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Simple Additive Weighting Method for Improving Decision Support Systems Laptop Selection

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Abstract

The development of information technology significantly benefits various activities, particularly for students, by facilitating access to information and supporting academic tasks. However, students majoring in Information Technology often face challenges in selecting a suitable laptop due to the wide range of options with varying specifications and prices. This study aims to develop a Decision Support System (DSS) based on the Simple Additive Weighting (SAW) method to assist in choosing the best laptop. The SAW method was selected for its ability to evaluate multiple criteria through a weighting process. The study utilizes five main criteria: price, processor, RAM, storage type, and storage capacity. Data were collected through interviews and observations at the "IComp" laptop store. The analysis process involves matrix normalization and preference value calculation to determine recommendations. The DSS recommends the best laptop based on the highest preference score: Lenovo IP Flex 5 (0.78), followed by Lenovo IP3 (0.77) and HP Pav14 (0.76). The results indicate that these laptops offer an optimal balance between performance and price. The web-based sy stem designed accelerates the evaluation process, enhances objectivity, and improves user accessibility. The implementation of the SAW method proves effective and accurate in determining the best laptop, particularly in scenarios combining cost and benefit criteria. The system successfully meets the needs of Information Technology students by providing relevant and reliable results. This study successfully develops a DSS using the SAW method for selecting the best laptop. The system designed is effective and reliable for multi-criteria decision-making. Future research can integrate real-time data and broader user surveys to improve result generalization, making it applicable to other product selection contexts.

Keywords: *SAW, Students, Laptop, Decision Support System, Technology*

1. Introduction

The rapid development of information technology in the era of globalization has brought significant benefits across various sectors, including education[1]. Students, especially those in the Information Technology (IT) study program, heavily rely on laptops to support their learning activities, such as data processing, programming, and completing assignments[2]. However, the wide range of laptop options on the market, with varying specifications and prices, often makes it challenging for students to choose the right one to suit their needs[3].

This issue highlights the need for a decision support system (DSS) that can assist students in selecting the best laptop based on specific criteria such as price, processor type, RAM capacity, storage type, and storage capacity[4]. One effective method for implementing a DSS is the Simple Additive Weighting (SAW) method[5]. The SAW method allows for multi-criteria evaluation by objectively comparing various alternatives and providing recommendations based on the highest scores derived from the weighting and normalization process[6].

This research aims to develop a web-based decision support system utilizing the SAW method to assist IT students in choosing a laptop that meets their needs[7]. With this system, the decision-making process is expected to become more efficient, objective, and aligned with students' requirements[8].

The SAW method is chosen for this study due to its ability to rank alternatives based on weighted criteria. The method assigns a weight to each attribute, and through a ranking process, selects the best alternative[9]. The accuracy of the results improves as more data is used, ensuring the system provides precise recommendations. The conversion scale and weight preferences significantly influence the final rankings[10].

Through this research, a decision support system will be created to help Informatics students choose the best laptop based on their specific criteria[11]. Initial calculations have identified five criteria and seven laptop alternatives. The best laptop identified was the Lenovo IP Flex 5 14ALC7, with a total score of 0.72, offering a practical recommendation for students in the Informatics program looking to purchase a laptop. This study provides a valuable tool for making informed decisions about laptop selection.

2. Method

In accordance with the problem formulation, the framework is used as a guide in conducting this research described as follows

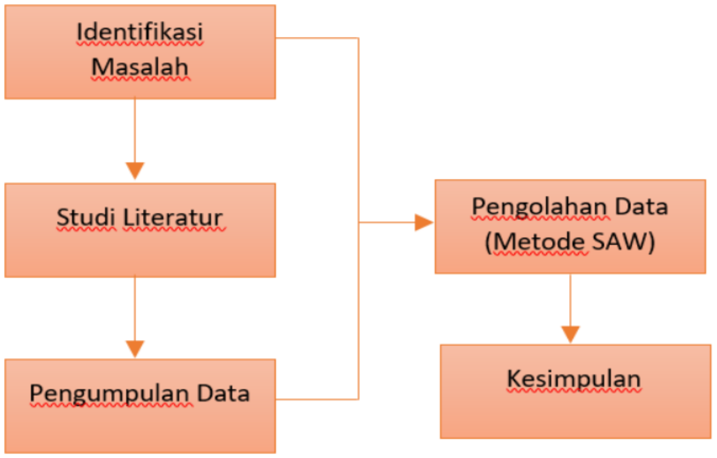


Fig. 1: Research Framework

To simplify the understanding of the research process in this research framework, the author outlines the steps in the explanation section of the research framework as follows:

a. **Problem Identification**
In this stage, the author identifies the issues that have been defined.

