Determination of Candidates for Madrasah Aliyah Student Scholarships Using The Simple Additive Weighting Method

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Abstract − Scholarships are a facility expected by some students who need financial assistance in their education. Case study research at MAN 3 Tangerang as a state Islamic senior high school, MAN 3 Tangerang has facilities to propose students who have achievements and need educational funding assistance to the Indonesian Ministry of Religion (Kemenag). Schools often find it difficult to determine which prospective students are most eligible for scholarships. This research is to help the school design and develop a decision support system (DSS) application with the Simple Additive Weighting (SAW) method. DSS application built using UML design and PHP (Hypertext Processor File) programming with MySQL database. The resulting DSS application has been able to provide a sequence of data for prospective scholarship recipients according to the criteria and weightings that have been set. Based on the data generated by the system, the principal can make a decision on who is entitled to a scholarship from the Ministry of Religion (Kemenag).

Keywords – DSS, Scholarship, Student, Islamic Senior High School, SAW

I.   INTRODUCTION

Getting a good education is one of the most basic human rights as stated in the 1945 Constitution. By getting a good education, will make a person get a better life. Scholarships are the provision of financial assistance to high-achieving and underprivileged students from a government or private institution. Scholarships aim to help students take their education to completion [1], [2].

In every educational institution, especially senior high school, there are a lot of scholarships offered to high-achieving and disadvantaged students[3]. There are scholarships that come from government and private institutions. To get the scholarship, students must go through a selection phase in accordance with the established rules. Likewise, in MAN 3 Tangerang school, where currently there is a scholarship program that has been distributed by the Ministry of Religion to students according to established criteria, this is one of the jobs of the school administration system. The administration system is one of the activities that must be present in the activities of an organization [4] [5].

In this study, researchers conducted the process of designing and developing DSS applications. A decision support system is a computer-based system, consisting of three interacting components, a language system, a knowledge system, and one or more problem processing systems with general problem manipulation capabilities needed for decision-making [6], [7]. Decision making is the act of choosing among various alternative solutions to problem solving [8]. Decisions are defined as choices and it is often necessary to make many decisions in the process of solving one problem .

Based on the background above, it can be identified several issues related to the decision making process of submitting prospective scholarship recipients in MAN 3 Tangerang.

Problems are as follows:

1. What methods are used to help make a decision to determine the Submission of Prospective Student Scholarship Recipients at MAN 3 Tangerang?
2. Are there any difficulties in entering and processing data on the submission of prospective scholarship recipients in MAN 3 Tangerang?
3. What are the difficulties faced by schools in determining who are the scholarship recipients in MAN 3 Tangerang?

In the research conducted by the author, the author limits the problem to the design and development of decision support systems (DSS) with the criteria used in which these criteria are criteria that have been applied in MAN 3 Tangerang with a predetermined weighting, and using the Simple Additive Weighting (SAW) method. DSS SAW method is suitable to be applied to solve selection problems with many criteria and alternatives [9], [10].

This research uses the waterfall model, which illustrates a systematic and sequential approach to software development, starting with the specification of user needs and then continuing through the stages of planning, modeling, construction, as well as the delivery of the system to the customer/user (deployment), which ends with support for the complete software produced [11], [12].

The application developed also displays graphics as a dashboard that can be used as a tool to analyze the results of the process. Analysis of the results is needed by top management of each organization to visualize, analyze and prepare for strategic planning in the future [13], [14].

II.   RESEARCH METHODOLOGY

This research applies a mixed research method (quantitative & qualitative), where data gathering will be carried out by conducting surveys and interviews using a list of questions and direct interviews with related parties. The research method above is a mixed research method, which is a research method that combines quantitative methods and qualitative methods [15], [16].

The researcher uses the SDLC (Software Development Life Cycle) cycle which is a systematic and sequential approach method starting at the level of system analysis to be developed and then moving on to the system design, system implementation, testing, and maintenance stages. Figure 1 shows the stages of research carried out in this study.
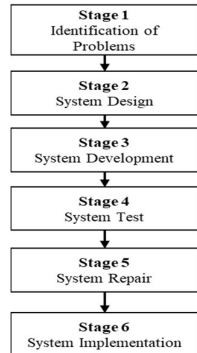

Figure 1. Research stages

2.1. Identification of Problem

At this stage the researchers communicated with the resource persons, namely the staff of MAN 3 Tangerang who took care of the selection process and student scholarship applications. From the results of the staff discussion, it was difficult to determine which students were most entitled to receive scholarships because there was no method of calculating points based on the criteria for scholarship candidates who were most entitled to receive scholarships.

