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Simple Additive Weighting (SAW) Method on The Selection of New Teacher Candidates at Integrated Islamic Elementary School

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Abstract

A decision support system is a computer-based information system that produces various alternative decisions to assist management in dealing with various structured or unstructured problems using data or models, one of which is in the problem of recruiting new teachers so that decisions are made in the right direction. The research method that used in this study is SAW (Simple Additive Weighting), which is one of the algorithms used for decision making. The SAW algorithm is also known as the weighted addition algorithm. This method requires a decision matrix normalization process (x) to a scale that can be compared with all available alternative ratings. The authors took a case study at SD IT Cinta Qur'an. SD IT Cinta Qur'an is one of the elementary schools managed by the As Salam Ilal Jannah Foundation, which is located in Tanjung Balik Village, Solok Regency. The result of the calculation of the saw method is in the form of information that can be taken into consideration by the school in making decisions on new teacher selection. In this study, six candidates as samples with five criteria were used in the calculation of the SAW method to obtain the best candidate rankings to make decisions by ordering from maximum to minimum value. It can be concluded that the SAW method can be used to support decisions in the selection of new teacher candidates by building a decision support system modeling.

Keywords: *Decision support system, SAW, new teacher acceptance*

1. Introduction

The success or failure of education is very influential on the role of a teacher. In school, teachers have full control over their students. Whether or not learning in the classroom depends on the teacher as the spearhead. Teachers are professional educators with the main task of educating, teaching, guiding, directing, training, assessing, and evaluating students in early childhood education through formal education, basic education, and secondary education[1]. Therefore, teachers are required to have academic qualifications, competence, be physically and mentally healthy, and have the ability to realize the goals of national education, an educator certificate, and have the ability to realize the goals of national education. Developing a quality teacher can be seen from various aspects, the author tries to create a decision support system to help recommend decision making for the selection of new teacher candidates.

Decision Support Systems (DSS) are part of computer-based information systems including knowledge-based systems (knowledge management) that are used to support decision-making in a corporate organization or educational institution. It can also be said as a computer system that processes data into information to make decisions on specific problems[2]. Decision Support System (DSS) is intended for decisions that require estimation or decisions that cannot be supported by algorithms [3]. DSS is intended to assist management in analyzing situations that are less structured and with unclear criteria. DSS is not intended to automate decision making, but provides an interactive tool that allows decision makers to perform various analyzes using available models[4].

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There have been many previous studies on DSS including the Simple Additive Weighting approach to Personnel Selection Problem by Alireza Afshari, Majid Mojahed and Rosnah Mohd Yusuff who examined the personnel selection process in companies in Iran with the conclusion that the selection of qualified personnel is a key factor in the success of an organization. The complexity and importance of the problem requires analytical methods rather than intuitive decisions by applying seven criteria namely qualitative and positive to select one of the best five personnel and also rank it[5].

Meriano Setya Dwi Utomo, through his research, concluded that the application of a decision support system using the SAW method can make it easier to determine candidates or prospective scholarship recipients at SMA Negeri 1 Cepu[6].

Hermanto and Izzah, through their research, concluded that the decision support system for motor product selection was the Simple Additive Weighting (SAW) method which made it easier for users to run a decision support system for selecting the best motorbike products and supporting the decision of a motorbike buyer in choosing a motorbike according to the desired criteria[7].

Dede and Adrian have also concluded through their studies that the SAW method is more suitable for use in credit cases where the results given are clearer because they are based on predetermined ratings and weights[8].

In this study, the authors took a case study at SD IT Cinta Qur'an. SD IT Cinta Qur'an is one of the elementary schools managed by the As Salam Ilal Jannah Foundation, which is located in Tanjung Balik Village, Solok Regency. Almost every year the foundation recruits new teachers. The new teacher candidates is based on the criteria set by the foundation and the school, including competence in reading quran, tahfidz, education, personality, achievement. However, in this case the foundations and schools have difficulty making decisions in choosing new teacher candidates because of the consideration of the criteria which are interrelated and affect the quality of prospective teachers. Therefore, by paying attention to existing problems and the results of previous studies, the authors use the Simple Addituve Weighting (SAW) method to solve these problems by making a decision support system modeling.

