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Decision Support System for Identifying Best Students in the Class with Simple Additive Weighting (SAW) Method

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Abstract

Education is an important requirement for someone in managing the future. In this case, educational institutions seek to improve the quality of students by increasing student achievement. Each student must have different achievements, especially in the academic field. Student achievement is a measure of success obtained by a person or student during the process of learning activities. In achieving outstanding students there must be a role and contribution from various parties such as the government and schools. The criteria used to determine the best student in each class are report cards, attendance, extracurriculars and attitudes. In determining it, the MIMA 37 Sunan Kalijogo, Ambulu District took a long time. To simplify the process, it is necessary to create a decision support system to determine the best students. This decision support system uses the Simple Additive Weighting (SAW) method with a website-based application. In this system, the determination of the best student in each class is based on the ranking obtained from calculating the weight of the criteria and the weight of the student. From the ranking results it can be seen that students with the highest ranking can be said to be the best students. With the creation of this decision support system, it is hoped that it can produce objective decisions to determine outstanding students.

Keywords : Decision Support System, Ranking, Simple Additive Weighting (SAW)

1 INTRODUCTION

Every student's parents want their child to excel. Various ways are used to improve their children's achievements, such as providing additional education outside of school hours, providing tutoring at learning institutions, and carrying out additional learning at home. This is done to increase students' academic scores in order to enter the best schools or the best schools at the next level. Student achievement is one measure of a student's success during learning. The success of a student is determined by several factors, namely academic value, personality value and also the extracurricular activities that are followed. In making outstanding students there are other parties involved, namely the school concerned, the government as a policy maker, the private sector as a supporter and also the family environment. The main and most important factors in achieving student achievement are teachers and parents or family [1].

Each individual student has hard skills and soft skills that have the potential to support their future. However, not all of these individuals have the will and ability to explore their potential. In order to find out which students excel at school, at the end of each semester a student ranking is always carried out. The ranking of outstanding students is carried out by the school for external reporting purposes, namely to the City Government Service and can also be used for awarding scholarships. At the school level, the principal has the authority to determine the outstanding students. However, before it is determined, it is necessary to carry out a ranking process based on several existing criteria, such as students' academic scores. In addition to academic grades, outstanding students can also be determined by the criteria of attitudes, skills and general knowledge. The determination technique uses the average value of all the total values. The weighting technique by calculating the average is a technique commonly used at various school levels [2].

The process of selecting outstanding students which has been carried out so far by the school still has several weaknesses which raises several problems, including the process of processing the data for selecting

outstanding students which takes a long time and the possibility of human error occurring in the data processing [3]. In determining the best student there are often obstacles, such as the potential for subjective assessment if the final results of the assessment have the same value, so that it often results in an understanding and mindset of students who think that the best student award is given because students can build good communication excessively between tutors/ teacher. This is because there is no weighting of each criterion assessed. Therefore the application of a computer-based decision support information system is needed to achieve certain targets or actions that must be carried out. Of course, it is also supported by any parameters or criteria that will be assessed. Decision support systems have the ability to provide alternative solutions to semi- and unstructured problems, both individuals and groups, with several processes and ways of making decisions. [4].

Systems development methods are methods, procedures, concepts work that will be used to develop an information system [5]. Decision Support System (DSS) is a collection of data processing procedures to assist decision makers in dealing with semi-structured problems. SPK is intended to assist decision makers in solving problems and not replace human positions as decision makers as is the case in selecting outstanding students in schools. Decision support systems greatly speed up the decision-making process by solving the problem into its parts, there are methods in decision-making, one of which is the Simple Additive Weighting (SAW) method. [6].

SAW is a method that can determine the weight value for each attribute, then proceed with a ranking process that will select the best alternative from a number of alternatives. [7]. The SAW method can be implemented to determine the best student in the class based on correctly determined criteria and weights. The decision support system for determining the best student at MIMA 37 Sunan Kalijogo Sumberejo Village, Ambulu District, Jember Regency using the SAW Method is expected to be able to provide convenience and assist the teacher / homeroom teacher in making decisions to determine students who deserve to be the best students in each class.

2 RESEARCH METHOD

The research method is basically a scientific way to obtain information with specific purposes and uses. The research method is a method used by researchers in collecting research data. The scientific method means that this research activity is based on scientific characteristics, namely rational, empirical, and systematic. This research method is used as a research guide in conducting research so that the results achieved do not deviate from predetermined goals [8].

