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Design of Web-Based Model Decision Support System for Selecting Exemplary Students Using Simple Additive Weighting (SAW) Method at SMAS Sultan Agung Puger

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ABSTRACT

The educational strategy adopted so far is general in nature, providing standard or average treatment to all students, so that it pays little attention to differences between students in their skills, interests and talents. With this kind of strategy, excellence will appear randomly and really depends on students' learning motivation and learning environment. Therefore, it is necessary to develop the advantages possessed by each student so that the potential possessed can be converted into superior achievements. In order to motivate students to continue to excel, Sultan Agung Private High School conducts activities to develop the potential of students through selecting exemplary students. A decision support system (SPK) to facilitate the selection of model students and utilize Simple Additive Weighting (SAW) as a decision-making method. The Simple Additive Weighting (SAW) method is a method that can determine the weight of the value of each attribute, then can determine the ranking so that the best alternative can be selected from several alternatives. The criteria used to evaluate the selection of exemplary students at the Sultan Agung Private High School are the average grades of report cards, attitudes/morals, and absenteeism. These calculations will be implemented in the PHP programming language and MySql database.

Keywords : Siswa Teladan; Kriteria; Sistem Penunjang Keputusan; Simple Additive Weighting

1. INTRODUCTION

The educational strategy adopted so far is general in nature, providing standard or average treatment to all students, so that it pays little attention to differences between students in their skills, interests and talents. With this kind of strategy, excellence will appear randomly and really depends on students' learning motivation and learning environment. Therefore, it is necessary to develop the advantages possessed by each student so that the potential possessed can be converted into superior achievements (Mulyani et al., 2015). In every school there are opportunities for students to become outstanding students or exemplary students every year. However, it still uses the manual method and takes a long time to determine who the model student is with the criteria, namely a combination of academic scores, extracurricular scores, and added absence or absence data. Until now, each school still selects the manual method to select exemplary or outstanding students, and even that method takes a very long time to find out the results because the number of students in each school is very large and one has to select one by one to find out who the exemplary students are. at the school (Ardi Kusuma, Amatillah Nasution et al., 2018).

Sultan Agung Private Senior High School is a school located in Kasiyan Timur Village, Puger District, Jember Regency. Sultan Agung Private Senior High School which is one of the favorite schools located in Puger District. With the help of teaching staff and equipped with optimal facilities and infrastructure in teaching and learning activities, students have extraordinary achievements. Therefore we need a process of selecting outstanding students from these students. The selection of exemplary students at Sultan Agung Private High School is currently still being done manually to determine students who are entitled to get the exemplary student title, even though the assessment criteria and range of assessment scores have been determined, this method is less effective in conducting objectivity assessments because the assessment of exemplary students still depends on the assessment of each member of the teacher or homeroom teache (Fathoni et al., 2021). To overcome these challenges, the use of Decision Support Systems (SPK) is an effective solution. SPK is a system that utilizes certain data and analysis methods to assist decision making. In the context of selecting model students, the SAW (Simple Additive Weighting) method has been proven to be an efficient and accurate approach (Ridhawati et al., 2018).

The SAW method is one of the methods used in DSS which functions to select the best alternative from a set of alternatives based on an assessment of several criteria (Sembiring et al., 2020). In this case, the criteria can be academic achievement, participation in extracurricular activities, leadership, attitudes, and moral values. Each criterion will be weighted according to its level of importance in selecting exemplary students. In the SAW method, each criterion will be given a score based on the level of student achievement. The score will then be multiplied by the weight of the predetermined criteria. The results of the multiplication will be added up for each student, and the

student with the highest score will be selected as a model student (Fatmasari, 2020). The advantage of using the SAW method in the SPK of model student selection is its objectivity and ease of use. This method uses a mathematical approach that can reduce subjectivity bias in the selection. In addition, with a computerized system to implement the SAW method, the process of selecting model students can be done quickly and efficiently. (Topadang & Tulili, 2018)

In the selection process, several criteria were determined. These criteria are determined by each school. In this selection, there are three criteria used in assessing exemplary students, namely: grades, attitudes, and attendance. It is hoped that with the SAW method-based Decision Support System for selecting exemplary students, the process of selecting exemplary students in schools can be carried out efficiently, accurately, and objectively. This system can be a useful tool for decision makers at Sultan Agung Private High School to select the most appropriate model students based on predetermined criteria..

