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IMPLEMENTATION OF THE SAW METHOD IN THE SCHOLARSHIP DECISION SUPPORT SYSTEM

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Abstract: The number of applicants for scholarship recipients is many, so in the registration process, the scholarship provider provides several requirements that students must meet, and these requirements have criteria with different weight values. The number of applicants for the scholarship recipients is enormous; a Decision Support System (DSS) is needed to help the selection process be more accessible and faster and reduce errors in determining scholarship recipients. The data collection method uses interviews, observations, and literature with the waterfall's system development method. The calculation of the criteria used in developing this system is the Simple Additive Weighting (SAW) method. Comparing the final results between manual and system analyses shows that the equation is close to 100%. Still, the final results may be different because manual calculations use raw values, while system calculations use the Simple Additive Weighting (SAW) method, which compares alternatives.
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Keywords: decision support system; scholarship; simple additive weighting

Abstrak: Pendaftar calon penerima beasiswa tidak sedikit jumlahnya, sehingga pada proses pendaftaran pihak pemberi beasiswa memberikan sejumlah persyaratan yang harus dipenuhi oleh siswa, dan persyaratan tersebut memiliki kriteria dengan nilai bobot yang berbeda-beda. Jumlah siswa yang mengajukan beasiswa sangat banyak, dan memerlukan sistem pendukung keputusan untuk mempermudah dan mempercepat proses seleksi serta mengurangi kesalahan dalam menentukan penerima beasiswa. Metode dalam mengumpulkan data menggunakan metode wawancara, observasi, dan literatur dengan metode pengembangan sistem menggunakan waterfall. perhitungan kriteria yang digunakan dalam pengembangan sistem ini adalah metode SAW (*Simple Additive Weighting).* Perbandingan hasil akhir antara perhitungan manual dan sistem menunjukkan persamaan mendekati 100%, namun hasil akhir bisa saja berbeda karena perhitungan manual menggunakan nilai mentah, sedangkan perhitungan sistem menggunakan metode SAW (*Simple Additive Weighting)* yang perhitungan dengan cara membandingkan alternatif.

Kata kunci: beasiswa; *simple additive weighting;* sistem pendukung keputusan

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INTRODUCTION

Kanisius Bharata Karanganyar Vocational High School (SMK) is a school belonging to the Kanisius Foundation, which has a program in the form of a Khanisius scholarship.

The Scholarships can only be given to deserving students under the policies set by the Kanisius Foundation. There are many applicants for scholarship recipients, so in the registration process, the scholarship provider provides several requirements that students must meet, and these requirements have different criteria. The number of students who apply for scholarships is enormous every year. It requires a decision support system to simplify and speed up the selection process and reduce ranking errors in determining scholarship recipients.

The Simple Additive Weighting (SAW) method is a decision-making support method, with the basic concept of getting the most weight from several criteria on each alternative in each attribute [1] and doing the ranking [2]–[4].

The Simple Additive Weighting (SAW) method can make it easier to carry out quantitative calculations on selecting scholarship recipients. There are no errors or mistakes in determining eligible students for scholarships. [5][6] The calculation technique with this method obtained the most prioritized criteria, namely the best value [7]–[10].

Therefore, this research was carried out to design and develop an information system that can provide recommendations for scholarship recipient decisions to policy makerspolicymakers at Kanisius Bharata Karanganyar Vocational School objectively by implementing the Simple Additive Weighting method.

METHODS

The primary data in this study is the data obtained by the researcher directly on the operator's observation and interview activities at Kanisius Bharata Vocational School Karanganyar. The criteria determined by Kanisius Bharata Karanganyar Vocational School to get the scholarship are the Criteria for Report Values, Total Parental Income, Attendance, and Personality. Each of these criteria has a different weight value; namely, with a percentage of 100, the weight of the report card value is 30. The parents' total income is 40, attendance is 10, and personality is 20.

The data collection was carried out using this interview by conducting direct questions and answers with the parties concerned to obtain information related to the needs of the selection of students at SMK Kanisius Bharata Karanganayar.

Metode Pengembangan Sistem Pada penelitian ini, menggunakan metode W*aterfall*. Menurut Pressman model [11] *Waterfall* diuraikan dengan tahap-tahap yaitu *Planning* (Perencanaan); *Analysis* (Analisis); *Design* (Desain); *Code* (Koding); *Test* (Pengujian); *Deployment* (Penyebarluasan dan Pemeliharaan).

