IDENTIFICATION OF STUDENT GRADES USING THE SAW METHOD IN A DECISION SUPPORT SYSTEM

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ARTICLE INFO	ABSTRACT
	The decision support system is one way to assist in making decisions based on calculation methods. Decisions often become a confusing obstacle because they have several considerations to make a decision. Several methods can be used to support a decision. The SAW method is a method that has results that can support decisions based on the weights and criteria of each alternative. Student ranking is always an achievement of the learning outcomes that have been carried out, so it requires appropriate validation or calculations and can be used as a ranking decision. In this case, identification was carried out using the SAW method to determine student rankings based on the academic scores obtained. Analysis and observation of constraints and ranking processes to support the calculation process. The results of this research indicate that the SAW method can be used in determining student rankings and can be applied to student assessment and ranking applications.

INTRODUCTION

The decision is a result obtained based on consideration of criteria, weights, and alternatives. However, with many alternatives and criteria as benchmarks, it can result in decisions that are sometimes confusing or inaccurate. Decision support systems are often used to assist the decision-making process with several alternatives. Various conditions and problems can be helped by calculation methods of decision support systems. Weight is one of the things that play a role in the process because weight will affect the outcome of the decision. So that the decision support system will produce the appropriate value and not only be based on opinion estimates. The thing that often appears in manual decision-making without using a method is the result of a balanced decision between several alternatives because the value is not specific for each alternative.

Student ranking is one thing that has always been the achievement of the learning outcomes that have been carried out, so it requires validation or appropriate calculations and can be used as ranking decisions. Rank assessment is mandatory and important at every level of education because it will produce outstanding students and can be appreciated. (Rizka et al., 2022) However, there are several obstacles in determining the ranking, such as almost the same criteria with the same weight, and the threshold value is still ambiguous. So we need a system that can overcome these obstacles. Decision support systems can be used to help the process of determining student rankings to be faster, more efficient, and more precise. The weight of all criteria for each alternative is based on the importance rating value.

In the selection of outstanding students with different developments, several criteria are used to produce decisions that are acceptable to many parties in education. The SAW method was used in the selection process. The results of the study resulted in students who excel based on several assessment criteria with maximum performance in determining students with high achievements or not. (Warnars et al., 2020)

Village assessment to improve village development with several criteria. The SAW method is used to assess the best villages so that they are right on target in improving the social, political, economic, and

cultural qualities of the village. Accurate assessment based on weight and preference values, to build a system that recommends the best village assessment. (Sri & Tamando Sihotang, 2019)

The selection of student interests and talents is important in determining elective courses. Student advisors apply a decision support system in determining areas of interest. The SAW method for generating recommendations with a rating of the results of the calculation. The results of this research, using the SAW method can support the selection of fields that match their interests so that students can easily complete their education. (Permadi et al., 2020)

SAW method for decision-making by determining the weight of each criterion. All the multiplication results between the value of interests will be added up and produce the overall value of the alternative. (Sri & Tamando Sihotang, 2019) In several other studies, the Simple Additive Weighting (SAW) method was used to improve the methodology for overcoming inaccuracies in multi-criteria decision-making. (Warnars et al., 2020) This research will identify the SAW method in a decision support system for student rankings so that it can be applied to student assessment and ranking applications.

LITERATURE REVIEW
1. Decision Support System (DSS)

A Decision Support System (DSS) is a system that can solve semi-structured and unstructured problems. The decision support system is the application of decision-making theory to find solutions to problems that occur through manual and computerized calculations. (Permatasari, 2020)

The system will support the process of problem, data collection, and approach and determine each appropriate alternative. Criteria and weight of assessment on each alternative that has been determined. In the calculation process, Multi-Attribute Decision Making (MADM) needs to normalize the data. (Rizka et al., 2022) The decision-making process has process stages to produce good decisions correctly, namely intelligence, design, choice, and implementation. (Anjar Wanto et al., 2020)