2. RESEARCH METHOD

The stages of the information system development framework for Model Student Selection Decision Support Systems are as follows (Wahid, 2020):

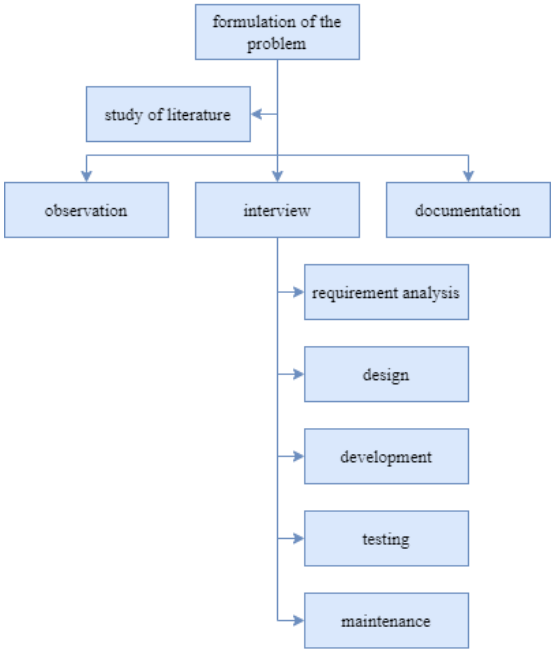

Figure 1. Research Stages

The stages that must be planned when conducting research based on Figure 1 are:

1. Formulation of problem
   How to build a system that provides support in selecting model students based on predetermined criteria and can be operated objectively and efficiently.
2. Study of literature
   Literature study is carried out by looking for what theories will be used to solve the problems to be studied, as well as obtaining strong reference bases for researchers to design and build a decision support system for selecting exemplary students.
3. Observation
   Collecting data the author conducted direct research at the Sultan Agung Private High School to make observations about the system used in selecting exemplary students. In order to obtain information that supports the development of a decision support system for the selection of these exemplary students.
4. Interview
   A collection of data by communicating with related parties to obtain the information sought. Interviewing the teachers of the Sultan Agung Private High School directly for reference material for making a decision support system.
5. Documentation
   In collecting data for a decision support system for selecting exemplary students using the SAW method, there are several stages of documentation that need to be documented, including: criteria, weights of criteria, student scores, and student data.
6. Requirement analysis
   The initial stage in building a decision support system. In this stage, the main goal is to identify user needs and determine the system requirements to be developed.
7. Design

The design stage in building a decision support system involves making a detailed design of how the system will operate and interact with users, including: system architecture, interface design, databases, algorithms and methods.

8. Development
   The development stage in building a decision support system (coding) involves implementing the system design into a functioning form.
9. Testing
   The testing phase in building a decision support system is very important to ensure that the system functions properly and meets the predetermined requirements, both in system testing and in the methods used..
10. Maintenance
    The maintenance stage in building a decision support system is important to ensure the system continues to function properly and meet user needs, both in monitoring and measuring performance or repairing system problems.

In this chapter, testing of decision support systems uses the Simple Additive Weighting (SAW) method, starting from analyzing the problem to the weighting criteria (Sopian & Ermatita, 2021):

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 the criteria (Cj), then normalize the matrix based on the equation adjusted for the type of attribute (benefit 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:

$$r_{ij} = \begin{cases} \dfrac{x_{ij}}{\max x_{ij}} & jika\ j\ adalah\ atribut\ keuntungan\ (benefit) \\ \dfrac{\min x_{ij}}{x_{ij}} & jika\ j\ adalah\ atribut\ biaya\ (cost) \end{cases} \quad (1)$$

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

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

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. RESULT AND DISSCUSION

The following is a description of the results of the study containing the results of the promotion decision analysis using the Simple Additive Weight (SAW) method.

3.1 Analysis of Input and Output Needs

The input requirement consists of determining the criteria for prospective scholarship recipients which is the first step in the SAW method, as follows:

1. Determination of Criteria (Ci)

Table 1. Criteria (Ci)

Criteria	Keterangan	Type
C1	Average value of report cards	Benefit
C2	Attitude/Akhlaq	Benefit
C3	Absence	Cost

Source: data collection

2. Preference Value

Table 2. Preference Value

Weight	Benefit Preference Value	Cost Preference Value
1	Very less	Very Good
2	Less	Good
3	Enough	Enough
4	Good	Less
5	Very Good	Very Less

