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DECISION SUPPORT SYSTEM FOR DETERMINATION OF SCHOLARSHIP USING SCRATCH PROGRAMMING BASED ON SAW METHOD

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ABSTRACT
Scholarships are one of the efforts to provide financial assistance or support to individuals who are expected to be able to support the need in the process of taking education. In 2020, 1st State Vocational School of Cepu had more than 1000 students and from 300 scholarship submissions only 9 people managed to get a scholarship. Therefore a tool is needed to select students who are entitled and less entitled to get scholarships. Decision Support System is one of the tools that can be used to calculate to select the students. The method used is Simple Additive Weighting(SAW) because the method is a simple but it's still an accurate method, because it has a very low error level. The aim of this study is to apply the Simple Additive Weighting(SAW) method for Decision Support System scholarships using Scratch Programming which is a programming language that is fairly newly developed and easy to apply to various attractive creations with a shorter time compared to using other programming languages. The criteria used in this study are parent's income, parent's dependents, Home-to-school Distance , and the students age. The results obtained and analyzed from this study concluded that the testing system using Mean Square Error(MSE) has a very low level of error which is equal to 1.3312E-31 it can be said that the system is accurate, and from the test functionality using the Black Box obtained 100% results.

INTRODUCTION

Education is one of the important factors that can support the life of a nation. The provision that every citizen has the right to study has been mentioned in the 1945 Constitution. Therefore, the government agreed to build a 12-year compulsory education program (Nugroho, 2014). Scholarships are one of the efforts to provide financial assistance or support to individuals who are expected to be able to support the need in the education process (Yulianti, 2013).

Based on information obtained through interviews by the Administration of 1st State Vocational School of Cepu, scholarships given to students are divided into three types, namely poor students' scholarships (BSM), smart Indonesian students (PIP), and Zakat (UPZ) (UPZ) units. Of the three scholarships the author will conduct a selection process to determine the feasibility of recipients of poor student scholarships that have limited number of recipient quota. The criteria that are references are parents' income, the number of parents, the distance of student houses, and the age of the student. In 2020 1st State Vocational School of Cepu had more than 1000 students and from 300 scholarship

submissions that managed to get the help of only 9 children. From these data it can be concluded that quite a number of students must be assessed to know which students are worthy of the scholarship.

The problem that arises is the process of selecting scholarship recipients having a shortage or still not on target because it still uses a manual system, namely by means of being thoughtful and still susceptible to human factors. Therefore a decision support system(DSS) is needed to assist the process of resolving problems and as a tool for supporting decision-making processes with established criteria (Kusrini, 2007).

One method in the decision support system is the SAW (Simple Additive Weighting) method. The SAW method is often used to assist in decision making because this method has advantages, namely the assessment process will be more appropriate because it is based on the criteria value of weight, and predetermined preferences, as well as the calculation of the normalization of the matrix that is adjusted to the value of the attribute (consecutive benefit or worth costs). It can be concluded that this SAW method determines the weight value of each criteria for determining optimal alternative (Chung, 2018).

Compared to other DSS methods such as Technique for Order Preference by Similarity To Ideal Solution (Topsis) by (Suyanti, 2018) resulting in the conclusion that the implementation of the SAW method turned out to be better than the implementation of the Topsis method, this was seen in the results of the sensitivity test, SAW by 1, 41% and the tops of 0.69% (Suyanti, 2018). Comparison analysis of SAW, Topsis and WP use Hamming Distance concluded that the method is closest to the results of the decision, namely the Saw and Topsis method, so that the method is feasible to use the decision-making process objectively (Kungkung, 2018).

The criteria used in research by (Topadang,), (Bhakti) and (Wolo et al, 2018) for providing poor scholarships just use 3 criteria and criteria most often arise are parents' income and parents, however The distance of the student's house will affect student spending and age of students also affect the priority of students in the process of selecting to get a scholarship. So the author will use the criteria for parent's income, parent's dependants, Home-to-school Distance, and students age in this study.

LITERATURE REVIEW

Here are some previous studies about the decision support system (DSS) using the Simple Additive Weighting (SAW) method that had been carried out by several previous writers. Comparisons of these studies can be seen in Table 2.1, with the results of the following research:

The first study was conducted by (Teja et al, 2020) entitled "The Simple Additive Weighting Method in Determining the Recipient of the John Paul's School Junior High School Achievement Scholarship" The results of the study are the Method of Simple Additive Weighting (SAW) can effectively determine the recipients of the achievement scholarship in Junior John Paul's School with a presentation of value above 80% using three criteria, namely the value of English test, the math test value, and interview test value. But in this study it has not been applied to an application.