At the problem identification stage, the researcher collected data with two methods:

A. Sample Selection Method

The selection of sample respondents is based on consideration of the criteria for the respondent in accordance with the duties and responsibilities involved in assisting the selection process of prospective scholarship recipients. The respondents referred to above are: School principal, Administrative leader and Counseling teacher.

B. Data Collection Method

Data collection methods used in this study are:

1. Interview Method.
    Researchers have interviewed all respondents to ascertain all problems and problems in the process of determining the scholarship recipients.

2. Survey Method.
    Researchers have prepared a list of questions related to the process of determining the scholarship recipient candidates then the authors distribute the list of questions to be filled and analyzed.

3. Observation Method.
    Researchers also conduct direct observation of the object of research in order to collect data to strengthen data collection activities that have been done previously through interviews and surveys.

4. Literature Study Methods.
    Researchers collect data by studying, researching, and reading books, journals, theses, and theses related to the DSS Build designation for determining scholarship recipient submissions.

2.2. System Design

At this stage, the application design modeling will be developed using the Unified Modeling Language (UML). The design of the use case of the information media application for the Informatics Engineering study program at the Muhammadiyah University of Tangerang which was developed. UML is used because it can provide a general vocabulary of object-based terms and a large number of diagramming techniques for the purposes of modeling any information system development and design project [17], [18].

A. Use Case Diagram

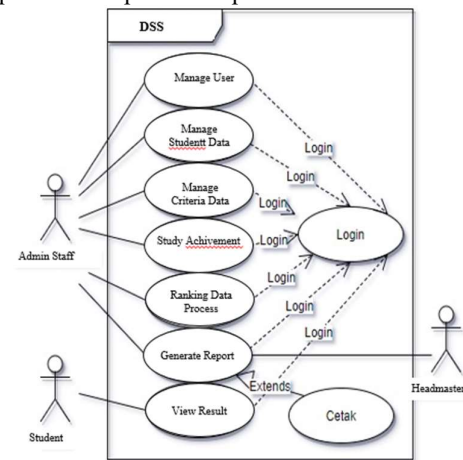Use cases are narratively used to textually describe the sequence of steps of each process.

Figure 2. Use case diagram

B. Class Diagram

Class diagram describes the structure of the system in terms of defining the classes that will be created to build the system. Classes have what are called attributes and methods or operations.
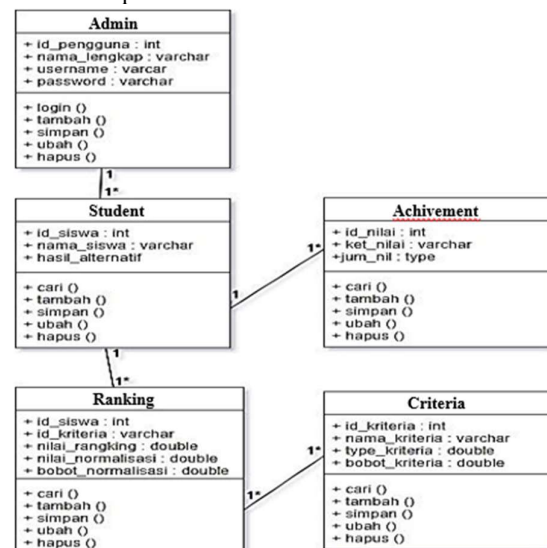

Figure 3. Class diagram

2.3. System Development

The next process researchers develop a system using the programming language PHP framework laravel. After the application has been developed, the researcher tests the system using black box testing. The DSS development process uses the SAW method with the following steps:

a. Determine Alternatives (Ai).
b. Determine the criteria that will be used as a reference in decision making (Cj).
c. Determine the weight of preference or level of importance (W) for each criterion.
d. Determine the Match Value for each criterion.
e. Make a decision matrix (X) obtained from the match rating on each alternative (Ai) with each criterion (Cj).
f. Perform the decision matrix normalization step (X) by calculating the value of the normalized performance rating (rij) of alternatives (Ai) on the criteria (Cj).

$$Rij = \left(\frac{Xij}{Max\ Xij} \right) \quad Rij = \left(\frac{Min\ Xij}{Xij} \right)$$

g. The results of normalization (rij) form a normalized matrix (R).

$$R = \begin{bmatrix} R11 & \cdots & R1j \\ \vdots & \cdots & \vdots \\ Ri1 & \cdots & Rij \end{bmatrix}$$

h. The final result of the preference value (Vi) is obtained from the sum of the multiplications of normalized matrix row elements (R) with preference weights (W) corresponding to the matrix column elements (W).

