

Implementation of Simple Additive Weighting (SAW) Method For Selecting a Tutoring Center

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Abstract

Tutoring Institutions (Bimbel) are non-formal educational institutions that work to maximize children's learning potential which may not be fully achieved through conventional education. There are many bilingual educational institutions that exist today, each with its own regulations and requirements designed to attract students, especially elementary school (SD) students. Standards that are often used as a guide to attract students are Tuition fees, distance from home, facilities, and teaching staff. Alternatives to bimbel institutions are Zefanya Bimbel, Study Star Bimbel, Camat Bimbel and Quantum Bimbel. Each bimbel institution has different requirements or policies, it presents a unique challenge for students to choose atutoring place that suits their expectations. One of the methods of problem solving that can be used is by building a computer-based system to help decision-making, the method used is the Simple Additive Weighting Method (SAW), The SAW method can select the best alternatives from several available alternatives because it is ranked after determining the weight of each feature. From this research, getting the results of Bimbel Camat becomes the recommendation of the best choice of bimbel.

Keywords: Decision Support System, Simple Additive Weighting, Alternative

1. Introduction

Learning guidance is a counseling and guidance service that enables students to develop themselves in terms of good learning attitudes and habits, learning materials that match their learning speed and difficulty, as well as various aspects of learning goals and activities, in accordance with the development of science, technology, and art [1]. Tutoring can be used as a benchmark for the academic success of elementary school students. Meanwhile, learning outcomes can be influenced by several factors, including internal and external factors of the students [2]. Many bilingual educational institutions exist today, each with its own rules and requirements designed to attract students, especially elementary school students. The standards often used as guidelines to attract students are tutoring fees, distance from home, facilities, and teaching staff. Alternative tutoring institutions include Bimbel Zefanya, Bimbel Bintang Belajar, Bimbel Camat, and Bimbel Quantum.

Choosing the best academic consulting service is a difficult decision with various features offered. Through various available media, some institutions claim that tutoring is better than other media. Each tutoring institution has different requirements or policies, which presents a unique challenge for students to choose a tutoring place that meets their expectations. One of the problem-solving methods that can be used is by building a Decision Support System (DSS). A decision support system is an information system used to assist in decision-making within an organization or company [3]. The method used is the Simple Additive Weighting (SAW) method. The SAW method can select the best alternative from several available alternatives because it ranks them after determining the weight of each feature [4].

Research with the title Decision Support System for Selecting Online Learning Platforms using the Analytical Hierarchy Process (AHP) method, using four criteria: trust, price, quality, and ease [5]. Research related to the title Decision Support System for Selecting Tutoring Institutions in Tegal City using the SMART method, using seven criteria: credibility, facilities, guarantees, transport, materials, instructors, and price [6]. Based on the research on the Implementation of the Weighted Product method in the decision support system for selecting tutoring institutions, using four criteria: cost, facilities, participant capacity, and instructor experience, the results from the decision support system built with manual calculations obtained the same value. This means that the WP method calculations in the system can be considered "Valid" [7].

In the research on the implementation of the SAW method in the decision support system for selecting a social customer relationship management model, the research results show that the SAW calculation values recommend YouTube as a business strategy medium for higher education institutions [8]. In the research titled Decision Support System for Selecting Wedding Organizer Packages Using the SAW (Simple Additive Weighting) Method, the research results indicate that the SAW method helps decision-makers obtain assessment results quickly [9].

2. Research Method

The research method used by the author is a mixed method with a sequential explanatory model. This combined model is used sequentially, where the first step involves using quantitative methods and the second step involves using qualitative methods. Quantitative research with the main data collection technique being a questionnaire. Subsequently, to check and correct the accuracy of the data from the questionnaire, data collection is conducted using qualitative methods, namely through observation and interviews [10].

2.1. Research Stages

Several stages of research conducted in this study include data collection through observation and interviews to obtain the necessary data. Research stages are an overview of the steps in solving research problems. Here is an explanation of the research stages:

- Data Collection, one of the methods used by researchers to process data is data collection, which involves the use of tools to support the research.
- Data Analysis, the data collected is obtained from the research results, then analyzed based on predetermined criteria and subsequently processed.
- Calculation with the SAW Method, in the calculation stage, after knowing the list of criteria and their respective weights, alternatives are then gathered in the alternative table.

2.2. Research Instrumen

In this study, the instrument used was a questionnaire distributed to respondents regarding the tutoring institution that serves as an alternative.