2.1 Method of Collecting Data

Data collection methods used in this study include:

1) Observation
   The observations we made were to directly observe the situation and conditions at MIMA 37 Sunan Kalijogo, Ambulu District in order to obtain information to be used as research material..
2) Interview
   The interview method was carried out directly to find out what the researcher needed. Interviews were conducted by asking the homeroom teacher and principal directly in determining the best student in each class.

2.2 Simple Additve Weighting (SAW) Method

The Simple Additive Weighting method is a method that seeks the greatest value of the performance rating of each alternative and attribute. The following are the stages of the Simple Additive Weighting method:

1) Determine the criteria to be used as a reference in making decisions.
2) Determine the level of application of each alternative according to their respective standards.
3) Make a decision matrix, and normalize the matrix according to the type of cost/benefit attribute so as to produce a normalized matrix value r.
4) The final result of the sorting process by calculating the multiplication of the normalized r matrix and the weight vector to choose the maximum value as the best alternative solution.
5) From the final normalized results, then sort them from the maximum value to the minimum value.

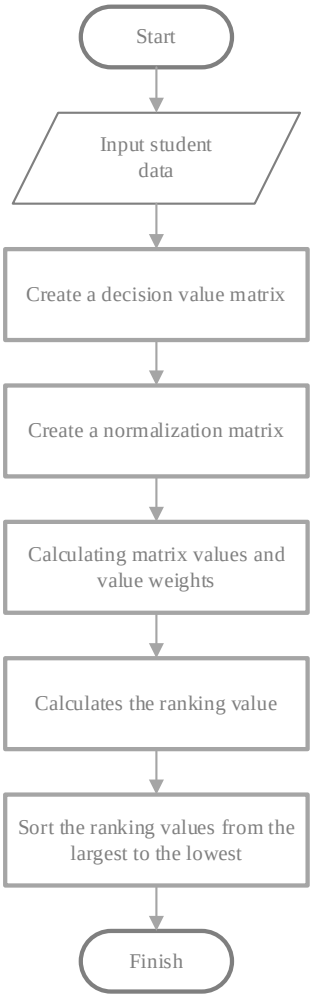

Figure 1. SAW Method Calculation

The basic concept of the SAW method is to find the weighted sum of the performance ratings for each alternative on all attributes. This method requires the process of normalizing the decision matrix into a scale that can be compared with all existing alternative ratings. The total score for the alternative is obtained by adding up all the multiplication results between the rating and the weight of each attribute [9]. In this chapter, testing of decision support systems uses the Simple Additive Weighting (SAW) method, starting from analyzing the problem to the weighting criteria [10]:

1) Determine the criteria that will be used as a reference in making decisions, namely Cj.
2) Determine the suitability rating of each alternative on each alternative on each criterion.
3) Make a decision matrix based on criteria (Cj), then normalize the matrix based on the equation adjusted for the type of attribute (profit attribute or cost attribute) so that a normalized matrix R is obtained.
4) The final result is obtained from the ranking process, namely the sum of the multiplication of the normalized matrix R with the weight vector (W) so that the largest value is selected as the best alternative (Ai) as a solution in equation (1) below:

$$r_{ij} = \{\frac{x_{ij}}{x_{ij}} \quad if\ j\ is\ attribut\ (benefit)\ \frac{x_{ij}}{x_{ij}} \quad if\ j\ is\ attribut(cost) \tag{1}$$

with:
rij : The normalized performance rating of the alternative Ai on the attribute Cj;
i=1,2,...,m dan j=1,2,....,n. (m and n is the number of criteria and alternatives).
xij is the match rating on Ai and Cj.
Preference values are presented in equation (2) below:

$$V_i = \sum_j^n \quad = 1 w_j r_{ij} \tag{2}$$

with:
rij is the normalized performance rating of alternative Ai on Cj attribute;

.

Wj is the weight of each criterion.
A larger value of Vi indicates that alternative Ai is more preferred.

3 RESULTS AND ANALYSIS

In this discussion, several steps are taken to analyze and design a system that aims to determine the best students at each grade level of MIMA 37 Sunan Kalijogo, Ambulu District using the Simple Additive Weighting (SAW) method. The analysis carried out is applying algorithms and calculations related to the research objectives.