b. **Literature Review**
At this stage, the author conducts a literature review from books, journals, and various scientific works closely related to the topic of implementing a decision support system using the SAW (Simple Additive Weighting) method.

c. **Data Collection**
The data collection phase involves gathering data through interviews, observations, and documentation by the author on the research object and location. In this instance, the collected data pertains to the laptop requirements for informatics students based on criteria such as processor type, price, hard disk type and capacity, RAM (Random Access Memory), monitor screen size, and laptop weight in kilograms.

d. **Data Processing Using the SAW Method**
The data processing using the Simple Additive Weighting (SAW) method involves several steps to obtain the results. The steps are as follows:

1. Defining the criteria to be used as the decision-making reference (Ci).
2. Determining the suitability ratings for each alternative in each criterion.
3. Creating a decision matrix (x) based on the criteria and alternatives (Ci).

The equation form is as follows:

$$Xij = \begin{Bmatrix} X11 & X12 & X1n \\ X21 & X22 & X2n \\ Xm1 & Xm2 & X3n \end{Bmatrix}$$

Keterangan:
Xij : Matrik Keputusan
i : Baris Alternatif
j : Kolom alternatif
n : Jumlah krteria
m : Jumlah baris

4. Perform the process of matrix normalization based on equations adjusted to the type of attribute (benefit attribute or cost attribute) so that the normalized matrix is obtained using the following formula:

$$rij \begin{cases} \frac{Xij}{\text{Maxi}\, Xij} \\ \frac{\text{Min}\, i\, Xij}{Xij} \end{cases}$$

Explanation:

Rij	: The normalized performance rating value
Xij	: The value of the row and column from the matrix
Maxim xij	: The maximum value of each row and column in the matrix (if attribute j is a benefit)
Minim xij	: The minimum value of each row and column in the matrix (if attribute j is a cost)

5. Perform the ranking calculation by multiplying all attributes by the weight of the criteria for each alternative. The formula used is as follows:

$$Vi=\sum wj+rij$$

Explanation:

Vi : The final preference value of the alternative The specified weight value
j : The normalized matrix rating value
rij : The number of criteria/attribute columns
J : The total number of criteria/attributes

3.3. Implementation

a. Login Page Interface

The Login Page interface is the initial screen displayed before accessing the application. This page serves to grant access rights to a user before using the application. The function of the buttons on the Login menu is as follows:

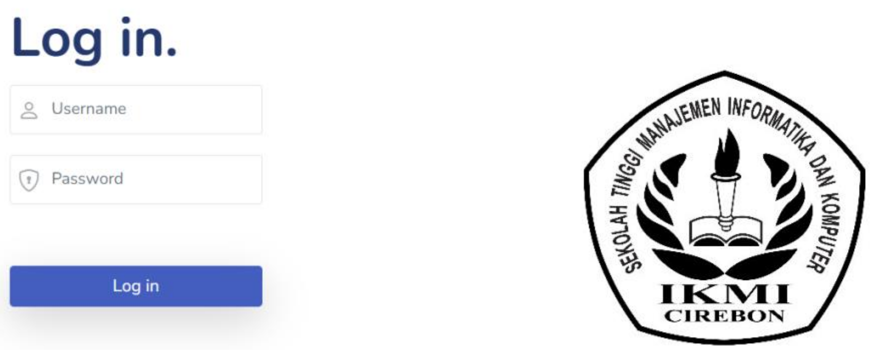


Fig. 2: Login Page Interface

b. Main Menu Interface

The Main Menu Interface design is the screen that appears first after successfully logging in with a valid username and password. This page has several functions to navigate to other interfaces.
The Main Menu interface is illustrated in the image below:

Fig. 3: Main Menu Interface

c. Alternative Data Menu Interface

The Alternative Data Menu Interface design is used for entering laptop data on the desktop, which will later be selected using the SAW method. The Alternative Data Menu interface is illustrated in the image below:

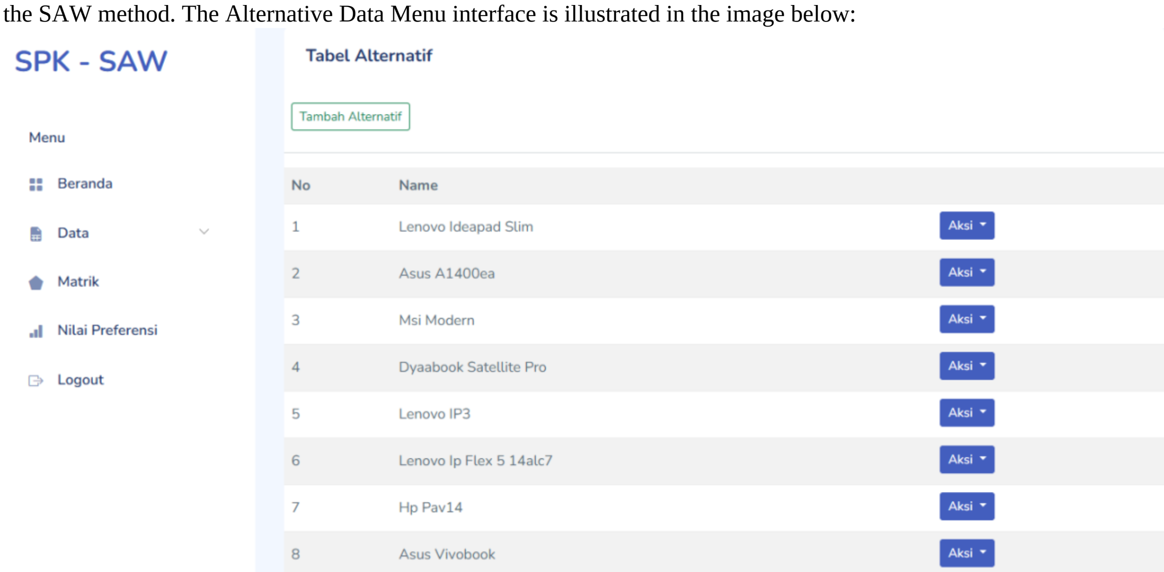


Fig. 4: Alternative Data Menu Interface

d. **Criteria Data Menu Interface**

The Criteria Data Menu contains several general criteria used as the basis for selecting the best students at SMK Negeri 1 Barumun. In this menu, there are processes for managing criteria, including options like Add Data and Actions. The Actions section includes options for deleting and editing data. The Criteria Data Menu interface is shown below:

Fig. 4: Criteria Data Menu Interface

e. Input Menu for Weight and Criteria Data Interface

The criteria data input form contains several general criteria and their corresponding weights, which are used in selecting the best laptop. The processes available on the criteria input form are "Save" and "Back." The criteria data input form is shown below:

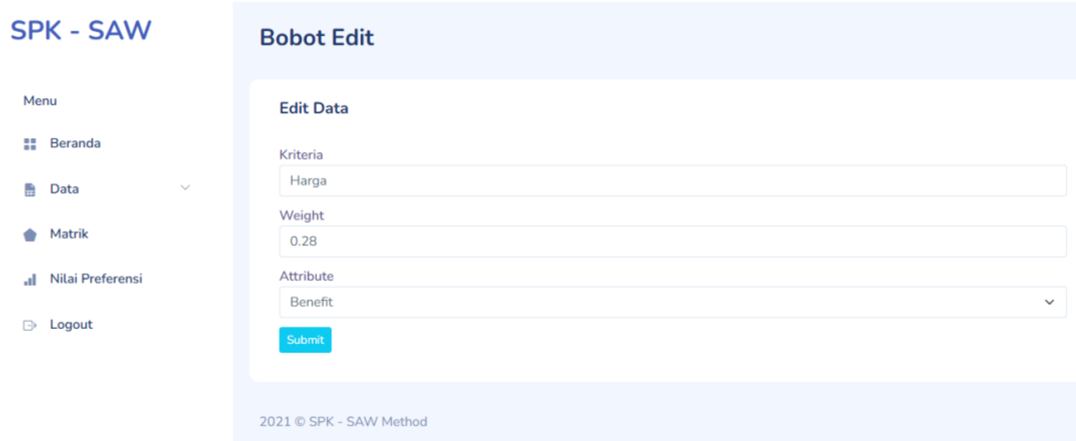


Fig. 5: Input Menu for Weight and Criteria Data Interface

f. **Alternative Value Input Menu Interface**

Below is the alternative value input form, which will be used for decision metrics in the SAW method.