The second research was conducted by (Taufik et al, 2020) entitled "Web-based scholarship decision support system using the Simple Additive Weighting (SAW) method in the Daarul Ahsan Islamic Boarding School". The results of the study are the Simple Additive Weighting (SAW) method can help the problem and help effectively in the Daarul Ahsan Islamic Boarding School to determine scholarship recipients. In this study, a web application was created by PHP programming language.

The third research by (Sadewa et al, 2021) entitled "System Support Decision The feasibility of scholarships using the Simple Additive Weighting method" The final result that can be obtained from this study is the Simple Additive Weighting (SAW) method at PT. Novell Pharmaceutical Laboratories can help produce decisions quickly and effectively regarding the feasibility of scholarship recipients. This research has been created an application using Java programming.

METHODOLOGY

The research methodology described through a diagrams is needed to plan a process, analysis, and documentation, as it is a guideline for conducting research. The Input Process Output(IPO) approach is used to describing the structure of an information processing or other process that exist in the system. The IPO method used can be seen in Fig 1.

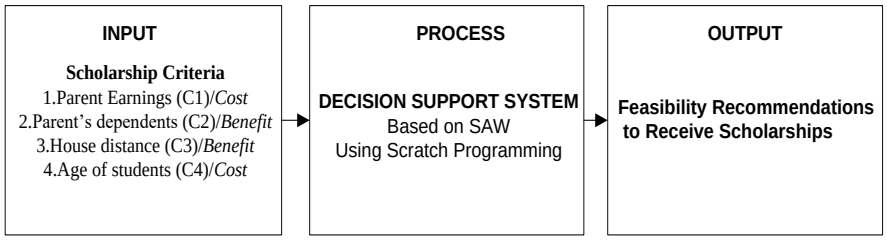

Figure 1. Research Methodology

Input is a step of preparing, collecting and entering data from the outside into the system. The variable used in the Input are: 1. Parent Earning, we encode it to C1. it is a Cost variable, it means the smaller value will have higher weight score and vice-versa. 2. Parent's dependant(C2) as a Benefit variable. 3. Home-to-school Distance(C3) as a Benefit variable. 4. Age of Student(C5) as Cost variable. Process is a step that we do a design and implementation using Scratch programming language into an application. Afterwards, all of data will be inputed, calculated and processed to produce an output using SAW algorithm. After the step is complete, the application will produce a score that also explains the feasibility to receive a scholarship of user.

After the Input, Process and Output are declared through an IPO diagram. We then develop the application using Waterfall methodology that consist of 5 steps: 1. Requirement Definition. 2. System and Software Design. 3. Implementation. 4. Integration. 5. Finding and Conclusion. We describe the waterfall methodology that we used using flow diagram that can be seen in Fig 2.

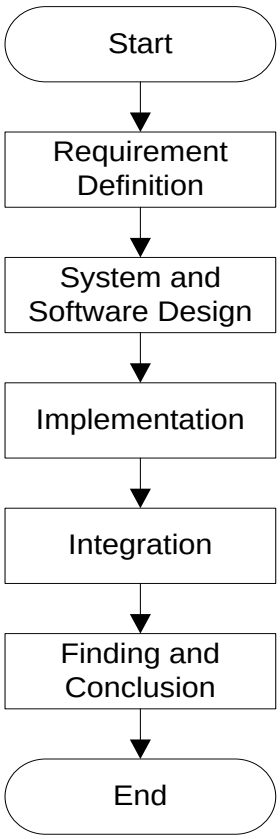

Figure 2. Research Flow Diagram

The Design stage is conducted using an UML diagram namely: Use Case Diagram, Activity Diagram, and Sequence Diagram. Those diagrams are used as a blueprint. Then, the blueprint is converted to an application at the development stage using a tool namely Scratch that can be downloaded from *http://scratch.mit.edu*.

The algorithm used in the application is a SAW. It is the best and simpliest method for evaluating a number of alternatives in terms of a number of decision criteria. The Simple Additive Weighting (SAW)

method is a method based on solving problems in making decisions by determining the most optimal alternative of a number of alternatives using a predetermined crateria.

The basic concept of the Simple Additive Weighting (SAW) method is seeking a bureably from a performance rating on every alternative of all the criteria used to take decisions. Therefore the Simple Additive Weighting (SAW) method is often known as a bureauted method. The calculation using the Simple Additive Weighting (SAW) method will produce the value of the preference and the greatest value that will be used as the best alternative. In the Simple Additive Weighting (SAW) method determines the weight on each criterion will greatly affect the final results or preference value.

