Cek Similariti An approach for teacher recruitment system using simple additive weighting and TOPSIS

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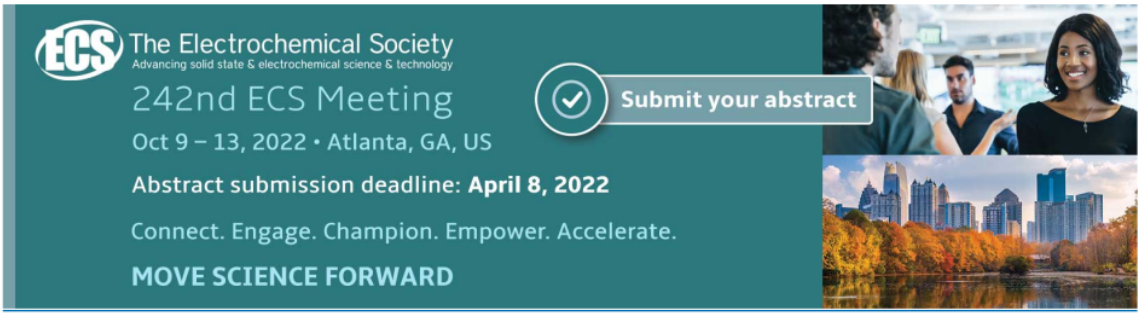

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An approach for teacher recruitment system using simple additive weighting and TOPSIS

W B Zulfikar[1], A Wahana[1]*, D S Maylawati[2], I Taufik[1] and H S Hodijah[1]

[1] Department of Informatics, UIN Sunan Gunung Djati Bandung, Jl. AH Nasution No. 105, Bandung, Indonesia
[2] Department of Informatics, Sekolah Tinggi Teknologi Garut, Jl. Mayor Syamsu No. 1, Garut, Indonesia

*wahana.agung@uinsgd.ac.id

Abstract. Teacher is one big assets of an educational institution. Each of teacher has a difference educational background, degree, work skill and also has a different attitude and ethic that affect to their performance in classroom. Generally, an educational institution implement teacher recruitment system in order to fullfill teacher's vacancy and improve academic quality. In our observation, we found several limitation and the biggest one is subjectivity issue. This work proposed a model to reduce the number of subjectivity. In experiment phase we implement both Simple Additive Weighting and TOPSIS also using several criteria as follow: appearance, work experience, communication skill, educational background, general knowledge, etc. to calculate the value of deservation. The result, both Simple Additive Weighting and TOPSIS mostly shows the same solution and futher work we suggest to add more criteria and combine other method to eliminate subjectivity issue.

1. Introduction

Teachers are a crucial part of the education system, as they play an important role in the educational development process, whether formal or informal. Teachers are human resources capable of utilizing other factors to create quality learning and become the main factor determining the quality of education [1][2].

School as an educational organization should be able to improve the quality of education by producing qualified human resources to achieve goals. Therefore, schools should have good management, one of them on the process of recruiting new teachers. Recruitment is a series of processes for the withdrawal of a group of candidates to fill that position empty in a company or agency. The recruitment process is done to people who have the ability and competence to occupy vacant positions that occur due to several things namely, teachers who are out of work, the occurrence of mutations or other things that are not planned [3][4].

Selection to prospective teachers is the first thing a school should do to get teachers who are of good quality and competent to produce quality students as well. Therefore, schools should be able to pay attention to matters related to the recruitment of teachers [5][6][7].

In observation phase, this work found several limitation and the biggest one is subjectivity issue [8][9][10]. This would be a disaster if an improper teacher is placed in an inappropriate class [11][12]. Of course this will result in decreased academic quality[13][14][15] in the school environment. This

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work purpose is to decrease subjectivity issue in teacher recruitment system using decision support system approach by Simple Additive Weighting and TOPSIS.

2. Literature review

2.1. Decision support system

Decision support system is a computer-based system consisting of three interacting components, language systems, knowledge systems and problem processing systems [16]. This technology is widely implemented in various fields, especially education [17][18][17][19].