Source: processing data

3. Determination of Preference Weight Based on Report Card Value Criteria

Table 3. Criteria Weight Based On The Average Value Of Report Cards

Rata-Rata Raport	Wight	Benefit Preference Value
0 < C1 <= 60	1	Very Less
61 < C1 <= 70	2	Less
71 < C1 <= 80	3	Enough
81 < C1 <= 90	4	Good
91 < C1 <= 100	5	Very Good

Source: processing data

4. Determination of Preference Weight Based on Attitude Value Criteria

Table 4. Criteria Weight Based on the Average Value of Attitudes

Average Attitude	Weight	Benefit Preference Value
0 < C2 <= 60	1	Very Less
61 < C2 <= 70	2	Less
71 < C2 <= 80	3	Enough
81 < C2 <= 90	4	Good
91 < C2 <= 100	5	Very Good

Source: processing data

5. Determination of Preference Weight Based on Attendance Value Criteria

Table 4. Bobot Kriteria Berdasarkan Rerata Nilai Absensi

Rata-Rata Raport	Weight	Cost Preference Value
0	5	Very Good
1 < C3 <= 3	4	Good
4 < C3 <= 6	3	Enough
7 < C3 <= 10	2	Less
C3 <= 11	1	Very Less

Source: processing data

The resulting output is in the form of an alternative sequence (prospective model students) starting from the highest to the lowest. The final result is the value of each criterion that has a different preference weight.

3.2 Analysis Case with the SAW Method

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 A.
2. Determine alternative suitability ratings
3. Examples of cases of suitability ratings from each alternative for each criterion of prospective scholarship recipients are as follows:
   a. Alternative student 1 (Andri): average report card score is 85, attitude score is 88, and attendance is 1.
   b. Alternative 2nd student (Budi): average report card score is 93, attitude score is 90, and attendance is 0.
   c. Alternative student 3 (Dedi): average report card score is 85, attitude score is 91, and attendance is 4.

From these data it can be mapped that the value of each alternative for each criterion is as follows:**Tabel 5. Rating Alternative Match**

Alternative	Criteria		
	C1	C2	C3
Andri	4	4	2
Budi	5	4	1
Dedi	4	5	3

Source: processing data

From this value, the decision maker then gives the preference weight as follows: W = (5, 3, 2).

1. Criteria Based Decision Matrix

The decision matrix based on these criteria, namely:

$$X = \begin{bmatrix} 4 & 4 & 2 \\ 5 & 4 & 1 \\ 4 & 5 & 3 \end{bmatrix}$$

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

$$r11 = \frac{4}{\max(4;5;4)} = \frac{4}{5} = 0{,}8$$

$$r21 = \frac{5}{\max(4;5;4)} = \frac{5}{5} = 1$$

$$r31 = \frac{4}{\max(4;5;4)} = \frac{4}{5} = 0{,}8$$

$$r12 = \frac{4}{\max(4;4;5)} = \frac{4}{5} = 0{,}8$$

$$r22 = \frac{4}{\max(4;4;5)} = \frac{4}{5} = 0{,}8$$

$$r32 = \frac{5}{\max(4;4;5)} = \frac{5}{5} = 1$$

$$r13 = \frac{\min(2;1;3)}{2} = \frac{1}{2} = 0{,}5$$

$$r23 = \frac{\min(2;1;3)}{1} = \frac{1}{1} = 1$$

$$r33 = \frac{\min(2;1;3)}{3} = \frac{1}{3} = 0{,}3$$

4. Normalized Matrix Total Value The normalized matrix can be seen as below

$$R = \begin{bmatrix} 0{,}8 & 0{,}8 & 0{,}5 \\ 1 & 0{,}8 & 1 \\ 0{,}8 & 1 & 0{,}3 \end{bmatrix}$$

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. Prospective recipient 1 (Andri) = (5)*(0,8) + (3)*(0,8) + (2)*(0,5) = 7,4
2. Prospective recipient 2 (Budi) = (5)*(1) + (3)*(0,8) + (2)*(1) = 9,4
3. Prospective recipient 3 (Dedi) = (5)*(0,8) + (3)*(1) + (2)*(0,3) = 7,6

From these data the result will be that student 2 (Budi) has the highest score of the other 2 students so that prospective recipient 2 (Budi) is more entitled to get a scholarship.

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 2.