Here are the steps to complete the Simple Additive Weighting (SAW) method:

1) Determine the alternative symbolized by AI.
2) Determine the various criteria that will be used in making decisions, symbolized by CI.
3) Specifies the compatibility rating of alternatives for all criteria.
4) Determine the weight of interest or the degree of interest for each criteria.
5) Creating tables containing a matching rating for any alternative to all criteria.
6) Changing the compatible rating table that has been determined into a decision matrix, where i = 1.2 ... m and j = 1.2 ... n

$$= \begin{matrix} & & \chi & \\ \begin{bmatrix} r11 & r12 & \dots & rij \\ \vdots & & & \vdots \\ ri1 & ri2 & \dots & rij \end{bmatrix} \end{matrix}$$

7) Calculate the normalist matrix of the decision matrix by determining the type of attribute (benefit or cost) for each CI in each AI. The equation used to calculate the normalization matrix is as follows:

$$r_{ij} = \begin{cases} \dfrac{x_{ij}}{Max_i\, x_{ij}} & \text{if j is a } benefit \text{ variable} \\ \dfrac{Min_i\, x_{ij}}{x_{ij}} & \text{if j is a } cost \text{ variable} \end{cases}$$

Description :

- RUH = the expreaded performance rating
- Maxi = maximum value of the line criteria to i
- Mini = minimum value of line criteria to i
- Xij = row value and column from the matrix

The results of the predictable performance rating calculation will form the tinged matrix, symbolized by R.

$$R = \begin{bmatrix} r11 & r12 & \dots & rij \\ & & & \\ ri1 & ri2 & \dots & rij \end{bmatrix}$$

Calculating the preference (VI) value that will be obtained from the predetermicized matrix multiplication (R) with a degree of interest or weighing (W) that has been determined for each criterion (CI) of an alternative (AI) which is then summed up the whole. Here are the equations used to calculate preference values:

$$V_i = \sum_{j=1}^{n} W_j\, r_{ij}$$

Description :

- Vi = final value of alternative or preference
- WJ = Weight or Degree of Affected Interest
- RIJ = normalization matrix element

RESULT

Data

The criteria for selecting scholarship grantee candidate was gathered from the literature and combined to the data from the object of the research as it can be seen in the Table 1.

Table 1. Data Variable

No	Criteria Name (C_i)	Category	Weight (%)
1	Parent's Earning (C1)	*Cost (min)*	30
2	Parent's Dependant (C2)	*Benefit (max)*	30
3	Home-to-school Distance (C3)	*Benefit (max)*	20
4	Student Age (C4)	*Cost (min)*	20

After the scholarship grantee candidate data from the object of the research been gathered, we classified the Parent Earning into 5 categories as can be seen in Table 2.

Table 2. C1 (Parent Earning)

C1	Weight
Rp.0-500.00	1
>Rp.500.000-1.000.000	2
>Rp.1.000.000-2.000.000	3
>Rp.2.000.000-3.000.000	4
>Rp.3.000.000-4.000.000	5

We make a maximum Parent's Dependant categories to 4, given that the number above 4 is a rare case. Hence, we classified it into 5 categories as can be seen in Table 3.

Table 3. C1 (Parent Earning) and C2 (Parent's Dependant)

C2	Weight
0	1
1	2
2	3
3	4
>4	5

The latest regulations that have been issued by the Ministry of Education said that every graduate can only register at the nearest school. The distribution of graduates and school zoning is regulated in detail by the authorized party. Therefore we only create a maximum distance category to 20 killometers based on that regulation. The five categories of Home-to-school Distance can be seen in Table 4.

Table 4. C3 (Home-to-school Distance)

C3	Weight
0-5 Km	1
>5-10 Km	2
>10-15 Km	3
>15-20 Km	4
>20 Km	5

In Indonesia in general the age of students on average is only one to two years of difference. This happens because, at the primary education level applies the minimum age rule is 6. So that the age of

students at the high school level is also relatively the same. Then, we classified age of student data into 5 categories from 14 to >17. It can be seen in Table 5.

Table 5. C4 (Age of Student)

C4	Weight
14 Years	1
15 Years	2
16 Years	3
17 Years	4
>17 Years	5

Designing the application through a diagrams is an initial picture to build a system. The application will be made based on use case diagram, sequence diagram, activity diagram, and user interface design. The Use Case Diagram is a functional picture of a system by describing actors and its relationship with the system. Use Case Diagram describe how the actor interact with other actor and the system. It can be seen in Fig 3.