2.2. Methods of decision support system

Simple Additive Weighting (SAW) is often known as the weighted summing method. The basic concept of the SAW method is to find the weighted sum of performance ratings on each alternative on all attributes. The SAW method requires the process of normalizing the X decission matrix to a scale comparable to all existing alternative ratings. The formula for performing the normalisai show on (1). This method widely implemented in several field as follow: scholarship recipient, biology, and especially education [20][21][22].

$$R_{ij} = \begin{cases} \dfrac{x_{ij}}{Max_{ij}^{x}} \; if\ j\ is\ benefit \\ \dfrac{Min\ x_{ij}}{x_{ij}} \; if\ j\ is\ cost\ attribute \end{cases} \quad (1)$$

R_{ij} = normalized performance rating of alternatives A_i (I =,2,…..m)
max_i = max value
min_i = min value
xij = row and column of matrix formula (Vi)

$$V_1 = \sum_{j=1}^{n} W_j r_i \quad (2)$$

Vi = last value of alternative
Wi = decided weigh
Rij = matrix normalization

The TOPSIS method is based on the concept that the best chosen alternative not only possesses the shortest distance from the ideal positive solution, but also has the longest distance from the ideal ideal solution. This method uses a simple concept and easy to understand so much used to solve problems in decision making. The TOPSIS method has the ability to measure the relative performance of decision alternatives in a simple mathematical form. This method widely implemented in several field as follow : software requirement, goat selection, evaluate hospital performance, university selection, etc. [23][24][25][26].

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=j}^{m} x^2_{ij}}} \quad (3)$$

for i = 1,2,3,…,m;
j = 1,2,3,…n;

a. W = (w1, w2, ….wn) matrix normalization shows on (4):

$$V = \begin{bmatrix} w_{11}r_{11} & \cdots & w_{1n}r_{1n} \\ \vdots & \ddots & \vdots \\ w_{m1}r_{m1} & \cdots & w_{nm}r_{nm} \end{bmatrix} \quad (4)$$

With I = 1,2,3,…m and j = 1,2,3…,n

b. Determine the ideal positive solution and the ideal negative solution. The positive ideal solution denoted by A^+ and the negative ideal solution denoted as A^-.
c. Separation measure is a measure of the distance from an alternative to a positive ideal solution and a negative ideal solution. The mathematical calculations show on (5) and (6):

$$D_i^+ = \sqrt{\sum_{j=1}^{n}(y_i^+ - y_{ij})^2} \quad (5)$$

$$D_i^- = \sqrt{\sum_{j=1}^{n}(y_{ij} - y_i)^2} \quad (6)$$

d. Calculates proximity relative to positive ideal. The relative proximity of an A + alternative with an ideal solution A- is represented by (7).

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \quad (7)$$

e. Sorting options, alernative can be ranked based on the sequence Ci. Therefore, the best alternative is one of the shortest distance to the ideal solution and distance with the ideal negative solution.

3. Experimental Method

This approach implement several criteria. This criterion becomes the reference in calculation using SAW and TOPSIS method. The criteria and the weight of the assessment of the teacher recruitment system that has been determined can be seen in table 1.

Table 1. Category and weighting of simple additive weighting and TOPSIS.

No.	Criteria	Description	SAW	TOPSIS
1	C1	Appearance	10%	3
2	C2	Work Experience	10%	3
3	C3	Communication Skill	20%	5
4	C4	Educational Background	20%	5
5	C5	Grade Point Average	5%	2
6	C6	General Knowledge	20%	5
7	C7	Tilawah and Tahfidz	15%	4

In solving the problem for decision making, the Simple Additive Weighting and TOPSIS algorithms look for weighted sums of performance ratings on each alternative on all attributes. The assessment standards implemented in this work are described in table 2.

Table 2. Assessment standard.

No.	Description	Point
1	Worst	1
2	Worse	2
3	Moderate	3
4	Good	4
5	Excellent	5

Table 3. Summary of assessment.

No	Candidate	C1	C2	C3	C4	C5	C6	C7
1	A1	3	3	4	4	4	3	3
2	A2	3	2	3	4	3	3	4
3	A3	4	5	5	4	5	4	4

Table 3. Cont.

4	A4	4	3	3	4	3	3	4
5	A5	3	3	3	3	2	3	4
6	A6	3	3	3	4	3	3	3
7	A7	4	2	2	4	2	3	3
8	A8	4	2	3	3	4	3	3
9	A9	3	3	3	4	4	3	3
10	A10	4	4	5	4	5	5	4
11	A11	3	3	3	4	4	3	3
12	A12	3	3	3	4	4	3	2
13	A13	3	2	3	4	3	3	2

. *Simple additive weighting approach*

The SAW method requires the process of normalizing the decision matrix to a scale comparable to all available alternatives. The first process is to determine the standard weight of the SAW method. After the alternative weight has been adjusted to the value of the fit then go into the normalization stage as in (1) done on A1 to An.