$$Vi = \sum_{j=1}^{n} Wj\ Rij$$

Vi   = Final value of the alternative
Wj   = Weight that has been determined
Rij   = Normalization matrix
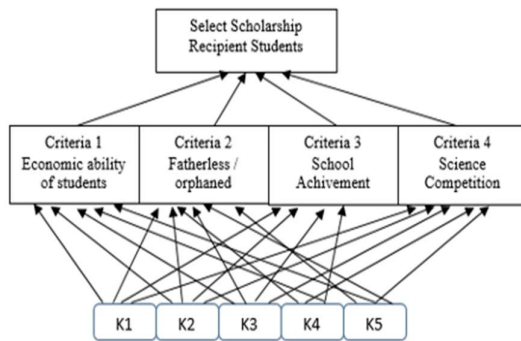A greater value of Vi indicates that alternative Ai more elected.

Figure 4. Alternative Hierarchical Structure of SAW

2.4. System Test

System testing uses the black box testing method where testing is based on application details, including the appearance of the application, the functions contained in the application, and the suitability of the function flow as required by the user.

2.5. System Repair

This stage is the stage of improving modules and functions that are deemed unable to meet user needs based on trials that have been carried out at the system testing stage.

2.6. System Implementation

The last stage carried out is the system submission stage, after the application has been developed and tested, the researcher provides training on the use of information systems.

III. RESULTS AND DISCUSSION

1. The following are the criteria needed to determine scholarship recipients at MAN 3 Tangerang:

Table 1. Economic Ability of Students

Criteria	Range	Scale	value
Economic ability of students	poverty level 60% (extremely poor)	1	0.2
	poverty level 70% (poor)	2	0.3
	poverty level 80% (not poor)	3	0.4
	poverty level 90% (rich)	4	0.5
	poverty level 90% (very rich)	5	0.6

2.
Table 2. Fatherless / Orphaned

Criteria	Range	Scale	value
Fatherless or orphaned	child who lost his/her father 80%	1	0.4
	child who lost his/her mother 90%	2	0.5
	child who lost his/her father and mother 100%	3	0.6

Table 3. School Achievement

Criteria	Range	Scale	Value
School Achievement	5th place in school 60%	1	0.2
	4th place in school 70%	2	0.3
	3th place in school 80%	3	0.4
	2nd place in school 90%	4	0.5
	1st place in school 100%	5	0.6

Table 4. Science Competition

Criteria	Range	Scale	Value
Science Competition	Do not have 60%	1	0.2
	Have sub-district level achievements 70%	2	0.3
	Have city-level achievements 80%	3	0.4
	Have province level achievements 90%	4	0.5
	Have national level achievements 100%	5	0.6

2. The following is an example of calculating 10 students data:

Tabel 5. Student Grades for Each Criterion

No	Student Name	Criteria			
		I	II	III	IV
1	Siti Komala	90	100	100	70
2	Mulyanah F	80	100	100	70
3	Azmi I.R	80	90	90	60
4	Arif R	80	80	80	80
5	Hermawan	70	90	100	60
6	Debi P.S	80	80	90	60
7	Ratu D	80	80	80	80
8	Almas R	70	90	100	60
9	Diah Nur	80	80	90	60
10	Dwi Puspa	70	90	100	60

Tabel 6. Match Rating

No	Student Name	Criteria			
		I	II	III	IV
1	Siti Komala	0.5	0.6	0.6	0.3
2	Mulyanah F	0.4	0.6	0.6	0.3
3	Azmi I.R	0.4	0.5	0.5	0.2
4	Arif R	0.4	0.4	0.4	0.4
5	Hermawan	0.3	0.5	0.6	0.2
6	Debi P.S	0.4	0.4	0.5	0.2
7	Ratu D	0.4	0.4	0.4	0.4
8	Almas R	0.3	0.5	0.6	0.2
9	Diah Nur	0.4	0.4	0.5	0.2
10	Dwi Puspa	0.3	0.5	0.6	0.2