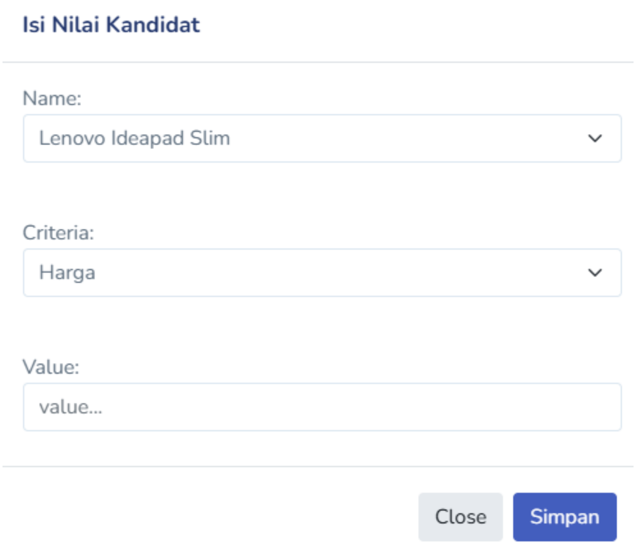
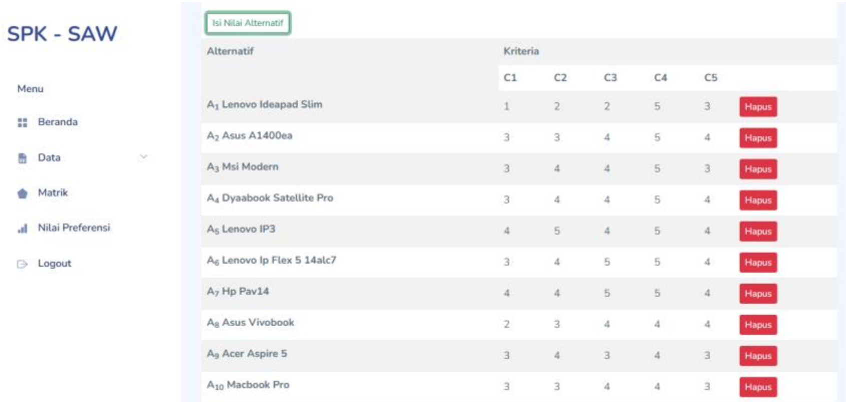


Fig. 5: Alternative Value Input Menu Interface

g. Alternative Value Input Menu Interface

Below is the alternative value input form, which will be used for decision metrics in the SAW method.