$$r_{1.1} = \frac{3}{Max\ \{3;3;4;4;3;3\}} = \frac{3}{4} = 0.75 \quad (8)$$

$$r_{1.2} = \frac{3}{Max\ \{3;3;4;4;4;3;3\}} = \frac{3}{4} = 0.75 \quad (9)$$

$$r_{1.3} = \frac{4}{Max\ \{3;3;4;4;4;3;3\}} = \frac{4}{4} = 1.00 \quad (10)$$

$$r_{1.4} = \frac{4}{Max\ \{3;3;4;4;4;3;3\}} = \frac{4}{4} = 1.00 \quad (11)$$

$$r_{1.5} = \frac{4}{Max\ \{3;3;4;4;4;3;3\}} = \frac{4}{4} = 1.00 \quad (12)$$

$$r_{1.6} = \frac{3}{Max\ \{3;3;4;4;4;3;3\}} = \frac{3}{4} = 0.75 \quad (13)$$

$$r_{1.7} = \frac{3}{Max\ \{3;3;4;4;4;3;3\}} = \frac{3}{4} = 0.75 \quad (14)$$

Furthermore, after obtaining the result of normalization, then will be made multiplication matrix (preference) to get ranking from all alternative use (2).

$$W = 0{,}10\ ;\ 0{,}10\ ;\ 0{,}20\ ;\ 0{,}20\ ;\ 0{,}05\ ;\ 0{,}20\ ;\ 0{,}15 \quad (15)$$

$$\begin{aligned} V1 &= (0{,}10 * 0{,}75) + (0{,}10 * 0{,}75) + (0{,}20 * 1{,}00) + (0{,}20 * 1{,}00) + (0{,}05 * 1{,}00) + (0{,}20 * 0{,}75) + (0{,}15 * 0{,}75) \\ &= 0{,}075 + 0{,}075 + 0{,}20 + 0{,}20 + 0{,}05 + 0{,}15 + 0{,}112 \\ &= 0{,}862 \end{aligned} \quad (16)$$

$$\begin{aligned} V2 &= (0{,}10 * 0{,}75) + (0{,}10 * 0{,}50) + (0{,}20 * 0{,}75) + (0{,}20 * 1{,}00) + (0{,}05 * 0{,}75) + (0{,}20 * 0{,}75) + (0{,}15 * 1{,}00) \\ &= 0{,}075 + 0{,}05 + 0{,}15 + 0{,}20 + 0{,}037 + 0{,}15 + 0{,}15 \\ &= 0{,}812 \end{aligned} \quad (17)$$

$$\begin{aligned} V3 &= (0{,}10 * 0{,}80) + (0{,}10 * 1{,}00) + (0{,}20 * 1{,}00) + (0{,}20 * 0{,}80) + (0{,}05 * 1{,}00) + (0{,}20 * 0{,}80) + (0{,}15 * 0{,}80) \\ &= 0{,}08 + 0{,}10 + 0{,}20 + 0{,}16 + 0{,}05 + 0{,}16 + 0{,}12 \end{aligned} \quad (18)$$

= 0,870

3.2. TOPSIS

The TOPSIS algorithm performs calculations with concepts based on the best selected alternative values that not only have the shortest distance from the ideal ideal solution, but also have a long distance from the ideal ideal solution. Next determine the normalization of the matrix. Topsis requires an alternative performance rating on every normalized ceriteria:

$$r_{1\,1} = \frac{3}{12{,}328} = 0{,}243 \quad (19)$$

$$r_{2\,1} = \frac{3}{12{,}328} = 0{,}243 \quad (20)$$

$$r_{3\,1} = \frac{4}{12{,}328} = 0{,}729 \quad (21)$$

$$r_{4\,1} = \frac{4}{12{,}328} = 0{,}729 \quad (22)$$

$$r_{5\,1} = \frac{3}{12{,}328} = 0{,}243 \quad (23)$$

$$r_{6\,1} = \frac{3}{12{,}328} = 0{,}243 \quad (24)$$

$$r_{7\,1} = \frac{4}{12{,}328} = 0{,}729 \quad (25)$$

Furthermore, it determines the value of the positive ideal solution A+ and the ideal ideal value of A- as follows:

$$Y_1^+ = \text{Max}\{0{,}729 ; 0{,}729 ; 0{,}729 ; 0{,}972 ; 0{,}729 ; 0{,}729 ; 0{,}972 ; 0{,}972 ; 0{,}729 ; 0{,}972 ; 0{,}729 ; 0{,}729 ; 0{,}729\} = 0{,}972 \quad (26)$$

$$Y_2^+ = \text{Max}\{0{,}829 ; 0{,}546 ; 1{,}368 ; 0{,}819 ; 0{,}819 ; 0{,}819 ; 0{,}546 ; 0{,}646 ; 0{,}819 ; 1{,}095 ; 0{,}819 ; 0{,}819 ; 0{,}819\} = 1{,}368 \quad (27)$$

$$Y_3^+ = \text{Max}\{1{,}625 ; 1{,}220 ; 2{,}030 ; 1{,}220 ; 1{,}220 ; 1{,}220 ; 0{,}810 ; 1{,}220 ; 1{,}220; 2{,}030 ; 1{,}220 ; 1{,}220 ; 1{,}220\} = 2{,}030 \quad (28)$$