System Development Method In this study, using the Waterfall method, calculating the criteria used in the development of this system is the Simple Additive Weighting (SAW) method. The solution algorithm for the SAW method was [12]:

Step 1: Coding of each criterion that will be used as a benchmark for problem-solving;

Step 2: Normalize the alternative attribute values by calculating the rating value for each attribute;

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Step 3: Calculate the preference weight value for each alternative;

Step 4: ranking

The Simple Additive Weighting method has a formula, namely Normalizing each alternative (computing the performance rating value), which can be calculated according to its attributes with the procedure (1) or (2).

If j is benefited (attribute of profit) (1)

$$r_{ij} = \frac{X_{ij}}{Max\ X_{ij}}$$

If j is cost (cost attribute) (2)

$$r_{ij} = \frac{Min\ X_{ij}}{X_{ij}}$$

Where rij is the normalized performance rating of alternative Ai on attribute Cj; i = 1,2,….,m and j = 1,2,…,n.

explicative:
$Max\ xij$ = The most significant value of each criterion i.
$Min\ xij$ = The smallest value of each bar i.
xij = The attribute value of each bar.
Benefit = If the most significant value is the best.
Cost = If the smallest value is the best.

After normalization is done, the next step is to calculate the preference weight value for each alternative using formula (3).

$$Vi = \sum_{j=1}^{n} \text{wj rij} \quad (3)$$

explicative:
Vi = Rank for each alternative.
wj = Criteria weight value.
rij = Normalized performance rating value.
A higher value indicates that alternative Ai is preferred.

RESULTS AND DISCUSSION

SAW Calculation

Calculating the Simple Additive Weighting starts by assigning a value to each criterion; four criteria are used in this decision support system: parents' income, report cards, attendance, and personality. The next step, by normalizing each bar, will be calculated according to the weight of each criterion. Calculations using Simple Additive Weighting need to be done before making the system, whose function is to determine the feasibility and accuracy of measures for the developed DSS application.

Table 1 Criteria

Criteria	Kode	Type	Weight
Parent's income	K1	*Cost*	0.4
Report score	K2	*Benefit*	0.3
Attendance	K3	*Benefit*	0.1
Personality	K4	*Benefit*	0.2

Table 1 is the data criteria used to perform calculations using the Simple Additive Weighting method. These criteria have been determined by the Principal of SMK Kanisius Bharata Karanganyar. Furthermore, the data criteria are inputted according to the data held by students. The next step is to normalize the data in table 2 using the Simple Additive Weighting method, with the results in table 3. The results of normalizing the data in table 2 are then processed in the weighting process by multiplying the weight value of each criterion. Meanwhile, table 4 is carried out computationally according to the SAW formula in numbers (2) and (3), with the results in table 4 and the ranking in Table 5.

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Table 2 Student Data

Student	K1	K2	K3	K4
S1	1200000	86,3	100	5
S2	1000000	82	100	5
S3	1950000	87,5	100	5
S4	1500000	82,5	100	5
S5	1400000	90	100	5
S6	2000000	78	95	5
S7	1100000	80,3	100	5
S8	900000	85	100	5
S9	1750000	77,5	100	5
S10	1250000	88	100	5

Table 3 Normalization Results

Hasil Normalisasi				
Student	**K1**	**K2**	**K3**	**K4**
S1	0,75	0,932973	1	1
S2	0,9	0,886486	1	1
S3	0,461538	0,945946	1	1
S4	0,6	0,891892	1	1
S5	0,642857	0,972973	1	1
S6	0,45	0,843243	0,95	1
S7	0,818182	0,868108	1	1
S8	1	0,918919	1	1
S9	0,514286	0,837838	1	1
S10	0,72	0,951351	1	1

Table 4 Weighting Results

student	K1	K2	K3	K4	Skor
S1	0,3	0,2798	0,1	0,2	0,8798
S2	0,36	0,2659	0,1	0,2	0,9259
S3	0,184615	0,2837	0,1	0,2	0,7683
S4	0,24	0,2675	0,1	0,2	0,8075
S5	0,257143	0,2918	0,1	0,2	0,8490
S6	0,18	0,2529	0,095	0,2	0,7279
S7	0,327273	0,2604	0,1	0,2	0,8877
S8	0,4	0,2756	0,1	0,2	0,9756
S9	0,205714	0,2513	0,1	0,2	0,7570
S10	0,288	0,2854	0,1	0,2	0,8734

Table 5 Ranking results using the SAW method

Student	Result	Ranking
S8	0,9756	1
S2	0,9259	2
S7	0,8877	3
S1	0,8798	4
S10	0,8734	5
S5	0,849	6
S4	0,8075	7
S3	0,7683	8
S9	0,757	9
S6	0,7279	10

The manual method in table 6 for calculating scholarships from Kanisius Bharata Karanganyar Vocational School is carried out using the Microsoft Excel application. The aim is to compare the results of the calculations with DSS SAW computations.