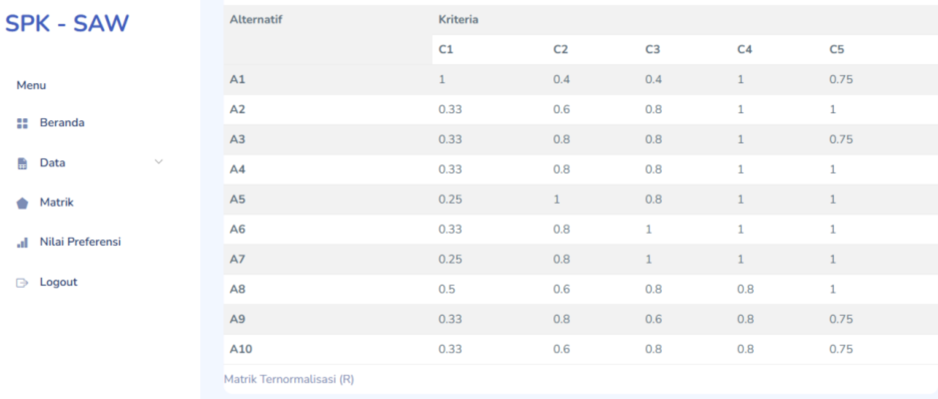


Alternatif	Kriteria					
	C1	C2	C3	C4	C5	
A_1 Lenovo Ideapad Slim	1	2	2	5	3	Hapus
A_2 Asus A1400ea	3	3	4	5	4	Hapus
A_3 Msi Modern	3	4	4	5	3	Hapus
A_4 Dyaabook Satellite Pro	3	4	4	5	4	Hapus
A_5 Lenovo IP3	4	5	4	5	4	Hapus
A_6 Lenovo Ip Flex 5 14alc7	3	4	5	5	4	Hapus
A_7 Hp Pav14	4	4	5	5	4	Hapus
A_8 Asus Vivobook	2	3	4	4	4	Hapus
A_9 Acer Aspire 5	3	4	3	4	3	Hapus
A_{10} Macbook Pro	3	3	4	4	3	Hapus

Fig. 6: Alternative Value Input Menu Interface

h. **Normalized Matrix Interface**

Below is the normalized matrix data, which is obtained by calculating the normalized performance rating value (rij) for alternative Ai on criterion Cj.



Alternatif	Kriteria				
	C1	C2	C3	C4	C5
A1	1	0.4	0.4	1	0.75
A2	0.33	0.6	0.8	1	1
A3	0.33	0.8	0.8	1	0.75
A4	0.33	0.8	0.8	1	1
A5	0.25	1	0.8	1	1
A6	0.33	0.8	1	1	1
A7	0.25	0.8	1	1	1
A8	0.5	0.6	0.8	0.8	1
A9	0.33	0.8	0.6	0.8	0.75
A10	0.33	0.6	0.8	0.8	0.75

Matrik Ternormalisasi (R)

Fig. 7: Normalized Matrix Interface

i. **SAW**

There are 5 variables used as reference criteria, including: Laptop Price, Processor, RAM Capacity, Storage Type, and Storage Capacity. The following is alternative data obtained from interviews with Shopi Setiawan regarding determining the best laptop at Icomp.

Table 1: Criteria Ci

Kode	Kriteria	Bobot	Keterangan
C1	Harga Laptop	0.28	Cost
C2	Processor	0.22	Benefit
C3	Kapasitas RAM	0.17	Benefit
C4	Tipe Penyimpanan	0.17	Benefit
C5	Kapasitas Penyimpanan	0.17	Benefit

The data regarding the laptop candidates to be evaluated is represented in the table below:

Tabel 2: Alternatif

Code Alternative	Laptop Alternative
A1	Lenovo Ideapad Slim
A2	Asus A1400ea
A3	Msi Modern
A4	Dyaabook Satellite Pro
A5	Lenovo IP3
A6	Lenovo Ip Flex 5
A7	Hp Pav14
A8	Asus Vivobook
A9	Acer Aspire 5
A10	Macbook Pro

Next is providing an assessment of the available criteria, making it easier to assign scores when alternatives are determined. Below is an explanation of the rating evaluation.

Table 2: Weighting of Price Evaluation

Kriteria	Subkriteria	Nilai
Harga	< 4.000.000	1
	4.000.000 - 5.000.000	2
	5.000.000 - 7.000.000	3
	7.000.000 - 10.000.000	4
	> 10000000	5

Tabel 3: Weighting of Processor Type Evaluation

Kriteria	Subkriteria	Nilai
Jenis Processor	Intel Pentium	1
	Intel Celeron	2
	Amd Ryzen 3 Intel Core i3	3
	Amd Ryzen 5 Intel Core i5	4
	Intel Core i7	5

Tabel 4: Weighting of RAM Capacity Evaluation

Kriteria	Subkriteria	Nilai
Kapastas RAM	< 4GB	1
	4GB	2
	6GB	3
	8GB	4
	12GB	5

Tabel 5: Weighting of Storage Type Evaluation

Kriteria	Subkriteria	Nilai
Tipe Penyimpanan	HDD	4
	SSD	5

Tabel 5: Weighting of Storage Capacity Evaluation

Kriteria	Subkriteria	Nilai
Kapsitas Penyimpanan	256GB	3
	512GB	4
	1TB	5

After determining the criteria, weights, sub-criteria, values and knowing the standard values or predicates of the assessment results, a suitability rating table is created for each alternative for each criterion. The matrix table can be seen in table.

