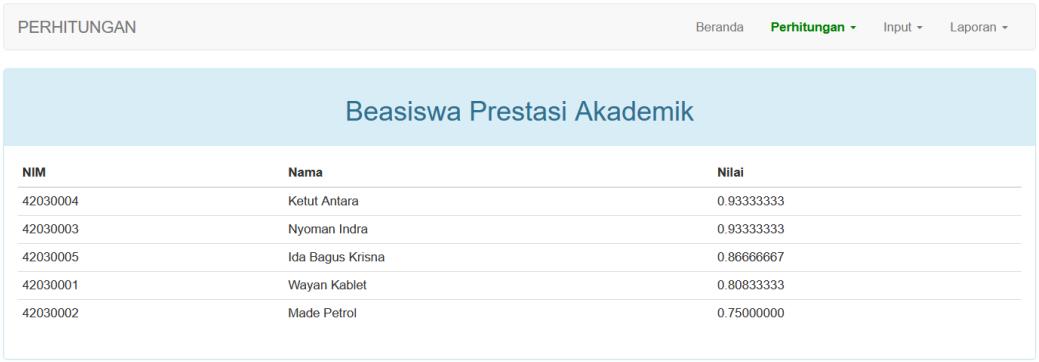

Figure 11. Calculation Result of Academic Achievement Scholarship

This is the result of the calculation with SAW method in academic achievement scholarship.

Figure 12. BIDIKMISI Scholarship Calculation Result

This is the final result of the calculation of the BIDIKMISI scholarship.

Figure 13. Underprivileged Scholarship Calculation Results

This is the final result of the underprivileged scholarship calculation.

4. CONCLUSION

The results of this study indicate that the decision support system with the SAW method can determine scholarship recipients based on the specified criteria. This system can make it easier to determine students who are eligible for scholarships without requiring a long time that can support decision making. Suggestions for further development of decision support systems are to use real data so that system performance can be measured properly and add intelligent methods such as naive bayes or other methods.

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