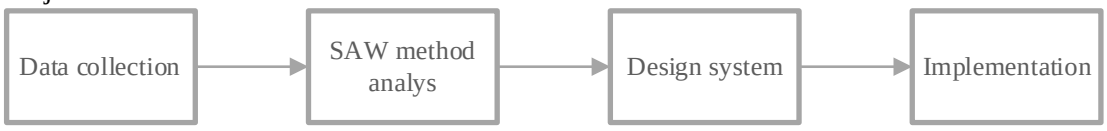

Figure 2. Analysis Flow Model

3.1 Data Collection

In this study, the data used in processing the decision support system is in the form of student data and criteria data. As a sample here shown in Table 1 is the data for class V MIMA 37 Sunan Kalijogo students, totaling 31 students and in Table 2 is the criterion data used to determine the best student in the class.

Table 1. Student Data/Alternative Data

No.	NIS	Nama Siswa	Gender
1.	18-5-68	Ahmad Dhafin Rizki Khoirul Aziz	Man
2.	18-5-69	Ahmad Nizar Syafiqul Azhar	Man
3.	18-5-70	Adam Dhaniel Faizal	Man
…	…	…	…
31.	18-5-98	Zakky Maulana Azri	Man

Table 2. Criteria Data

Code Criteria	Name Criteria	Type Criteria
C01	Presence	Benefit
C02	Extracurricular Value	Benefit
C03	Average Score Report	Benefit
C04	Behavior	Benefit

There are 4 criteria in this study, each criterion has a preference weight based on the importance value of each criterion, the criterion weight value can be seen in Table 3 below.:

Table 3. Criteria Weight

Code Criteria	Name Criteria	Type Criteria	Weight	Percentage
C01	Presence	Benefit	0,20	20%
C02	Extracurricular Value	Benefit	0,10	10%
C03	Average Score Report	Benefit	0,45	45%
C04	Behavior	Benefit	0,25	25%

Based on the case study on MIMA 37 Sunan Kalijogo, the range of preference ratings for each criterion is obtained as follows:

Table 4. Attendance Assessment Preferences

Criteria	Weight	Weight
86 – 100 (%)	Very Good	5
76 – 85,9 (%)	Good	4
66 – 75,9 (%)	Enough	3
56 – 65,9 (%)	Less	2
<= 55 (%)	Very Less	1

Table 5. Extracurricular Value Assessment Preferences

Criteria	Weight	Weight

A	Very Good	5
B	Good	4
C	Enough	3
D	Less	2
E	Very Less	1

Table 6. Rating Preferences for the Average Value of Report Cards

Criteria	Weight	Weight
86 – 100	Very Good	5
76 – 85,9	Good	4
66 – 75,9	Enough	3
56 – 65,9	Less	2
<= 55	Very Less	1

Table 7. Behavior Assessment Preferences

Criteria	Weight	Weight
86 – 100	Very Good	5
76 – 85,9	Good	4
66 – 75,9	Enough	3
56 – 65,9	Less	2
<= 55	Very Less	1

3.2 SAW Method Analysis

In this application system test, three samples of outstanding student candidates were taken with the following data:

1) Determination of criteria has been described in section 3.
2) Determine the alternative suitability rating
   Examples of cases of suitability ratings from each alternative for each criterion of prospective scholarship recipients are as follows:
   a. Alternative student 1 (A): attendance value 90, extracurricular value B, average report card score 90, and behavior score 80.
   b. Alternative 2nd student (B): attendance value 80, extracurricular value B, average report card score 82 and behavior score 80.
   c. Alternative 3 students (C): attendance value 90, extracurricular value C, report card average value 92, and behavior value 88.

From these data it can be mapped for the value of each alternative for each criterion as follows:

Table 8. Alternative Compatibility Ratings

Student's Name	Criteria			
	C01	C02	C03	C04
A	5	4	4	4
B	4	4	4	4
C	5	3	5	5

From this value, the decision maker then gives the preference weight as follows: W = (2, 1, 4.5, 2.5).

3) Decision Matrix Based on Criteria
   The decision matrix based on these criteria, namely:

$$X = [5\,4\,5 \;\; 4\,4\,3 \;\; 4\,4\,5 \;\; 4\,4\,5]$$

The results of the normalization of the sample data decision matrix, namely:

$$r_{11} = \frac{5}{max\,(5;4;5)} = \frac{5}{5} = 1$$

$$r_{21} = \frac{4}{max\,(5;4;5)} = \frac{4}{5} = 0{,}8$$

$$r_{31} = \frac{5}{max\,(5;4;5)} = \frac{5}{5} = 1$$

.

