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Implementation of SAW Method in Web-based Scholarship Acceptance Recommendation Application: Case Study on "PPTQ Nurul Qur'an"

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15 ABSTRACT

The rapid advancement of information technology has changed the lifestyle of some people in carrying out their activities. One of them is processing scholarship information systems. Scholarship is an award for someone as a form of effort to support them in pursuing further education. However, the determination of scholarship acceptance is currently still done manually from the selection to the determination of the selection of scholarship recipient students. With this manual implementation, of course, it takes a long time and the possibility of data loss/damage and calculation errors. In order to support boarding school administrators in selecting scholarship recipient students, a recommendation system has been developed. The purpose of this application system is to be designed as a benchmark for accepting prospective scholarship recipients. The Simple Additive Weighting (SAW) method is used in this scholarship recommendation system to evaluate prospective scholarship recipients. In developing the scholarship selection recommendation system, the PHP programming language is used. The application database development is done by utilizing MySQL as well as the PHPMyAdmin interface that runs locally on Localhost

General Terms

Simple Additive Weighting Method.

Keywords

Scholarship, MySQL, PHP, SPK, Simple Additive Weighting.

1. INTRODUCTION

The progress of information technology is increasingly rapid and has changed the lifestyle of some people in carrying out their activities. One of them is in the field of education, namely the e-learning system or distance education system, online library and scholarship information system processing. The higher the quality of education in a country, the higher the quality of education received by the next generation of the country. [1], [2].

A scholarship is an award or recognition given to an individual to encourage them to continue their education at a higher level. These awards may include access to certain educational institutions or financial assistance. Scholarships themselves can be awarded through institutions such as government agencies, foundations or companies. Scholarships can take the form of money given directly to individuals, so that their education can continue. Scholarships can be in the form of service bonds or free of charge that can be categorized after completion of education [3], [4].

Scholarships are not only available for outstanding students but also for people with economic limitations who meet the terms and conditions. According to Law No. 20/2003 on the National

Education System, Chapter V Article 12 (1.c) every learner in every education unit is entitled to a scholarship for those who excel whose parents are unable to finance their education. And in article 12 (1.d) states that every learner in each education unit is entitled to receive education costs for those whose parents are unable to finance their education [5].

However, the determination of scholarship acceptance is currently still done manually while others have moved to computerized technology. The process of determining scholarship acceptance is still using manual techniques from selection to determination of selection and receipt of scholarships. With this manual implementation, of course, it has several obstacles, including the selection that takes a long time and the possibility of loss or damage to data and calculation errors, so the need for a decision support system is a system where a computer-based information system that is interactive, customizable, and flexible so that management problems that are not specific and structured can be resolved.

Decision Support Systems (DSS) also utilize data and provide user-friendly user interfaces, and can integrate different components in the decision-making process. This system is a decision support application designed to simplify and facilitate the decision-making process [6], [7], [8].

In order to support boarding school administrators in the process of selecting scholarship recipient students, a recommendation system has been developed. This system aims to facilitate the selection of prospective scholarship recipients. The application of the Simple Additive Weighting (SAW) method in making this decision support system application was chosen because this method involves weighted summation to assess alternative performance and provide rankings according to the weight of the criteria applied [9], [10].

The basic principle of the Simple Additive Weight (SAW) method is to calculate the total weight of the performance assessment of each alternative on all attributes. In the SAW method there are terms in its use, namely: 1) Criteria, these criteria are used as benchmarks for assessment. Criteria can be divided into 2 categories, namely cost and benefit, Cost and benefit are opposite or contradictory, namely the smaller the cost the better, while for benefits the greater the better, 2) Alternatives are lists or objects that will be given an assessment, 3) Attributes are the values of the criteria on existing alternatives, 4) Data crips a grouping of attribute values on the data used [11]. The Simple Additive Weighting (SAW) method can be implemented in a scholarship recommendation system to evaluate prospective scholarship recipients because it provides the best alternative value from the weight of the criteria for prospective scholarship recipients.

2. LITERATURE OVERVIEW

2.1 Data Collection Procedure

The data source used in this research uses primary data. Primary data is information obtained directly by researchers from data sources. In this data collection process, researchers obtain information directly from the first source or location where the object of research is taking place.

2.1.1 Observation

This observation was conducted at Pondok Pesantren Tahfidzul Qur'an Muhammadiyah Nurul Qur'an Magelang which is located in Piyungan Tengah, Tirtosari, Sawangan Sub-district, Magelang Regency, Central Java.