Table 6. Scholarship Recipients Manual Ranking

Student	Result	Ranking
S3	4,6	1
S8	4,4	2
S1	4,3	3
S5	4,3	4
S10	4,3	5
S4	4,3	6
S7	4,3	7
S9	4,3	8
S6	4,1	9
S2	4	10

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Implementation

This Decision Support Information System for Scholarship Selection has several pages: the Scholarship Data page; the operator can enter scholarship data in the form of the scholarship application year. The system will save the input results. — criteria, used by operators to enter criteria data used to calculate the Simple Additive Weighting method. The Registrant Data page can be accessed by all registrant students who have filled out the personal data form.

On the Applicant Criteria Page, operators can display student criteria data uploaded to the Scholarship Selection SPK based on the scholarship academic year; operators can validate the criteria data entered by students according to the report card file and the Student's Parents Salary form.

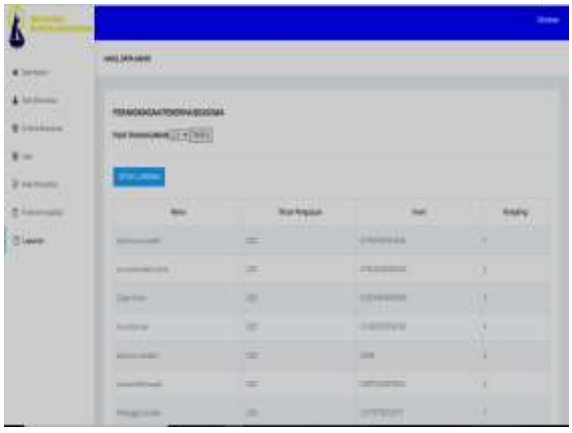

Image 4 Scholarship Selection DSS Calculation page with SAW method

In Figure 4, the function to calculate all input data using the Simple Additive Weighting method is carried out on this page, from the normalization process, weighting, and weighting results storage. The report page in Figure 5 shows the results of the weighting calculation using the Simple Additive Weighting method.

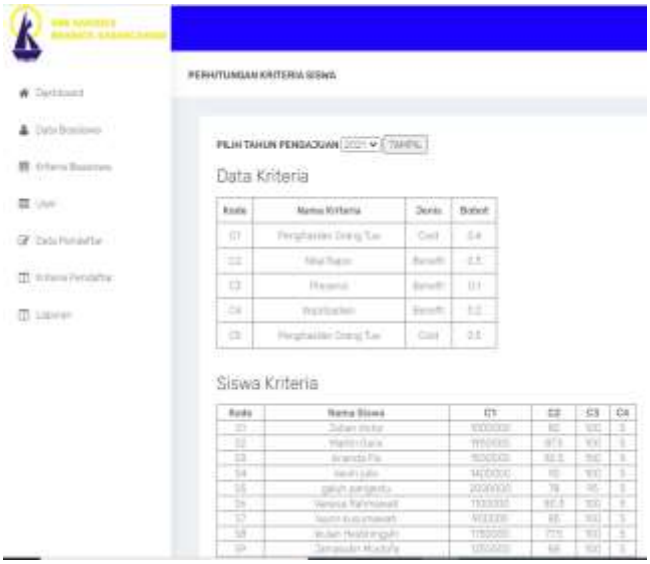

Image 5. Results of Decisions and Ranking of DSS Scholarship Selection

CONCLUSION

The Simple Additive Weighting (SAW) method can solve problems in the Scholarship Selection SPK research at Kanisius Bharata Karanganyar Vocational School using four criteria: Parents' Income, Report Values, Presence, and Personality. Comparing the final results between manual and system calculations (with the data used in this research) shows that the equation is close to 100%. However, if the data is changed and enlarged, the final results may be different because manual calculations use raw values. In contrast, system calculations use the SAW (Simple Additive Weighting) method, which compares alternatives.

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