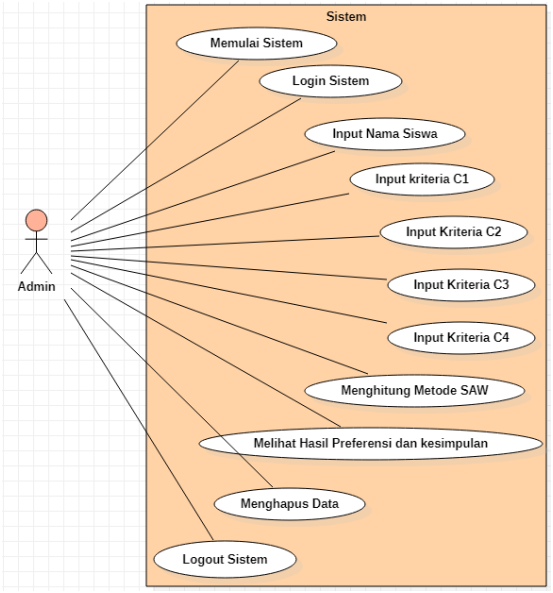

Figure 3. Use Case Diagram

Sequence diagrams describe the activity of the object by describing the life time of objects and messages sent and received between objects. The number of sequence diagrams made at least have to define all parts of the use case that has been made before. Here we only display sequence diagrams in the main process, namely the calculating process. The diagram can be seen in the Fig. 4.

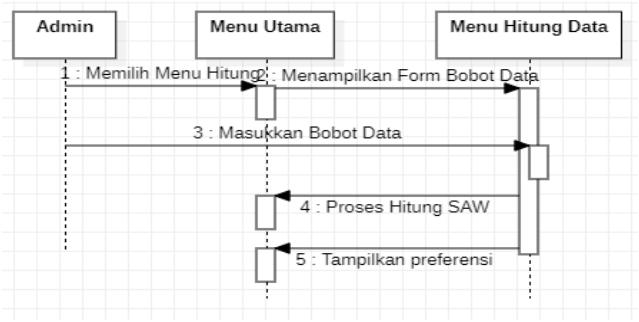

Figure 4. Sequence Diagram of Calculation Process

Activity diagrams are design activities or work flow in the system to be run. Activity diagram is used to define or group the flow of display from the system. The following is the Activity Diagram that describe the work flow of the system that will be built as it can be seen in Fig.5

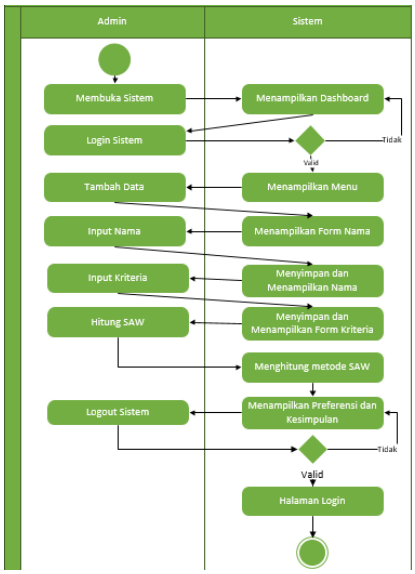

Figure 5. Activity Diagram

After the entire design stage is completed, the application development is carried out using Scratch Programming. The Decision Support System of Scholarship Selection Grantee Candidate based on SAW algorithm can be seen in Fig. 6

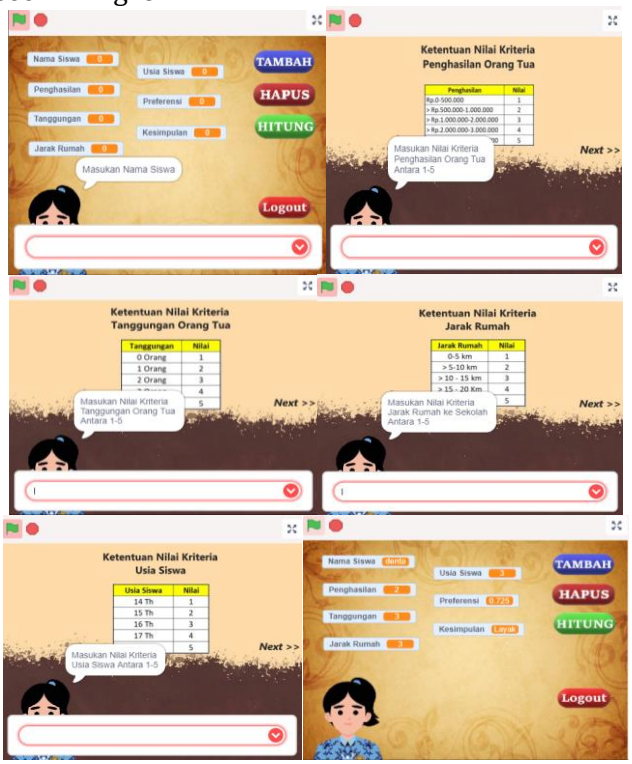

Figure 6. Scholarship DSS App Powered by Scratch Programming

CONCLUSION

Based on the results of the research system of decision supporting scholarships using Scratch Visual Programming which has been described in the previous chapter can be withdrawn several conclusions, namely: 1. The decision support application that has been made using Scratch Visual