2.1.2 Interview

This interview was conducted at Pondok Pesantren Tahfidzul Qur'an Muhammadiyah Nurul Qur'an with the authorized party, namely the principal. The results of the interview obtained in the form of data needed to make the scholarship acceptance recommendation application and the main problems that exist.

2.1.3 Literature Study

In the form of collecting data and information through relevant research in the form of journal references, and other sources. So that the appropriate information is obtained.

2.2 SPK Application Design Method

This application is made by implementing the Simple Additive Weighting (SAW) method. In transforming this application by using modeling from the application of the Simple Additive Weighting method. In Figure 1 are the steps in applying the Simple Additive Weighting method.

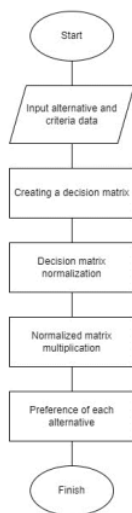


Figure 1 Steps of the Simple Additive Weighting method

In Figure 1. Is an explanation of several stages carried out in the Simple Additive Weighting method process, namely:

1. Define alternatives and criteria first
2. Entering data from each criterion into each alternative
3. Each criterion is given a weight according to what has been previously determined

4. After that, determine whether the criterion value is a benefit attribute or a cost attribute.
5. Then, normalization can be done by following the formula contained in the Simple Additive Weighting method using equation (1)

$$r_{ij} = \begin{cases} \frac{x_{ij}}{\max x_{ij}} \\ \frac{\min x_{ij}}{x_{ij}} \end{cases} \quad (1)$$

6. To determine the preference value, ranking of normalized data is carried out. By using formula (2) to find the preference value for each given alternative:

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

2.3 SPK Application Method

In the development of the system used to build the application using the waterfall method. The waterfall method is a system whose work process is carried out linearly or sequentially.

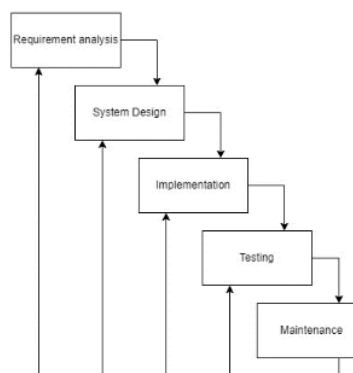


Figure 2 Waterfall Method

As shown in Figure 2. waterfall method, namely: 1) needs analysis, namely by identifying problems and collecting data, 2) system design, namely the process of designing or making the design of a system to be created, 3) implementation is the process of making applications by changing the design that has been made into a form of program code, 4) testing is the next stage by testing the results of the implementation to determine its functionality, 5) maintenance is the last stage in a waterfall method which is carried out by maintaining the system to develop applications made [12], [13]. However, in this research, the waterfall used only reaches the testing stage.

3. RESULT AND DISCUSSION

Criteria are the basis for determining or assessing a decision. In recommending the results of this scholarship ranking, several criteria are needed which will be used as a reference in the determination process.

3.1 Criteria for SPK Modeling

In the process of providing scholarship recommendations, the criteria used are using 5 types of criteria, which are adjusted to the provisions contained in the Muhammadiyah Nurul Qur'an Islamic Boarding School. The 5 criteria include, among others, namely: (C1) parental dependents, (C2) report card, (C3) written test, (C4) memorization test, (C5) parents' income. Each criterion will later be weighted. In the weighting criteria there are two references, namely benefit and cost. The benefit is a value that if the value is higher, the better, while the cost is a value where the value is lower, it will produce a good value

[14]. For the weighting value will be used with a scale of 0 to 1. As in the table below.

Table 1 Criteria Value Weighting

Criteria	Descripsi	Description	Weight
C1	Dependents	Benefit	0.3
C2	Report Card	Benefit	0.3
C3	Written test	Benefit	0.15
C4	Memorization test	Benefit	0.15
C5	Parents' income	Cost	0.1

3.2 Alternatives to SPK Modeling

An alternative is a choice that will later be recommended as a decision result. Based on this case, the alternatives used are data from Pondok Pesantren Tahfidzul Qur'an Muhammadiyah Nurul Qur'an which has been selected as many as 5 people randomly, namely Ahmad Raziq Al-Anshori, Ahmad Khasif Musodiq, Reza Dwi Pamungkas, Muhammad Romi Jatmiko.