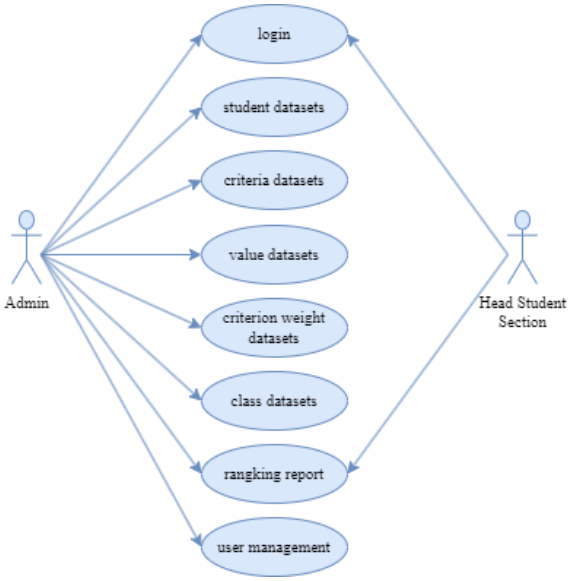

Figure 2. Use Case Diagram

The general description of the system that runs on the decision support system application for selecting model students 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 the two access rights that can be operated by system users. First, the admin section that can log in to the system serves as input student datasets, input criteria datasets, input value students

datasets, criterion weight datasets, class datasets, ranking datasets, and user management. Second, the student division has access rights to log in and view ranking results.

3.4 System Implementation

After all the steps of planning, analysis, system design, method calculations, and application coding, then the system can be fully implemented within the Sultan Agung Private High School environment. The results of the research from making a decision support system application for selecting exemplary students at the Sultan Agung Private Senior High School are as follows:

1. Main Menu

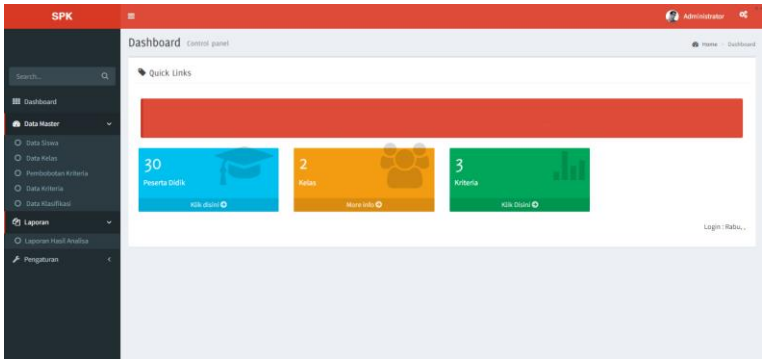

Figure 3. Main Menu

The dashboard/main menu page is the first page that is displayed after the admin logs in. This page displays 3 data, namely student data, class data, and criteria data. On each page in the top right corner there is the name of the account that is logged in and a button to log out.

2. Student Data Menu

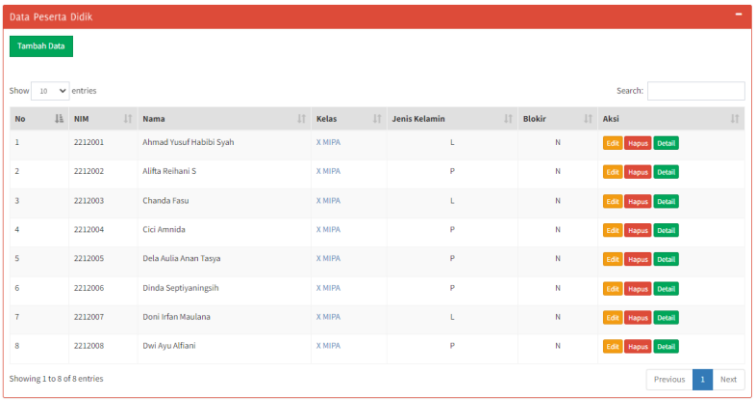

Figure 4. Student Data Menu

The student data menu page displays all student data that has been added by the admin by displaying key information such as NISN, Full Name, Class, and Gender. In each data there are edit, detail and delete options.

3. Class Data Menu

Figure 5. Class Data Menu

The class data menu page displays classes added from class X-XII. The data that appears is the class and the number of students in each class. For each data, there are options to edit, delete, and view students to see a list of students in that class.