2. Research Methodology

The work steps in this research include several parts:

a) Problem Analysis
   Problem analysis is carried out to get a description of the problems at the teacher acceptance selection stage at SD IT Cinta Qur'an.

b) Identification of Requirements
   Identification of requirements is done to determine the user's requirements for the decision support system that will be designed in the selection process for new teacher candidates at SD IT Cinta Qur'an.

c) System Design
   Designing a Decision Support System for the Selection of New Teachers at SD IT Cinta Qur'an using the SAW Method. The SAW method is one of the simplest and most widely used methods of solving Multi Attribute Decision Making (MADM) problems. In addition, this method is also the easiest method to apply, because it has an algorithm that is not too complicated. The SAW method is a weighted addition method. The basic concept of the SAW method is to find the weighted sum of the performance ratings for each alternative on all criteria[9]. The SAW method is often also known as a weighted addition method. The basic concept of the SAW method is to find the weighted sum of the performance ratings for each alternative on all attributes [10]. The SAW method recognizes 2 (two) attributes, namely the benefits criteria and the costs criteria. The fundamental difference between these two criteria lies in the choice of criteria when making decisions [11].

$$r_{ij} = \begin{cases} \frac{x_{ij}}{Max_i(x_{ij})} & \text{If j is the benefit criteria} \\ \frac{Min_i(x_{ij})}{x_{ij}} & \text{If j is the cost criteria} \end{cases} \quad (1)$$

Information:

r_{ij} = normalized performance rating value
x_{ij} = attribute value by each criteria
$Max_i\ x_{ij}$ = the maximum value of each criteria i
$Min_i\ x_{ij}$ = the mimimum value of each criteria i
Benefit = if maximum value is best
Cost = if minimum value is best

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

The preference value for each alternative (Vi) is given as:

$$V_i = \sum_{j-1}^{n} w_j r_{ij} \quad (2)$$

V_i = ranking for each alternative
w_j = the weight value of each criteria
r_{ij} = normalized performance rating value

a larger V_i value indicates that the alternative A_i is preferred.

Fuzzy MADM steps use the SAW method:

1) Determine the criteria used as a reference for decision making, namely ci.
2) Determine the suitability rating of each alternative on each criteria.
3) Making a decision matrix based on the criteria (c_i), then normalizing the matrix based on the equation that is adjusted to the type of attribute (profit attribute or cost attribute) in order to obtain a normalized matrix R.
4) The final result is obtained from the ranking process, namely the sum of the normalized matrix multiplication R with the weight vector so that the maximum value is chosen as the best alternative (Ai) as a solution.

d) Decision Support System Design

Decision support systems (DSS) are computer-based systems that present and process information that enables decision-making to be more productive, dynamic, and innovative[12].

The framework of this study can be seen in Figure 1.

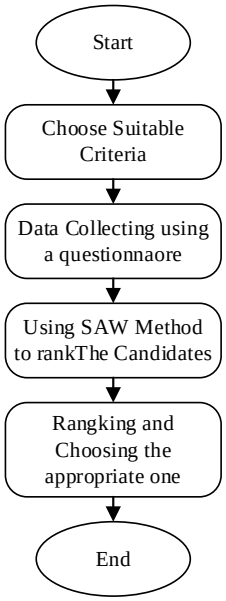

Figure 1. The Framework

3. Results and Discussion

3.1. Analysis of Input and Output requirements

The data used in this study were obtained from SD IT Cinta Qur'an which was obtained from data on the selection of new teacher candidates in 2019. Foundations and leaders set five criteria in the selection of new teacher candidates that are used as input variables, namely the ability to read and write Al-Qur'an, *Tahfidz*, graduate qualifications, personality, achievement. The output variable is the sequence of new teacher candidates who will be accepted at SD IT Cinta Qur'an from the highest to the lowest ranking.

3.2. Requirement Criteria

After determining the input variables to be used in the SAW method, the input variables are defined as criteria symbolized by C1, C2, C3, C4, and C5 for the five criteria.

a) The ability to read and write Al-Qur'an (C1)
   The ability to read and write Al-Qur'an is classified in the benefit criteria because The ability to read and write Al-Qur'an, the higher the benefits, where The ability to read and write Al-Qur'an can be used as an indicator of candidates pass.
b) *Tahfidz* (C2)
   Tahfidz is classified in the benefit criteria because *Tahfidz*, the higher the benefits, where *tahfidz* can be used as an indicator of candidates pass.
c) Graduate qualifications (C3)
   Graduate qualifications is classified in the benefit criteria because graduate qualifications, the higher the benefits, where graduate qualifications can be used as an indicator of candidates pass.
d) Personality (C4)
   Personality is classified in the benefit criteria because personality, the higher the benefits, where personality can be used as an indicator of candidates pass.
e) Achievement (C5)
   Achievement is classified in the benefit criteria because achievement, the higher the benefits, where achievement can be used as an indicator of candidates pass.
   These criteria have been mentioned in table 1.