3. Based on the match table above then the researcher makes the matrix into **the decision matrix as the matrix below:**

$$
X = \begin{bmatrix}
0.5 & 0.6 & 0.6 & 0.3 \\
0.4 & 0.6 & 0.6 & 0.3 \\
0.4 & 0.5 & 0.5 & 0.2 \\
0.4 & 0.4 & 0.4 & 0.4 \\
0.3 & 0.5 & 0.6 & 0.2 \\
0.4 & 0.4 & 0.5 & 0.2 \\
0.4 & 0.4 & 0.4 & 0.4 \\
0.3 & 0.5 & 0.6 & 0.2 \\
0.4 & 0.4 & 0.5 & 0.2 \\
0.3 & 0.5 & 0.6 & 0.2
\end{bmatrix}
$$

4. The results of the calculation of the value of Vi of each student who will get the submission of prospective scholarship recipients can then be made **a table determining the ranking of results as follows:**

Table 7. The Final Ranking

No	Student Name	Value	Ranking
1	**Siti Komala**	**96.25**	**1**
2	Mulyanah F	90.2500	2
3	Azmi I.R	77.3333	3
4	Arif R	75.6667	4
5	Ratu D	75.6667	5
6	Almas R	75.5000	6
7	Dwi Puspa	75.5000	7
8	Hermawan	75.5000	8
9	Debi P.S	72.3333	9
10	Diah Nur	72.3333	10

5. The following is the DSS Submission Determination of Prospective Scholarship Recipients for Islamic Senior High School Students application layout:
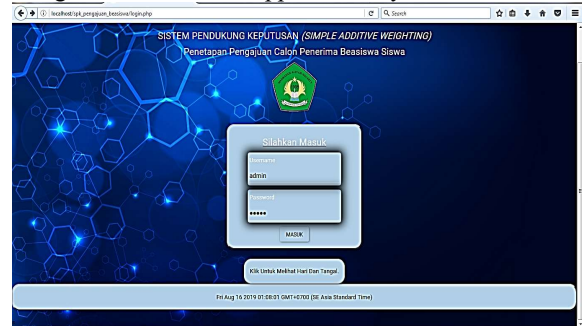

Figure 4. Login Menu

Figure 4. is the login menu, the menu that will appear for the first time when the user uses the application being developed. The user must enter the username and password data that was previously registered by the system administrator
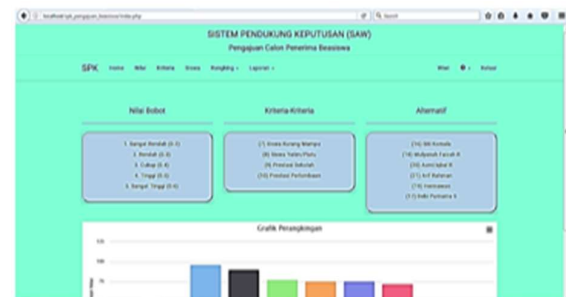

Figure 5. Main Menu

After the user can log in to the application, an initial menu will appear in the form of a dss application dashboard which was developed as shown in figure 5.
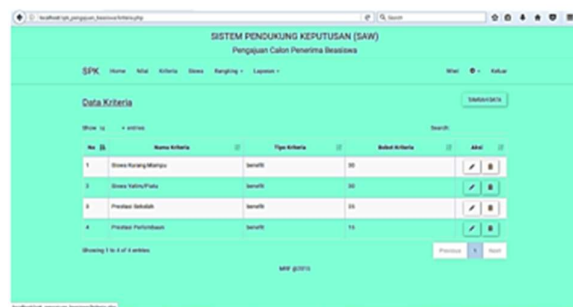

Figure 6. Criteria Menu

Users can enter criteria data that will be used as a reference in the calculation process in the DSS application developed as shown in figure 6

Figure 7. Student Menu

Furthermore, the user can enter the names of students who are proposed to receive scholarships as shown in figure 7

Figure 8. Ranking Process

Then the user clicks the process button, and the system will perform calculations according to the criteria and input data entered by the user. then the system will display a list of prospective scholarship recipients based on the highest order as shown in figure 8.

Figure 9. Reporting

Users can display reporting produced by DSS applications developed as in figure 9 and users can also print these reports using a printer.

IV. CONCLUSION

DSS design research of determining the submission of prospective scholarship recipients for MAN students to the Ministry of Religion using the SAW method, it can be concluded as follows:

1. The DSS application made using the SAW method can help authorized officials at MAN 3 Tangerang in compiling a list of stipulations for proposing scholarship recipients from the Ministry of Religion.
2. With the application of the DSS with the determination of criteria and alternatives, the prospective scholarship recipient data is produced quickly, precisely and accurately, which is expected to make the process of determining scholarship candidates transparent and accountable.
3. The more alternatives (submission of prospective scholarship recipients) and the use of more specific criteria, the system will produce more accurate and accurate selection results

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