3.3 Calculation Process of Simple Additive Weighting Method

In the calculation of SPK with the Simple Additive Weighting method, it can be described as follows:

3.3.1 Determining Alternatives and Criteria

Each alternative gets its value based on criteria. The values obtained are based on data from Pondok Pesantren Tahfidzul Qur'an Muhammadiyah Nurul Qur'an. The criteria for each alternative value can be seen in Table 2.

Table 2 Alternative Value of Criteria

Alternatives	Criteria				
	C1	C2	C3	C4	C5
Ahmad Raziq Al-Anshori	1	87	75	80	5.000.000
Ahmad Khasif Musodiq	4	85	90	60	2.500.000
Reza Dwi Pamungkas	2	86	60	90	5.000.000
Muhammad Romi Jatmiko	2	85	60	60	3.500.000

3.3.2 Calculation of Normalization Matrix (R)

After knowing the value of criteria on each alternative. The next stage is to perform a manual normalization calculation process to get a normalized value matrix (R):

$$R11 = \frac{1}{\max [1; 4; 2; 2]} = \frac{1}{4} = 0,25$$

$$R21 = \frac{4}{\max [1; 4; 2; 2]} = \frac{4}{4} = 1$$

$$R31 = \frac{2}{\max [1; 4; 2; 2]} = \frac{2}{4} = 0,5$$

$$R41 = \frac{2}{\max [1; 4; 2; 2]} = \frac{2}{4} = 0,5$$

$$R12 = \frac{87}{\max [87; 85; 86; 85]} = \frac{87}{87} = 1$$

$$R22 = \frac{85}{\max [87; 85; 86; 85]} = \frac{85}{87} = 0,9770$$

$$R32 = \frac{86}{\max [87; 85; 86; 85]} = \frac{86}{87} = 0,9885$$

$$R42 = \frac{85}{\max [87; 85; 86; 85]} = \frac{85}{87} = 0,9770$$

$$R13 = \frac{75}{\max [75; 90; 60; 60]} = \frac{75}{90} = 0,8333$$

$$R23 = \frac{90}{\max [75; 90; 60; 60]} = \frac{90}{90} = 1$$

$$R33 = \frac{60}{\max [75; 90; 60; 60]} = \frac{60}{90} = 0,6666$$

$$R43 = \frac{60}{\max [75; 90; 60; 60]} = \frac{60}{90} = 0,6666$$

$$R14 = \frac{80}{\max [80; 60; 90; 60]} = \frac{80}{90} = 0,8888$$

$$R24 = \frac{60}{\max [80; 60; 90; 60]} = \frac{60}{90} = 0,6666$$

$$R34 = \frac{90}{\max [80; 60; 90; 60]} = \frac{90}{90} = 1$$

$$R44 = \frac{60}{\max [80; 60; 90; 60]} = \frac{60}{90} = 0,6666$$

$$R15 = \frac{\min [5.000.000; 2.500.000; 5.000.000; 3.500.000]}{2.500.000} = \frac{2.500.000}{2.500.000} = 1$$

$$R25 = \frac{\min [5.000.000; 2.500.000; 5.000.000; 3.500.000]}{5.000.000} = \frac{2.500.000}{5.000.000} = 0,5$$

$$R35 = \frac{\min [5.000.000; 2.500.000; 5.000.000; 3.500.000]}{2.500.000} = \frac{2.500.000}{2.500.000} = 1$$

$$R45 = \frac{\min [5.000.000; 2.500.000; 5.000.000; 3.500.000]}{3.500.000} = \frac{2.500.000}{3.500.000} = 0,7$$

After that, from each of the above calculation results, a normalized matrix (R) is made as follows:

$$R = \begin{bmatrix} 0,25 & 1 & 0,8333 & 0,8888 & 1 \\ 1 & 0,9970 & 1 & 0,6666 & 0,5 \\ 0,5 & 0,9885 & 0,6666 & 1 & 1 \\ 0,5 & 0,9770 & 0,6666 & 0,6666 & 0,7 \end{bmatrix}$$