Table 1. Criteria

Criteria	Information	Attribute
C1	The ability to read and write Al-Qur'an	Benefit
C2	*Tahfidz*	Benefit
C3	Graduate qualifications	Benefit
C4	Personality	Benefit
C5	Achievement	Benefit

After the criteria are determined, the preference weight or level of importance of each criteria is determined, with the following values:
Ci <= 70 is given a weight of 0.15 with bad value
Ci = 71-80 is given a weight of 0.25 with sufficient value
Ci = 81-90 is given a weight of 0.25 with good value
Ci> = 91 is given a weight of 0.35 with very good value
The level of importance of each criteria can be shown in table 2.

Table 2. Level of Importance of Each Criteria

Criteria	Range Value	Weight	Information
C1	Ci<=70	0,15	Buruk

Criteria	Range Value	Weight	Information
C2	Ci=71-80	0,25	Cukup
C3	Ci=81-90	0,25	Baik
C4	Ci>=91	0,35	Sangat Baik
C5			

Foundations and managements of SD IT Cinta Qur'an assign weights to each criterion. This weight will be used in calculations that produce a ranking that will use formula (2) as follows:

a) C1 is given a weight of 25%
b) C2 is given a weight of 15%
c) C3 is given a weight of 25%
d) C4 is given a weight of 20%
e) C5 is given a weight of 15%

3.3. Data Processing

From the questionnaire data processing carried out by the new teacher candidates selection team at SD IT Cinta Qur'an using six candidates, the value of each criteria for each candidates was obtained as can be shown in table 3.

Table 3. Alternative Value

Alt	C1	C2	C3	C4	C5
SH	0,35	0,25	0,35	0,25	0,25
YR	0,25	0,25	0,35	0,25	0,25
R	0,15	0,15	0,35	0,15	0,15
DA	0,25	0,25	0,35	0,25	0,25
RR	0,25	0,25	0,35	0,25	0,25
RW	0,25	0,25	0,35	0,25	0,25

After that a decision matrix is made which is formed from the suitability rating table of each alternative on each criteria as follows:

$$X = \begin{pmatrix} 0,35 & 0,25 & 0,35 & 0,25 & 0,25 \\ 0,25 & 0,25 & 0,35 & 0,25 & 0,25 \\ 0,15 & 0,15 & 0,35 & 0,15 & 0,15 \\ 0,25 & 0,25 & 0,35 & 0,25 & 0,25 \\ 0,25 & 0,25 & 0,35 & 0,25 & 0,25 \\ 0,25 & 0,25 & 0,35 & 0,25 & 0,25 \end{pmatrix}$$

3.4. Perform Normalization

At this step, the decision matrix is normalized using formula (1) as follows:

$$R_{11} = \frac{(0,35)}{MAX(0,35;0,25;0,15;0,25;0,25;0,25)} = 1 \qquad R_{21} = \frac{(0,25)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 1$$

$$R_{12} = \frac{(0,25)}{MAX(0,35;0,25;0,15;0,25;0,25;0,25)} = 0,71 \qquad R_{22} = \frac{(0,25)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 1$$

$$R_{13} = \frac{(0,15)}{MAX(0,35;0,25;0,15;0,25;0,25;0,25)} = 0,43 \qquad R_{23} = \frac{(0,15)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 0,6$$

$$R_{14} = \frac{(0,25)}{MAX(0,35;0,25;0,15;0,25;0,25;0,25)} = 0,71 \qquad R_{24} = \frac{(0,25)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 1$$

$$R_{15} = \frac{(0,25)}{MAX(0,35;0,25;0,15;0,25;0,25;0,25)} = 0,71 \qquad R_{25} = \frac{(0,25)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 1$$

$$R_{16} = \frac{(0,25)}{MAX(0,35;0,25;0,15;0,25;0,25;0,25)} = 0,71 \qquad R_{26} = \frac{(0,25)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 1$$

$$R_{31} = \frac{(0,35)}{MAX(0,35;0,35;0,35;0,35;0,35;0,35)} = 1$$
$$R_{32} = \frac{(0,35)}{MAX(0,35;0,35;0,35;0,35;0,35;0,35)} = 1$$
$$R_{33} = \frac{(0,35)}{MAX(0,35;0,35;0,35;0,35;0,35;0,35)} = 1$$
$$R_{34} = \frac{(0,35)}{MAX(0,35;0,35;0,35;0,35;0,35;0,35)} = 1$$
$$R_{35} = \frac{(0,35)}{MAX(0,35;0,35;0,35;0,35;0,35;0,35)} = 1$$
$$R_{36} = \frac{(0,35)}{MAX(0,35;0,35;0,35;0,35;0,35;0,35)} = 1$$