2. Simple Additive Weighting (SAW)

SAW is the total of the weights. The SAW method has a concept for obtaining the total performance rating weight for each alternative to all criteria. (Anggraeni et al., 2018) Each alternative will be calculated for its preference value, namely by adding alternative scale values mixed with predetermined weight values and the total of all criteria. SAW is a system that is easy to use in making decisions with a simple calculation process without using complex programs. SAW has two criteria, namely the criteria of benefit and cost. The difference in the selection of criteria when making decisions is based on the two criteria. (Rizka et al., 2018)

The stages of the SAW method are: (Fauzan et al., 2018)
Stage 1 is determining an Alternative (A_i).
Stage 2 is to determine the criteria (C_j) as a reference.
Stage 3 is to determine the preference weight (W) of each criterion.
Stage 4 is to determine the suitability assessment of each criterion.
Stage 5 is to make a decision matrix (X)
Stage 6 is to normalize the decision matrix (X), namely:

$$r_{ij} \left\{ \frac{x_{ij}}{\underset{i}{Max}\, x_{ij}} \right\}$$

Profit criteria.

$$r_{ij} \left\{ \frac{\underset{i}{Min}\, x_{ij}}{x_{ij}} \right\}$$

Cost criteria.
Stage 7 is the normalized matrix (R).

$$\begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1j} \\ \vdots & & & \vdots \\ r_{i1} & r_{i2} & \cdots & r_{ij} \end{bmatrix}$$

The last stage is the result of the preference value (Vi)
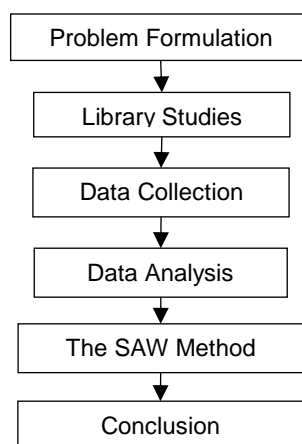
$$V_i = \sum_{j=1}^{n} w_j r_{ij}$$

Where :
V_i = rank of each alternative
W_j = weight value of each criterion
r_{ij} = normalized performance rating value

METHOD

This research uses a research methodology and framework that will describe the stages of the research process and data processing. Figure 1 is a framework for the research process.

Figure 1. Research Framework

The research framework in Figure 1 can be explained as follows:
1. Problem Formulation

The formulation of the problem is the process of identifying problems or constraints found in research to find solutions that are appropriate to the problems of student rankings for vocational high schools.
2. Library Studies

Library Studies are conducted to find and collect knowledge and theories from sources that can be validated such as previous research, journals, and books. The knowledge and theory obtained will complement the information needed in the research. Information related to the process of the stages of the SAW method in ranking student scores so that it becomes the basis of appropriate knowledge and theory.
3. Data Collection

Data collection was carried out based on data following the research. Data comes from literature study, observation, and interviews with teachers and school principals. The data is in the form of student academic scores each semester which includes all subject scores based on learning outcomes. The academic scores of several students will be used in identification. The criteria used are knowledge value, skill value, final value, and attitude value, and using an alternative, namely students.
4. Data Analysis

Data analysis is the process of selecting data that supports the process and results of data processing using the SAW method. Alternative student data is determined and criteria are grouped according to weight and importance.
5. The SAW method

The SAW method will be used in identifying student rankings. The stages that will be carried out are alternative preparation, determining criteria, determining the weight for each criterion, calculating the preference value of each alternative, and ranking students based on the highest alternative preference value.
6. Conclusion

The conclusion includes the results of the discussion of the process of identifying student grades based on the formulation of the problem to be solved for student rankings for vocational high schools.

RESULTS AND DISCUSSION
Results
The following is data on the value of knowledge, skills, final scores, and attitude values. Subjects included in the assessment were 15 subjects. Each criterion value will have an average value for all subjects. At the attitude value, there are assessment provisions that can be presented in table 1.