$$r_{12} = \frac{4}{max\ (4;4;3)} = \frac{4}{4} = 1$$
$$r_{22} = \frac{4}{max\ (4;4;3)} = \frac{4}{4} = 1$$
$$r_{32} = \frac{3}{max\ (4;4;3)} = \frac{3}{4} = 0{,}75$$
$$r_{13} = \frac{4}{max\ (4;4;5)} = \frac{4}{5} = 0{,}8$$
$$r_{23} = \frac{4}{max\ (4;4;5)} = \frac{4}{5} = 0{,}8$$
$$r_{33} = \frac{5}{max\ (4;4;5)} = \frac{5}{5} = 1$$
$$r_{14} = \frac{4}{max\ (4;4;5)} = \frac{4}{5} = 0{,}8$$
$$r_{24} = \frac{4}{max\ (4;4;5)} = \frac{4}{5} = 0{,}8$$
$$r_{34} = \frac{5}{max\ (4;4;5)} = \frac{5}{5} = 1$$

4) The total value of the normalized matrix can be seen as below:

$$R = [1\ 0{,}8\ 1 \quad 1\ 1\ 0{,}75 \quad 0{,}8\ 0{,}8\ 1 \quad 0{,}8\ 0{,}8\ 1\ ]$$

Then carry out the ranking process by multiplying the normalized matrix (R) with the weight value (W), while the ranking process is based on the weight value W = (5, 3, 2), namely:

1) Alternative student 1 (A) = (5)*(1) + (4)*(1) + (4)*(0,8) + (4)*(0,8) = 15,4
2) Alternative student 2 (B) = (4)*(0,8) + (4)*(1) + (4)*(0,8) + (4)*(0,8) = 13,6
3) Alternative student 3 (C) = (5)*(1) + (3)*(0,75) + (5)*(1) + (5)*(1) = 17,25

From these data it will be obtained that student 3 (C) has the highest score of the 2 other students so that the best student candidate 3 (C) is more entitled to get the title of the best student in his class.

3.3 System Design

System design is the process of planning and building the structure, components, and interactions between the various elements involved in the system. In designing a decision support system for selecting exemplary students, it is arranged using the design needs of the Use Case Diagram, which can be seen in Figure 3.

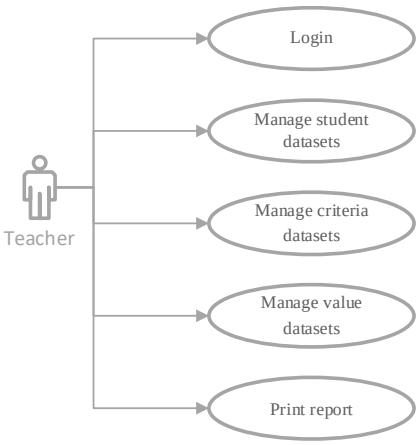

Figure 3. Use Case Diagram

The general description of the system running on the decision support system application for selecting the best students in each class uses the Simple Additive Weighting (SAW) method. Login to the application to be able to access the system, verify user access rights, enter the system. The ranking process uses the Simple

Additive Weighting (SAW) method, starting from determining the criteria until the final process produces a ranking. The resulting output is a ranking in the form of a report, where the highest final score is the best alternative.

The Use Case Diagram section explains one access right that can be operated by system users. First, the teacher/homeroom teacher who can log in to the system serves as input student datasets, input criteria datasets, input value student datasets, criterion weight datasets, class datasets, and ranking datasets..

3.4 Implementation

After all the steps of planning, analysis, system design, method calculations, and application coding, then the system can be fully implemented within the MIMA 37 Sunan Kalijogo school environment. The results of the research from making a decision support system application for selecting the best students in each class at the MIMA 37 Sunan Kalijogo school are as follows:

1) Login Page

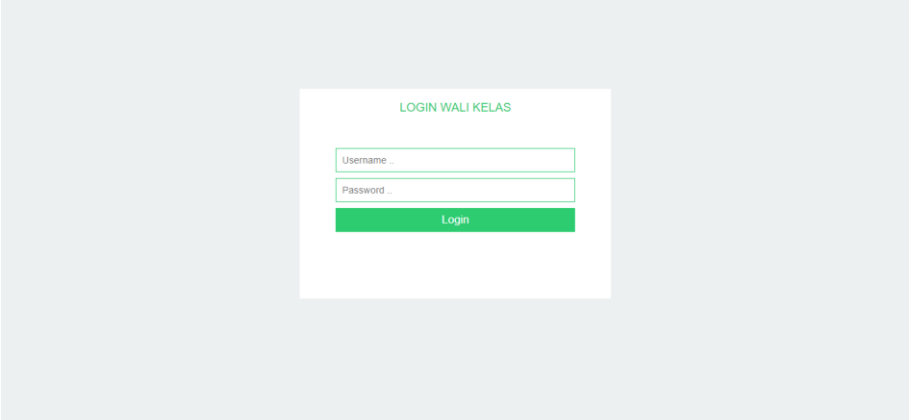

Figure 4. Login Page

The login form page is the first page that will appear after opening the application. on this page. Homeroom teacher can perform or run menus or activities that can be done on the system after logging in.