Tabel 4: Matriks

Code	Merk Laptop	Cl	C2	C3	C4	C5
A1	Lenovo Ideapad Slim	1	2	2	5	3
A2	Asus A1400ea	3	3	4	5	4
A3	Msi Modern	3	4	4	5	3
A4	Dyaabook Satellite Pro	3	4	4	5	4
A5	Lenovo IP3	4	5	4	5	4
A6	Lenovo Ip Flex 5 14alc7	3	4	5	5	4
A7	Hp Pav14	4	4	5	5	4
A8	Asus Vivobook	2	3	4	4	4
A9	Acer Aspire 5	3	4	3	4	3
A10	Macbook Pro	3	3	4	4	3

Here is the normalized data for the laptops based on the given attributes:

a. Normalization for Price (Cost)

A1 = 1/1 = 1
A2 = 1/3 = 0,33
A3 = 1/3 = 0,33
A4 = 1/3 = 0,33
A5 = 1/4 = 0,25
A6 = 1/3 =0,33
A7 = 1/4 = 0,25
A8 = 1/2 = 0,5
A9 = 1/3 = 0,33

A10 = 1/3 = 0,33

b. Normalization for Processor (Benefit)
A1 = 2/5 = 0,4
A2 = 3/5 = 0,6
A3 = 4/5 = 0,8
A4 = 4/5 = 0,8
A5 = 5/5 = 1
A6 = 4/5 = 0,8
A7 = 4/5 = 0,8
A8 = 3/5 = 0,6
A9 = 4/5 = 0,8
A10 = 3/5 = 0,6

c. Normalization for RAM (Benefit)
A1 = 2/5 = 0,4
A2 = 4/5 = 0,8
A3 = 4/5 = 0.8
A4 = 4/5 = 0,8
A5 = 4/5 = 0,8
A6 = 5/5 = 1
A7 = 5/5 = 1
A8 = 4/5 = 0,8
A9 = 3/5 = 0,6
A10 = 4/5 = 0,8

d. Normalization for Storage Type (Benefit)
A1 = 5/5 = 1
A2 = 5/5 = 1
A3 = 5/5 = 1
A4 = 5/5 = 1
A5 = 5/5 = 1
A6 = 5/5 = 1
A7 = 5/5 = 1
A8 = 4/5 = 0,8
A9 = 4/5 = 0,8
A10 = 4/5 = 0,8

e. Normalization for Storage Capacity (Benefit)
A1 = 3/4 = 0,75
A2 = 4/4 = 1
A3 = 3/4 = 0,75
A4 = 4/4 = 1
A5 = 4/4 = 1
A6 = 4/4 = 1
A7 = 4/4 = 1
A8 = 4/4 = 1
A9 = 3/4 = 0,75
A10 = 3/4 = 0,75

Table 5: Normalization matrix table

1	0,4	0,4	1	0,75
0,33	0,6	0,8	1	1
0,33	0,8	0,8	1	0,75
0,33	0,8	0,8	1	1
0,25	1	0,8	1	1
0,33	0,8	1	1	1
0,25	0,8	1	1	1
0,5	0,6	0,8	0,8	1
0,33	0,8	0,6	0,8	0,75

The final step is to calculate the final preference value (V_i) obtained from the summation of the multiplication of normalized matrix row elements (R) by the preference weights (W). The weights used are:

W = [0.28, 0.22, 0.17, 0.17, 0.17]

The formula used is as follows:

Vi=j=1∑nWj·Rij

Explanation:
- Vi : The final preference value for alternative (i)
- Wj : Weight of criterion (j)
- R{ij} : Normalized value for alternative (i) on criterion (j)
- n : Total number of criteria