Table 1. Attitude Value Table

Information	Score
Very Good	5
Good	4
Enough	3
Not Enough	2

Table 2. Table of Alternative Data and Criteria

Alternative	Knowledge Value	Skill Value	Final Score	Attitude Value
Aditya Priya	1319	1317	1323	Very Good
Aditya Rahmadi	1288	1283	1290	Very Good
Alfia Sani	1280	1279	1285	Good
Alya Ratna	1243	1240	1244	Good
Anggi Dwilia	1334	1331	1337	Very Good
Antika Maulia	1261	1254	1259	Very Good
Aqila Tri	1281	1275	1284	Good
Bagas Ardiansyah	1239	1233	1238	Very Good
Daffa Abdillah	1276	1269	1277	Very Good
Ella Ageng	1223	1222	1220	Very Good

Table 2 is information on alternative data and total value data for each criterion. In terms of knowledge scores, skill scores and final scores are the sums of all 15 subject scores. The weight of each criterion can be presented in table 3.

Table 3. Criteria Weight

Criteria	Weight Value
Knowledge Value	0.4
Skill Value	0.6
Final Score	1
Attitude Value	0.5

Discussion
This research uses the SAW method for data processing. The SAW method has several stages. After determining the alternative data to be processed and the appropriate criteria along with the weight of the criteria, the next process will be carried out as follows:

Stage 1 is to determine the average value of the entire number of subject scores which can be seen in table 4. The average value is the sum of all subject scores divided by the number of subjects.

Table 4. Alternative Values and Criteria

Alternative	Knowledge Value	Skill Value	Final Score	Attitude Value
Aditya Priya	87.93	87.8	88.2	5
Aditya Rahmadi	85.87	85.53	85.87	5
Alfia Sani	85.33	85.27	85.33	4
Alya Ratna	82.87	82.67	82.87	4
Anggi Dwilia	88.93	88.73	88.93	5
Antika Maulia	84.07	83.60	84.07	5

Aqila Tri	85.4	85.00	85.40	4
Bagas Ardiansyah	82.6	82.20	82.60	5
Daffa Abdillah	85.07	84.60	85.07	5
Ella Ageng	81.53	81.47	81.83	5

Stage 2 is to determine the maximum and minimum values for each criterion, the maximum values will be used for profit criteria and the minimum values for cost criteria.

Stage 3 is to normalize the matrix based on the criteria of each alternative with the criteria of profit (max) or cost (min). matrix normalization results are as follows.

$$R = \begin{bmatrix} 0.99 & 0.99 & 0.99 & 1 \\ 0.97 & 0.96 & 0.96 & 1 \\ 0.96 & 0.96 & 0.96 & 0.8 \\ 0.93 & 0.93 & 0.93 & 0.8 \\ 1 & 1 & 1 & 1 \\ 0.95 & 0.94 & 0.94 & 1 \\ 0.98 & 0.96 & 0.96 & 0.8 \\ 0.93 & 0.93 & 0.93 & 1 \\ 0.96 & 0.95 & 0.96 & 1 \\ 0.92 & 0.92 & 0.91 & 1 \end{bmatrix}$$

Stage 4 is processing the preference value of each alternative by adding up the results of multiplying the criterion value by the weight. The results of preference values are in table 5.

Table 5. The results of Preference Values

Alternative	Preference Value
Aditya Priya	2.48
Aditya Rahmadi	2.43
Alfia Sani	2.32
Alya Ratna	2.26
Anggi Dwilia	2.50
Antika Maulia	2.39
Aqila Tri	2.32
Bagas Ardiansyah	2.35
Daffa Abdillah	2.41
Ella Ageng	2.33

Table 5 it can be seen the results of calculating student scores using the SAW method. Based on the results of alternative preference values, it can be seen that the highest to lowest student rankings. The highest rating is in Anggi Dwilia with a preference value of 2.5 and the lowest is in Alya Ratna with a value of 2.26.