4. Criteria Weighting Data Menu

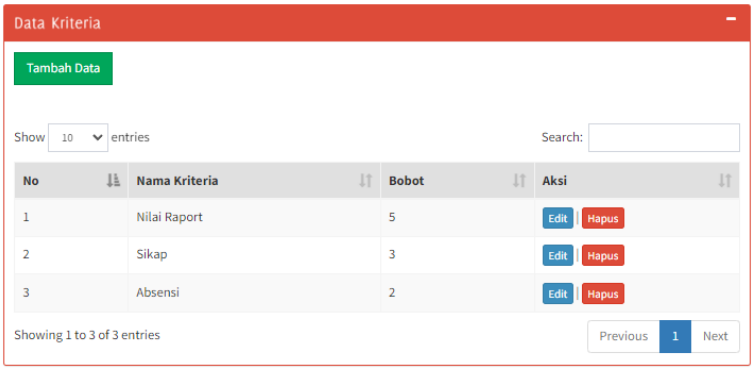

Figure 6. Criteria Data Menu

The criteria weighting data menu page displays all the criteria weighting data that has been added along with the desired weight. Each data displays edit and delete buttons.

5. Criteria Weight Preference Value Menu

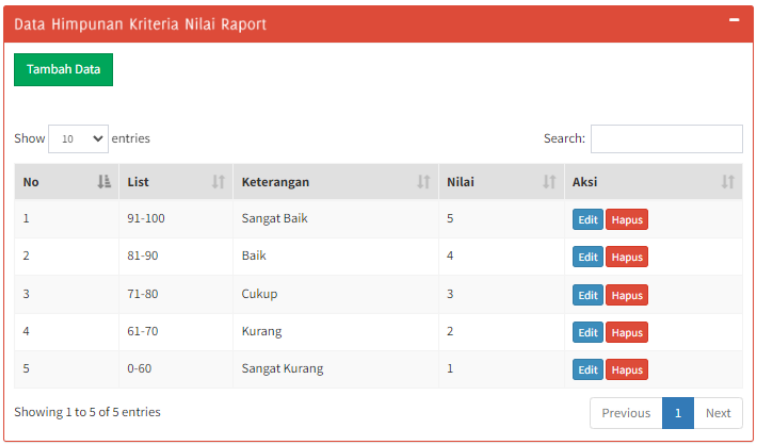

Figure 7. Criteria Weight Preference Value Menu

The criteria weight preference value menu page displays all the criteria weight preference value data that has been added along with the desired weight. Each data displays edit and delete buttons.

6. Student Value Input Menu

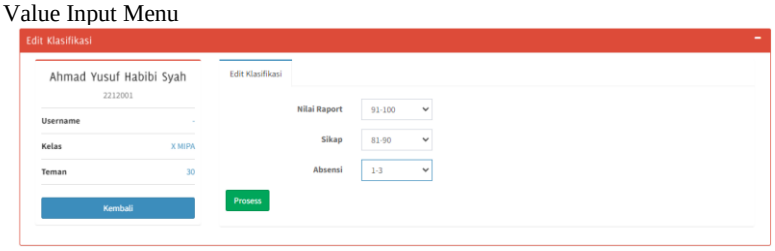

Figure 8. Student Value Input Menu

The student value input menu page displays all input value data based on criteria. Each data displays the calculation process button and the return button.

7. Ranking Page

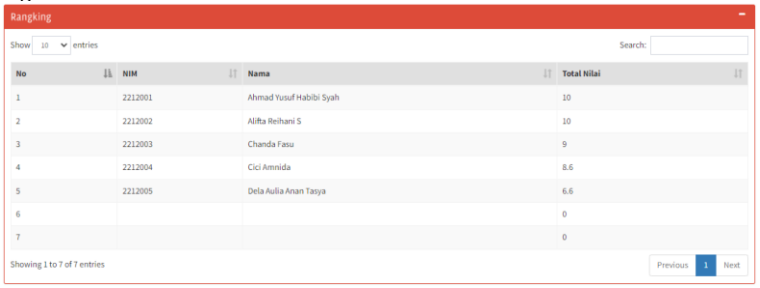

Figure 9. Ranking Page

The ranking page displays the results of the previous process on the value input process page. Displays all students who were previously processed in each column of initial, normalized, and ranking matrix data. The ranking column displays the final results from the process of determining outstanding students which can then be printed.

4. CONCLUTION

Based on the results of this study, the researcher can draw several conclusions, including the following:

1. The information system for determining model students can be used as a tool in Sultan Agung Private High School schools in determining model students who are right on target because the determination of model students is carried out by an objective computer-based system.
2. With the information system for determining exemplary students, the school can more easily choose the criteria that are used as a reference for assessing outstanding students, so that the assessment for determining outstanding students is not just one aspect.
3. In an effort to facilitate access in management, it is recommended that this information system for determining exemplary students be hosted on the school domain.

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