3.3.3 Calculation of Preference Value

The next stage is the preference value or final value obtained from the sum of the normalized multiplication (R) with the weight of the criteria (W) for each alternative (V), the calculation process for each alternative (V) is as follows:

$$W = \{0,3, 0,3, 0,15, 0,15, 0,1\}$$

$$\begin{aligned} V1 &= (0,25 \cdot 0,3) + (1 \cdot 0,3) + (0,833333 \cdot 0,15) + \\ & (0,888889 \cdot 0,15) + (1 \cdot 0,1) \\ &= 0,075 + 0,3 + 0,12499995 + 0,13333335 + 0,1 \\ &= 0,7333333 \end{aligned}$$

$$\begin{aligned} V2 &= (1 \cdot 0,3) + (0,977011 \cdot 0,3) + (1 \cdot 0,15) + \\ & (0,666667 \cdot 0,15) + (0,5 \cdot 0,1) \\ &= 0,3 + 0,2931033 + 0,15 + 0,10000005 + 0,05 \\ &= 0,893103 \end{aligned}$$

$$\begin{aligned} V4 &= (0,5 \cdot 0,3) + (0,977011 \cdot 0,3) + (0,666667 \cdot 0,15) + \\ & (0,666667 \cdot 0,15) + (0,7 \cdot 0,1) \\ &= 0,15 + 0,2931033 + 0,10000005 + 0,10000005 + 0,07 \\ &= 0,713103 \end{aligned}$$

The preference value that has been obtained for each alternative can be ranked based on the largest value to get a recommendation for scholarship acceptance. The results of the scholarship acceptance ranking value can be seen in Table 3.

Table 3 Scholarship Acceptance Ranking Results

Alternatif	Nilai preferensi	Perangkingan
Ahmad Khasif Musodiq	0,983103	1
Reza Dwi Pamungkas	0,796552	2
Ahmad Raziq Al-Anshori	0,733333	3
Muhammad Romi Jatmiko	0,713103	4

The final result of this alternative ranking found that the alternative with the smallest final value is Muhammad Romi Jatmiko with a preference value of 0,713103 and the largest final value is Ahmad Khasif Musodiq with a final value of 0,983103. Based on the above results, the best scholarship recommendation is Ahmad Khasif Musodiq.

3.4 Implementation of SPK Application

The implementation stage is the testing or application stage of a system that has been analyzed and designed with the actual situation. The implementation stage aims to find out the performance of the system that has been made and find out the advantages and disadvantages of the system [15], [16].

To provide the results of the Muhammadiyah Nurul Qur'an Tahfidzul Qur'an Islamic Boarding School scholarship recommendations in order to get the appropriate results, the next step is to build an SPK application. The purpose of building this SPK application is to speed up and simplify the calculation of the SPK Simple Additive Weighting method and make it easier for cottage administrators to manage and input data on scholarship participants.

In the process of building a scholarship acceptance recommendation application using the Simple Additive Weighting method, which uses computer hardware and software. Application development in related implementations using hardware which can be seen in Table 4.

Table 4 Hardware

No	Hardware
1	RAM 8 GB
2	Hardisk 500 GB
3	Asus VivoBook m431DA
4	Processor AMD Ryzen™ 3
5	Mouse

While the software used, as in Table 5

Table 5 Software

No	Software
1	Operating System Windows 10
2	Visual Studio Code
3	MySQL
4	Xampp
5	Browser (Google Chrome)

next is a flowmap, where the system flow in the scholarship acceptance recommendation application uses the Simple Additive Weighting method.

Flowmap is a mixture of map and flowchart, which in its application shows the movement from one location to another. For programmers, flowmaps are very helpful for analyzing other alternatives in system operation and solving problems into the smallest segments [12], [13].