3. Result and Discussion

The Decision Support System research for selecting tutoring centers for elementary school students using the Simple Additive Weighting (SAW) method has the following steps:

3.1. Determining Criteria Data

Criteria Data that contains code, name, attribute, weight. The weight of the criteria determines how important the criteria is. The attributes of the criteria consist of benefit or cost, where benefit means the higher the value, the better, while cost means the lower the value, the better.

Table 1: Criteria Data

Criteria Code	Criteria Name	Attribute	Weight
C1	Tuition Fees	Cost	35
C2	Distance from Home	Cost	30
C3	Facilities	<i>benefit</i>	15
C4	Instructors	<i>benefit</i>	20

Of the four criteria above, there are two criteria that have cost attributes, namely tutoring fees and distance from home, because the higher the tutoring fees and the farther the distance from home, the lower the chance of being selected.

3.2. Determining Data Crips

- Data Crips (criteria values) that contain criteria codes, descriptions, and weights. Crips are optional, serving as limits for the value of each criterion. For example, if the criterion is cost, then the crips would be:
 - \leq Rp 500,000 (weight: 1)
 - \leq Rp 1,000,000 (weight: 2)
 - \leq Rp 1,500,000 (weight: 3), and so on.
- In the case of the SPK for selecting a tutoring center, the cost criterion will obviously be considered a "cost" (the smaller, the better), and the crisp weighting given above is also appropriate. Do not assign weights as follows:
 - \leq Rp 500,000 (weight: 3)
 - \leq Rp 1,000,000 (weight: 2)
 - \leq Rp 1,500,000 (weight: 1), and so on
- From the weight above, if according to the reasoning, it is indeed true that the smaller, the better. But because in your criteria you have already made the Cost attribute into a cost, the assignment of crisp values is not reversed.

Table 2: Data Crips

Criteria Code	Criteria Name	Crips	Value
C1	Tuition Fees	$>$ Rp 1.500.000	40
C1	Tuition Fees	\leq Rp 1.500.000	60
C1	Tuition Fees	\leq Rp 1.000.000	80
C1	Tuition Fees	\leq Rp 500.000	100
C2	Distance from Home	$>$ 5 Km	40
C2	Distance from Home	\leq 5 Km	60
C2	Distance from Home	\leq 3 Km	80

C2	Distance from Home	< 1 Km	100
C3	Facilities	Incomplete	40
C3	Facilities	Sufficiently Complete	60
C3	Facilities	Complete	80
C3	Facilities	Very Complete	100
C4	Instructors	High School Graduates	40
C4	Instructors	D1/D2/D3 Graduates	60
C4	Instructors	Bachelor's Degree Graduates	80
C4	Instructors	Master's Degree Graduates	100

3.3. Determining Alternative Data

Alternative Data is an alternative that will be evaluated and selected as the best alternative. Usually, alternative data includes codes and names. Other details can be adjusted according to the context of the relevant case study. In the context of selecting tutoring centers (Bimbel) for elementary school children, alternative data refers to the various tutoring centers available for elementary school children.

Table 3: Alternative Data

Alternative Code	Alternative Name
A1	Bimbel Zefanya
A2	Bimbel Bintang Pelajar
A3	Bimbel Camat
A4	Bimbel Quantum

3.4. Determining Alternative Value Data

Alternative Value reflects the assessment of each option based on all available criterion data. Here is an example of alternative values from various prospective tutoring centers.

Table 4: Alternative Value Data

Kode Alternatif	C1	C2	C3	C4
A1	Rp 1.000.000	5,5 Km	Sufficiently Complete	D1/D2/D3 Graduates
A2	Rp 1.000.000	4,8 Km	Complete	Bachelor's Degree Graduates
A3	Rp 500.000	5,2 Km	Sufficiently Complete	Bachelor's Degree Graduates
A4	Rp 1.500.000	700 M	Complete	Bachelor's Degree Graduates

3.5. Simple Additive Weighted Calculation (SAW)

3.4.1. Analysis stage

At this stage, you adjust the values of the alternatives according to the weights in the crisp data, resulting in data as shown in the following table:

Table 5: Analysis Stage

	C1	C2	C3	C4
A1	80	40	60	60
A2	80	60	80	80
A3	100	40	60	80
A4	60	100	80	80

3.4.2. Normalization stage

To perform table normalization at the analysis stage, we need to understand the following formula:

$$R_{ij} = X_{ij} / \text{Maxi } X_{ij} \text{ (if } j \text{ is a benefit attribute)}$$

$$= \text{Mini } X_{ij} / X_{ij} \text{ (if } j \text{ is a cost attribute)}$$
(1)