CONCLUSION

The results of data processing using the SAW method for student rankings can be used as recommendations in decision-making. Based on the preference value, the ranking can be sorted from highest to lowest, namely Anggi Dwilia with a value of 2.5, Aditya Priya with a value of 2.48, Aditya Rahmadi with a value of 2.43, Daffa Abdillah with a value of 2.41, Antika Maulia with a value of 2.39, Bagas Ardiansyah with a value of 2.35, Ella Ageng with a value of 2.33, Alfia Sani and Aqila Tri with a value of 2.32, and Alya Ratna with a value of 2.26. The results of the recommendations will be an evaluation and award for students who have the highest or lowest ranking. The results of this research will be the initial stage for building an assessment application and ranking students using the SAW method. This research is an identification stage in the process of ranking students so that constraints or problems in data processing are known, the next research will use an application to provide easier, faster, and more efficient facilities.

REFERENCES

Anggraeni, E. Y., Huda, M., Maseleno, A., Safar, J., Jasmi, K. A., Kilani Mohamed, A., Hehsan, A., Basiron, B., Suhaila Ihwani, S., Hassan, W., Embong, W., Mohamad, A. M., Shakib, S., Noor, M., Fauzi, A. N., Wijaya, D. A., & Masrur, M. (2018). MiftachulHuda2018_PovertyLevelGroupingUsingSAW. *International Journal of Engineering & Technology*, *7*(2), 218–224. www.sciencepubco.com/index.php/IJET

Anjar Wanto, Tonni Limbong, Muttaqin, Akbar Iskandar, Agus Perdana Windarto, Janner Simarmata, Mesran, Oris Krianto Sulaiman, Dodi Siregar, Dicky Nofriansyah, & Darmawan Napitupulu. (2020). *Sistem Pendukung Keputusan: Metode & Implementasi*. Yayasan Kita Menulis. https://books.google.co.id/books?id=t5PYDwAAQBAJ&printsec=copyright&redir_esc=y#v=onepage&q&f=false

Fauzan, R., Indrasary, Y., & Muthia, N. (2018). Sistem Pendukung Keputusan Penerimaan Beasiswa Bidik Misi di POLIBAN dengan Metode SAW Berbasis Web. *Jurnal Online Informatika*, *2*(2), 79. https://doi.org/10.15575/join.v2i2.101

Permadi, V. A., Agusdin, R. P., & Tahalea, S. P. (2020). Identification of Student Area of Interest using Fuzzy Multi- Attribute Decision Making (FMADM) and Simple Additive Weighting (SAW) Methods (Case Study : Information System Major , Universitas Pembangunan Nasional " Veteran " Yogyakarta). *Proceeding on Engineering and Science Series (ESS)*, *1*(1), 420–428.

Permatasari, I. (2020). *Decision Support System Determining Majors at Islam Kader Bangsa Vocational School using the SAW Method*. *9*(1), 1–5.

Rizka, A., Efendi, S., & Sirait, P. (2018). Gain ratio in weighting attributes on simple additive weighting. *IOP Conference Series: Materials Science and Engineering*, *420*(1). https://doi.org/10.1088/1757-899X/420/1/012099

Rizka, A., Sains, F., Komputer, J. S., Pembangunan, U., Budi, P., & Medan, K. (2022). *Identifikasi Peringkat Nilai Mahasiswa Menggunakan Metode Weighted Product*. 83–88.

Sri, D., & Tamando Sihotang, H. (2019). Decision Support Systems Assessment of the best village in Perbaungan sub-district with the Simple Additive Weighting (SAW) Method. *Jurnal Mantik*, *3*(January), 31–38.

Warnars, H. L. H. S., Fahrudin, A., & Utomo, W. H. (2020). Student performance prediction using simple additive weighting method. *IAES International Journal of Artificial Intelligence*, *9*(4), 630–637. https://doi.org/10.11591/ijai.v9.i4.pp630-637