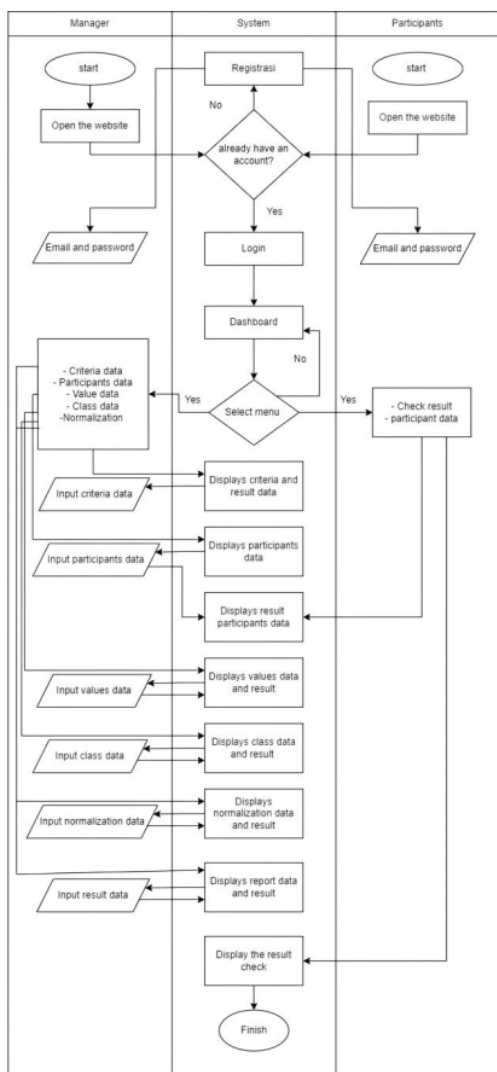


Figure 3 Flowmap

Figure 3 shows that at the beginning, each participant and administrator is given a condition whether they already have an account or not. If you already have an account, you will be redirected to the login page where you will be given or asked for an email and password. However, if you do not have an account, it will be redirected to the registration page menu and then you will be given a registration form. For later it will be used into the login page. both administrators and participants have different views. On the administrator's display there is a menu with administrator data, criteria data, participant data, score data, class data, normalization and reports while for the participant menu it will only be redirected to the results check data which will later display that participants get a pass or not on the scholarship they registered for.

Then the system display on the scholarship acceptance recommendation application using the Simple Additive

Weighting method uses. The user interface system on the implementation consists of

3.4.1 Login Display

The results of the implementation on the login page where the initial page that will be given to all users both participants and administrators when accessing the application. From this login page, participants and administrators will enter their email and password and then be directed to the next page according to their respective levels, as shown in Figure 4.

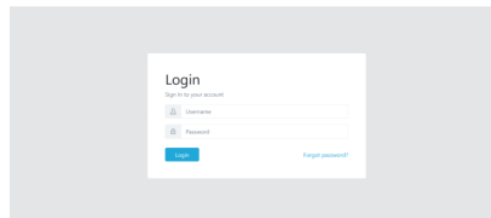


Figure 4 Login Display

3.4.2 Dashboard Display

In Figure 5 displays a page to display the number of classes, the number of participants, the number of administrators and the number of criteria that are on the user



Figure 5 Dashboard Display

3.4.3 Display of Management Data

In Figure 6 displays a page for management data for both members or teachers and admins and displays several users, adding users, changing data or deleting data. In Figure 7 displays a page for adding names, positions, usernames, and passwords to users

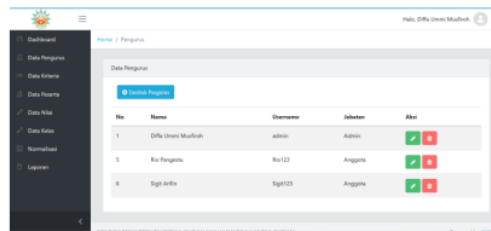


Figure 6 Display of Management Data

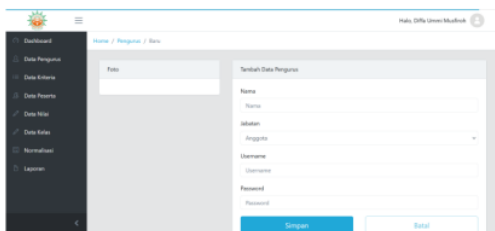


Figure 7 Administrator Data Add Page

3.4.4 Criteria Data Display

Figure 8 serves to display the criteria data page and edit and change the criteria, weights, and information of the benefit or cost type for each criterion.

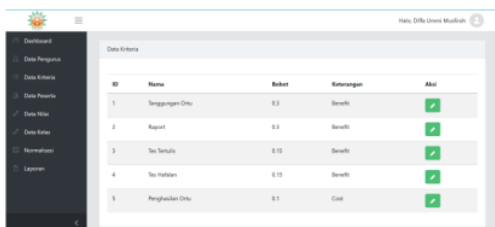


Figure 8 Criteria Data Display

3.4.5 Participant Data Display

Figure 9 shows the participant data page which functions to add, delete, change or edit participant data.

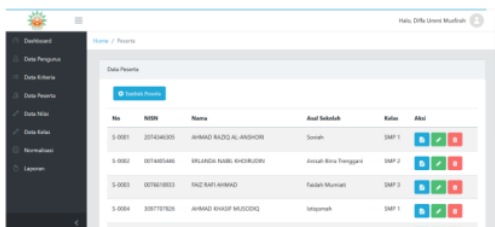


Figure 9 Participant Data Display

3.4.6 Value Data Display

Figure 10 serves to display the value data page and edit or change the value of each participant.