2) Input Data Page

Figure 5. Input Data Page

The best prospective student data page is a page for entering student data and criteria values that aim for the assessment process where on this page the homeroom teacher inputs data on the best prospective students who will be assessed using the SAW method.

3) View Data Page

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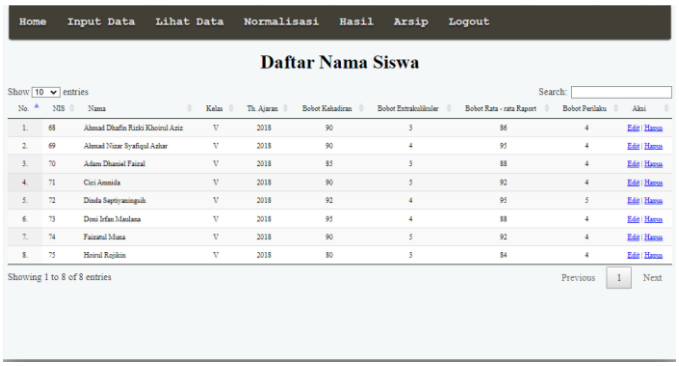

Figure 6. View Data Page

The view student data page contains details of student grades that have been inputted by the homeroom teacher. On that page there is also an edit and delete data menu.

4) Data Normalization Page

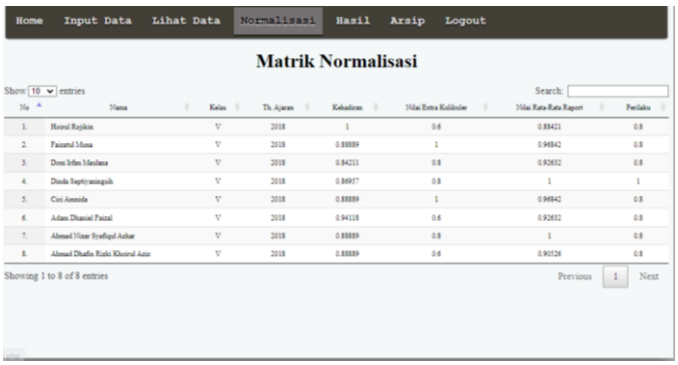

Figure 7. Data Normalization Page

The normalization data page displays the results of calculating the value of each student that has been entered into the weight preferences and processed using the SAW method.

5) Ranking Results Page

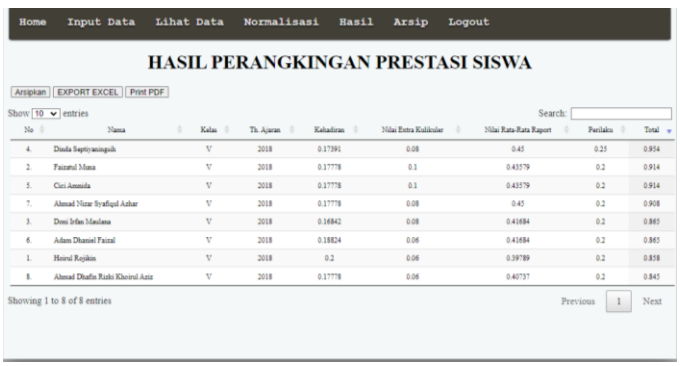

Figure 8. Ranking Results Page

The ranking page is the final result of the assessment process using the SAW method. On that page the names of the students as a whole are displayed based on the highest final result and then you can see the names of the students according to their ranking order.

4 CONCLUSION

The decision support system for assessing the best prospective students in each class to determine the best students using the web-based SAW method is realized by making an application. By making a decision support system for assessing the best prospective students in each class to determine the best students, it can provide high motivation so that it can help make decisions to determine the best students who are objective. It is hoped that this system can help the school and homeroom teacher to determine the best students.

The designed system for determining the best students is not perfect, for this reason improvements are needed both in terms of data processing and in the application section. For further research, it can be compared with other decision support system methods so that a more accurate and objective method can be identified for determining the best student in each class..

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