$$Y_1^- = \text{Min}\{0{,}729 ; 0{,}729 ; 0{,}729 ; 0{,}972 ; 0{,}729 ; 0{,}729 ; 0{,}972 ; 0{,}972 ; 0{,}729 ; 0{,}972 ; 0{,}729 ; 0{,}729 ; 0{,}729\} = 0{,}729 \quad (29)$$

$$Y_2^- = \text{Min}\{0{,}829 ; 0{,}546 ; 1{,}368 ; 0{,}819 ; 0{,}819 ; 0{,}819 ; 0{,}546 ; 0{,}646 ; 0{,}819 ; 1{,}095 ; 0{,}819 ; 0{,}819 ; 0{,}819\} = 0{,}546 \quad (30)$$

$$Y_3^- = \text{Min}\{1{,}625 ; 1{,}220 ; 2{,}030 ; 1{,}220 ; 1{,}220 ; 1{,}220 ; 0{,}810 ; 1{,}220 ; 1{,}220; 2{,}030 ; 1{,}220 ; 1{,}220 ; 1{,}220\} = 0{,}810 \quad (31)$$

Next step, this approach determines the distance between the value of each alternative with a positive ideal solution matrix and the ideal negative solution matrix. The final process of determining the preference value for each alternative preference value can be given as follows:

$$A1 = \frac{1,034}{1,034+1,171} = \frac{1,034}{2,205} = 0,468 \quad (32)$$

$$A2 = \frac{0,878}{0,878+1,481} = \frac{0,878}{2,359} = 0,372 \quad (33)$$

$$A3 = \frac{1,691}{1,691+0,484} = \frac{1,691}{2,175} = 0,777 \quad (34)$$

$$A4 = \frac{0,950}{0,950+1,327} = \frac{0,950}{2,227} = 0,417 \quad (35)$$

$$A5 = \frac{0,832}{0,832+1,437} = \frac{0,832}{2,269} = 0,366 \quad (36)$$

$$A6 = \frac{0,771}{0,771+1,390} = \frac{0,771}{2,201} = 0,338 \quad (37)$$

$$A7 = \frac{0,547}{0,547+1,711} = \frac{0,547}{2,258} = 0,242 \quad (38)$$

4. Result and discussion

In other research, simple additive weighting working properl[16]n order to decision support system [15][27][28][29]. According to the experiment phase, we found that there are no significant differences. In table 4 it can be seen that the highest value in each method lies in the alternative A10 as well as the lowest value found on alternative A7. The difference lies in the rankings 6, 7, 8 and 9, on the SAW method ranked 6th is the A9 alternative, the 7th is the A11 alternative, the 8th is the A6 alternative and the 9th is the A5 alternative. While using the TOPSIS method, the 6th rank is an A5 alternative, the 7th rank is an A9 alternative, the 8th is the A11 alternative and the 9th is the A6 alternative.

This approach occured the greatest value lies in A3, A10 and A1. The results are in accordance with the actual circumstances in which alternative 3, Alternative 10, and Alternative 1 are accepted as teachers. The result of the comparison of SAW algorithm and TOPSIS algorithm is that both algorithms have similarity in the process of problem solving, but the results obtained from the calculations performed by using TOPSIS algorithm is better than the SAW method.

Table 4. Comparation summary.

No.	SAW		TOPSIS	
	Candidate	**Value**	**Candidate**	**Value**
1	A10	0.890	A10	0.865
2	A3	0.870	A3	0.777
3	A1	0.862	A1	0.468
4	A4	0.862	A4	0.417
5	A2	0.812	A2	0.372
6	A9	0.812	A5	0.366
7	A11	0.812	A9	0.357
8	A6	0.799	A11	0.357

Table 4. Cont.

9	A5	0.775	A6	0.338
10	A12	0.775	A12	0.314

11	A8	0.762	A8	0.301
12	A13	0.737	A13	0.293
13	A7	0.737	A7	0.242

5. Conclusion

According to evaluation phase, 13 applicants on the calculation result using Simple Additive Weighting (SAW) method and Technique Order Preference by Similarity to Ideal Solution (TOPSIS), the highest value is in A3, A10 and A1. The results are in accordance with the actual circumstances in which Alternatives 3, Alternative 10, and Alternative 1 are accepted as teachers at the AlMishbah Foundation. While the difference in ranking lies in the rankings A6, A7, A8 and A9. The result of comparison of SAW algorithm and TOPSIS algorithm is that both algorithms have similarities in the process of problem solving, but the results obtained from calculations performed by using TOPSIS algorithm is better than SAW method. In future work, we suggest to add more specific criteria. For example, a english teacher may has several differ criteria than a math teacher.

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