Programming with the Saw method developed can run according to the design that has been created and based on the test results using the MSE system developed has a very low error level of 1.3312E-31, it can be said that the system is accurate. 2. The results of testing functionality using the Black Box obtained by 100%. According to the testing carried out the application can run well.

In this study there are still a number of shortcomings that must be corrected in future research. Here are some suggestions that can be used as a reference for future research: 1. On the system developed does not have a database on the cloud server. The storage is only on a temporary memory. 2. It is expected to add other users such as the principal or other and the addition of data editing features or applying with algorithms other than SAW. 3. It is expected to be able to change the way the input of student data and the criteria used from the manual using the keyboard becomes automatic just by clicking.

REFERENCES

Bhakti, S. P. R. (2017). Seleksi Beasiswa Siswa Miskin Bsm Di Smk Islam Sudirman Andong Dengan Metode Simple Additive Weigthing (Saw) (Doctoral Dissertation, Stmik Sinar Nusantara Surakarta).

Chung, P. S. (2018). Studi Kasus Sistem Penunjang Keputusan Metode SAW dan TOPSIS. *Malang: CV. Seribu Bintang*.

Kungkung, A., & Kiswanto, R. H. (2018). Analisa Perbandingan Metode SAW, WP dan TOPSIS Menggunakan Hamming Distance. *Konferensi Nasional Sistem Informasi (KNSI) 2018*.

Kusrini, K. (2007). Aplikasi Sistem Pendukung Keputusan. *Yogyakarta: Andi*.

Nugroho, S. B. M. (2016). Pengaruh Pendidikan Terhadap Pertumbuhan Ekonomi. *Media Ekonomi dan Manajemen*, *29*(2).

Sadewo, B., Akhirina, T. Y., & Suhaemi, T. (2021, January). Sistem Pendukung Keputusan Kelayakan Beasiswa Menggunakan Metode Simple Additive Weighting. In *Semnas Ristek (Seminar Nasional Riset dan Inovasi Teknologi)* (Vol. 5, No. 1).

Suyanti, S., & Roestam, R. (2018). Analisis Perbandingan Metode Simple Additive Weighting (SAW) dan TOPSIS dalam Pemilihan Guru Teladan pada SMA Negeri 4 Sarolangun. *Jurnal Manajemen Sistem Informasi*, *3*(3), 1208-1225.

Taufik et al, R, "Sistem Pendukung Keputusan Penerima Beasiswa Berbasis WEB Menggunakan Metode Simple Additive Weighting (SAW) pada Pondok Pesantren Daarul Ahsan", *Jurnal Informatika Universitas Pamulang*, 2020, 5(1), 54–60.

Liesnaningsih, L., Taufiq, R., Destriana, R., & Suyitno, A. P. (2020). Sistem Pendukung Keputusan Penerima Beasiswa Berbasis WEB Menggunakan Metode Simple Additive Weighting (SAW) pada Pondok Pesantren Daarul Ahsan. *Jurnal Informatika Universitas Pamulang*, *5*(1), 54-60.

Topadang, A. (2020). Analisis Sistem Penunjang Keputusan Untuk Penentuan Siswa Berprestasi Sekolah Dasar Katolik Hati Kudus Samarinda. *Just Ti (Jurnal Sains Terapan Teknologi Informasi)*, *12*(1), 13-16.

Wolo, P., Sambi, A., Pibe, C. A., & Ismayanti, F. (2018, December). Sistem Pendukung Keputusan Seleksi Penerimaan Beasiswa Miskin Menggunakan Metode Simple Additive Weighting (SAW) Studi Kasus: SDK Wairpelit. In *Seminar Nasional Riset Terapan* (Vol. 3, pp. D15-D23).

Yulianti, E., Haryanti, T., & Kurniawati, L. (2013). Sistem Penunjang Keputusan Penerimaan Beasiswa Pegawai Dengan Metode Fuzzy MADM. *Konferensi Nasional Ilmu Sosial dan Teknologi*, *1*(1).