V1 = (0,28 x 1)+(0,22 x 0,4)+(0,17 x 0,4)+(0,17 x 1)+(0,17 x 0,75)
= 0,28 + 0,09 + 0,07 + 0,17 + 0,13
= 0,74
V2 = (0,28 x 0.33)+(0,22 x 0,6)+(0,17 x 0,8)+(0,17 x 1)+(0,17 x 1)
= 0,09 + 0,13 + 0,14 + 0,17 + 0,17
= 0,7
V3 = (0,28 x 0.33)+(0,22 x 0,8)+(0,17 x 0,8)+(0,17 x 1)+(0,17 x 0,75)
= 0,09 + 0,18 + 0,14 + 0,17 + 0,13
= 0,71
V4 = (0,28 x 0.33)+(0,22 x 0,8)+(0,17 x 0,8)+(0,17 x 1)+(0,17 x 1)
= 0,09 + 0,18 + 0,14 + 0,17 + 0,17
= 0,75
V5 = (0,28 x 0.25)+(0,22 x 1)+(0,17 x 0,8)+(0,17 x 1)+(0,17 x 1)
= 0,07 + 0,22 + 0,14 + 0,17 + 0,17
= 0,77
V6 = (0,28 x 0.33)+(0,22 x 0,8)+(0,17 x 1)+(0,17 x 1)+(0,17 x 1)
= 0,09 + 0,18 + 0,17 + 0,17 + 0,17
= 0,78
V7 = (0,28 x 0.25)+(0,22 x 0,8)+(0,17 x 1)+(0,17 x 1)+(0,17 x 1)
= 0,07 + 0,18 + 0,17 + 0,17 + 0,17
= 0,76
V8 = (0,28 x 0.5)+(0,22 x 0,6)+(0,17 x 0,8)+(0,17 x 0,8)+(0,17 x 1)
= 0,14 + 0,13 + 0,14 + 0,14 + 0,17
= 0,72
V9 = (0,28 x 0.33)+(0,22 x 0,8)+(0,17 x 0,6)+(0,17 x 10,8)+(0,17 x 0,75)
= 0,09 + 0,18 + 0,10 + 0,14 + 0,13
= 0,64
V10 = (0,28 x 0.33)+(0,22 x 0,6)+(0,17 x 0,8)+(0,17 x 0,8)+(0,17 x 0,75)
= 0,09 + 0,13 + 0,14 + 0,14 + 0,13
= 0,63

This calculation results in a final score for each alternative, which is then used to rank the options. Would you like to calculate these values using the given weights?
The following are the calculation results and preference predicates for each alternative which can be seen in table

Table 6: Table of calculation results and predicates

Kode	Alternatif	Hasil	Ranking
A1	Lenovo Ideapad Slim	0.74	5
A2	Asus A1400ea	0,7	8

A3	Msi Modern	0.71	7
A4	Dyaabook Satellite Pro	0,75	4
A5	Lenovo IP3	0,77	2
A6	Lenovo Ip Flex 5	0,78	1
A7	Hp Pav14	0,76	3
A8	Asus Vivobook	0,72	6
A9	Acer Aspire 5	0,64	9
A10	Macbook Pro	0,63	10

3.4. Testing

This research uses the Simple Additive Weighting (SAW) method to improve the decision support system (SPK) in selecting the best laptop for Informatics Engineering students. Based on the results of the preference value calculation, the laptop alternative that has the highest value is Lenovo IP Flex 5 with a preference value of 0.78, followed by Lenovo IP3 (0.77) and HP Pav14 (0.76). The selection is based on several key criteria, including price, processor type, RAM capacity, storage type, and storage capacity.

The advantage of this system lies in its ability to provide weight-based recommendations that suit the specific needs of users, such as Informatics Engineering students, by combining cost and benefit variables. Web-based data processing also increases the speed and accuracy of the evaluation process. These results are consistent with previous research showing the effectiveness of the SAW method in multi-criteria decision making.

However, although the system has shown good performance, there are some shortcomings. For example, the system does not consider subjective aspects, such as laptop design or brand preferences that may be important to some users. In addition, the criteria data may change with the development of the latest laptop technology.

4. Conclusion

This study successfully built a decision support system based on the SAW method that is effective in helping students choose a laptop according to their needs. The designed system is capable:

1. Provide the best laptop recommendations based on the highest preference value.
2. Increase efficiency and accuracy in the decision-making process.
3. Offer practical solutions that can be applied in real scenarios.

For future research, it is recommended to integrate real-time data and expand the scope of user surveys to increase the relevance and generalization of results. In addition, developing a system that considers aesthetic factors and brand preferences can increase user satisfaction.

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