Explanation of each criterion:

R_{ij} : normalized performance rating value

X_{ij} : the attribute value possessed by

Maks X_{ij} : the highest value of each criterion

Min X_{ij} : the smallest value of each criterion

Benefit : each element of the matrix is divided by the maximum of the matrix row

Cost : the minimum of the matrix column divided by each element of the matrix

a. Normalization of Attribute C1 (Tutoring Cost)

For criterion C1, since it is a cost, we find the minimum (80, 80, 100, 60) = 60

Calculation of C1:

$$A1 = 60 / 80 = 0.75$$

$$A2 = 60 / 80 = 0.75$$

$$A3 = 60 / 100 = 0.6$$

$$A4 = 60 / 60 = 1$$

b. Normalization of Attribute C2 (Distance from home)

For criterion C2, since it is a cost, we find $\min(40,60,40,100) = 40$

Calculation of C2:

$$A1 = 40 / 40 = 1$$

$$A2 = 40 / 60 = 0.666667$$

$$A3 = 40 / 40 = 1$$

$$A4 = 40 / 100 = 0.4$$

c. Normalization of Attribute C3 (Facilities)

For criterion C3, since it is a benefit, we find the $\max(60,80,60,80) = 80$

Calculation for C3:

$$A1 = 60 / 80 = 0.75$$

$$A2 = 80 / 80 = 1$$

$$A3 = 60 / 80 = 0.75$$

$$A4 = 80 / 80 = 1$$

d. Normalization of Attribute C4 (Instructors)

For criterion C4, since it is a benefit, we find the $\max(60,80,80,80) = 80$

Calculation for C4:

$$A1 = 60 / 80 = 0.75$$

$$A2 = 80 / 80 = 1$$

$$A3 = 80 / 80 = 1$$

$$A4 = 80 / 80 = 1$$

Here is the normalization calculation table based on the above calculations:

Table 6: Normalization Stage

	C1	C2	C3	C4
A1	0.75	1	0.75	0.75
A2	0.75	0.666667	1	1
A3	0.6	1	0.75	1
A4	1	0.4	1	1

3.4.3. Ranking stage

At the ranking stage, we multiply the criterion weights by each row of the normalized value matrix.

$$A1 = (0.75 * 35) + (1 * 30) + (0.75 * 15) + (0.75 * 20) = 82.50$$

$$A2 = (0.75 * 35) + (0.666667 * 30) + (1 * 15) + (1 * 20) = 81.25$$

$$A3 = (0.6 * 35) + (1 * 30) + (0.75 * 15) + (1 * 20) = 82.25$$

$$A4 = (1 * 35) + (0.4 * 30) + (1 * 15) + (1 * 20) = 82.00$$

Table 7: Ranking Stage

	C1	C2	C3	C4	TOTAL	RANK
BOBOT	35	30	15	20		
A1	0.75	1	0.75	0.75	82.05	2
A2	0.75	0.666667	1	1	81.25	4
A3	0.6	1	0.75	1	82.25	1
A4	1	0.4	1	1	82	3

In the following image, the normalization calculations and ranking calculations are displayed.

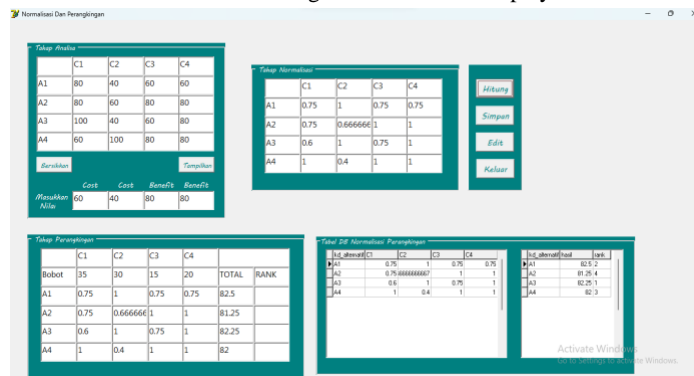


Fig. 1: Normalization and Ranking Stage through the system

4. Conclusion

Based on the calculation results using the Simple Additive Weighting (SAW) method on the decision support system for selecting a tutoring place, the 1st rank in the calculation results is Bimbel Camat with a score of 82.25. The 2nd rank in the calculation results is Bimbel Zefanya with a score of 82.05. The 3rd rank in the calculation results is Bimbel Quantum with a score of 82.00 and the 4th rank in the calculation results is Bimbel Bintang Pelajar. For further research, it is expected to use other methods or can use two methods in the decision-making process.

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