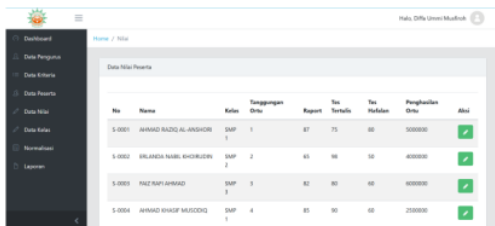


Figure 10 Value Data Display

3.4.7 Class Data Display

Figure 11 serves to display the class data page and add quotas to each class and delete class data.

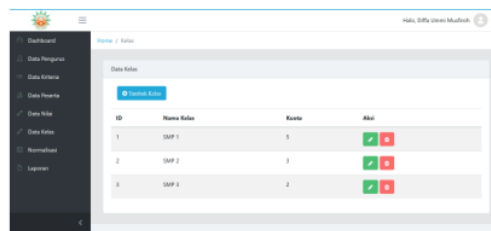


Figure 11 Class Data Display

3.4.8 Normalization Display

The implementation display in Figure 12 is a display of system calculations that can be selected according to the class of participants who will be directly connected and display the results of the alternative value of criteria, normalization value R, and the final results shown in Figure 13.

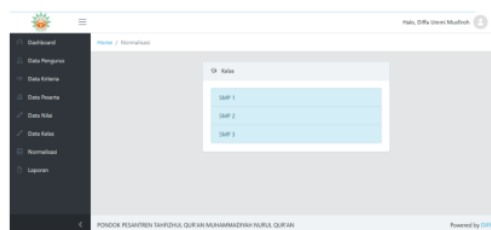


Figure 12 Normalized Class Page

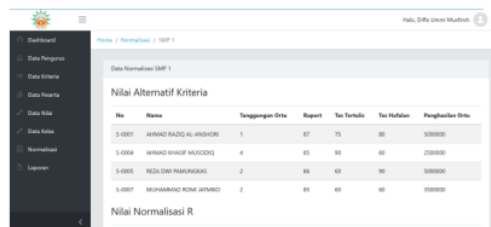


Figure 13 Normalized Class Page

3.4.9 Report View

Figure 14 displays a report page that will be connected to the class of each participant shown in Figure 15 and all classes or all participants shown in Figure 16 and there is a feature to print the report.

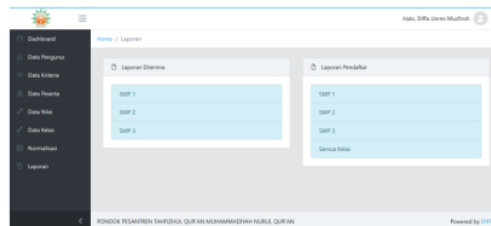


Figure 14 Class Selection Page of The Report

Ranking	No Pendaftaran	Nama	WJd Muncul	Nilai Akhir
1	S-0003	RIZKI SAFI AHMAD	Harah Murnani	800000
2	S-0004	KHANIM TRUL ATAL	Shi Harah	837750

Figure 15 Report Page Junior High School Class 3

No	Nama	Tanggapan Ortu	Report	Tes Tertulis	Tes Harkat	Penghasilan Ortu
S-0001	AHMAD RAZEL AL ANSORI	1	87	75	60	1000000
S-0004	AHMAD KHAFI MUSYOH	4	85	80	60	2000000
S-0005	REZA DWI RAMANGAS	2	80	60	60	1000000
S-0007	MUHAMMAD NORA AHMAD	2	80	80	60	1000000

Figure 16 Report Page of All Classes

3.4.10 Result Check Display

In Figure 17 is a results check page that functions to display the graduation or not of each participant who registers for a scholarship and has a feature to print graduation results which will later be deposited or become proof of a scholarship graduation letter to the Muhammadiyah Nurul Qur'an Islamic Boarding School management.

Figure 17 Result Check Display

4. CONCLUSION

This scholarship acceptance recommendation application using the Simple Additive Weighting method can make it easier for boarding school administrators to manage, input data on prospective scholarship participants and can facilitate decision making in determining students who meet the criteria as scholarship recipients precisely, accurately, and quickly according to the weight value on each criteria for calculating prospective scholarship recipients.

In future research, there are several improvements that can be made to improve this application. One improvement that can be considered is adding special features for Android users. This feature will make it easier for students to enter their personal data into the application. In addition, the development of other features that support this application is also very important to note. Thus, this application will become more complete and can provide greater benefits to its users.

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