$$R_{41} = \frac{(0,25)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 1$$
$$R_{42} = \frac{(0,25)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 1$$
$$R_{43} = \frac{(0,15)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 0,6$$
$$R_{44} = \frac{(0,25)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 1$$
$$R_{45} = \frac{(0,25)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 1$$
$$R_{46} = \frac{(0,25)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 1$$

$$R_{51} = \frac{(0,25)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 1$$
$$R_{52} = \frac{(0,25)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 1$$
$$R_{53} = \frac{(0,15)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 0,6$$
$$R_{54} = \frac{(0,25)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 1$$
$$R_{55} = \frac{(0,25)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 1$$
$$R_{56} = \frac{(0,25)}{MAX(0,25;0,25;0,15;0,25;0,25;0,25)} = 1$$

The normalization matrix is as follows:

$$R = \begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 0,71 & 1 & 1 & 1 & 1 \\ 0,43 & 0,6 & 1 & 0,6 & 0,6 \\ 0,71 & 1 & 1 & 1 & 1 \\ 0,71 & 1 & 1 & 1 & 1 \\ 0,71 & 1 & 1 & 1 & 1 \end{pmatrix}$$

3.5. The Final Result

The final result is obtained from ranking the sum of the matrix multiplication R by the weights using the formula (2)

W=[0,25 ; 0,15 ; 0,25 ; 0,20 ; 015]

V_{11} = [(1*0,25) + (1*0,15) + (1*0,25) + (1*0,20) + (1*0,15)]
= 0,25 + 0,15 + 0,25 + 0,20 + 0,15
= 1

V_{12} = [(0,71*0,25) + (1*0,15) + (1*0,25) + (1*0,20) + (1*0,15)]
= 0,178 + 0,15 + 0,25 + 0,20 + 0,15
= 0,928

V_{I3} = [(0,43*0,25) + (0,6*0,15) + (1*0,25) + (0,6*0,20) + (0,6*0,15)]
= 0,108+0,09+0,25+0,12+0,09
= 0,658

V_{14} = [(0,71*0,25) + (1*0,15) + (1*0,25) + (1*0,20) + (1*0,15)]
= 0,178 + 0,15 + 0,25 + 0,20 + 0,15
= 0,928

V_{15} = [(0,71*0,25) + (1*0,15) + (1*0,25) + (1*0,20) + (1*0,15)]
= 0,178 + 0,15 + 0,25 + 0,20 + 0,15
= 0,928

V_{16} = [(0,71*0,25) + (1*0,15) + (1*0,25) + (1*0,20) + (1*0,15)]
= 0,178 + 0,15 + 0,25 + 0,20 + 0,15
= 0,928

From the calculation using the SAW method, the highest value is 1 and the lowest is 0.516 can be shown in Table 4.

Table 4. The Final Result

Kriteria Alternatif	Rank
SH	1

Kriteria Alternatif	Rank
YR	0,928
R	0,658
DA	0,928
RR	0,928
RW	0,928

From the value of each candidates who have been processed, the maximum value is 1 obtained by SH, so the priority of candidates who will be recommended to be accepted by the foundation and management of SD IT Cinta Qur'an.

3.6. Implementation

After obtaining recommendations through the SAW method for decision making, a decision support system is designed.

a) Designing Candidate Data Forms

Name	:
Identity Number	:
Place/Date of Birth	:
Sex	:
Religion	:
Latest Graduation	:
Address	:
Mobile Number	:
Email	:

No	Criteria	Weight
1.	The ability to read and write Al-Qur'an	0 - 1
2.	*Tahfidz*	0 - 1
3.	Graduate qualifications	0 - 1
4.	Personality	0 - 1
5.	Achievement	0 - 1

b) Designing the Ranking Result Form

No	Candidate Names	Ranking

4. Conclusion

It can be concluded that the Simple Additive Weighting (SAW) method can be applied in designing a decision support system for the selection of new teacher candidates at SD IT Cinta Qur'an. Decision support systems can help the the Foundation and management of SD IT Cinta Qur'an in making decisions in the selection process for new teacher candidates with the criteria for the ability to read and write Al-Qur'an, *Tahfidz*, graduate qualifications, personality, and achievement. Selection is based on ranking. By using the SAW method with five criteria for six candidates, the maximum value is 1 and the minimum value is 0.658. The value are ranked from largest to smallest to obtain the best candidate. The results obtained from this study also strengthen the research conducted by Sundari and Taufik, who concluded that the SAW method can be used in building a decision support system for new company employee recruitment[13].

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