Application of fuzzy selection method of accompany computer laboratory assistant recommendation

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Abstract. The admission process computer lab assistant candidates are a routine activity to get a candidate assistant in accordance with the desired criteria. In the selection process is often difficult to determine the candidate who passed the selection because there are some candidates who have the ability not much different. Therefore, to optimize the selection process for the admission of computer lab assistant candidates, a system is needed in decision making based on the weighting of each predetermined criteria, such as Semester, GPA, Practical Course Value, Written Test, Competency Test, and Test Interview. The method used in decision making is by applying the TOPSIS fuzzy problem-solving method, which is one of the multi-attribute fuzzy methods for decision-making based on the concept where the chosen alternative not only has the shortest distance from the ideal solution but also has the longest distance from the ideal solution negative. In the application, this method will generate an alternate ranking where the selected alternative is the top ranking alternative that is tailored to the needs/quota on the acceptance selection of the assistant and will produce a competent candidate according to the criteria which has been specified.

1. Introduction

Computer laboratory is one of the facilities to support teaching activity. This facility has a function as a mean for conducting a practice or a theoretic implementation, research, and scientific development. To support the teaching and learning process in a computer laboratory, a laboratory assistant is needed. The laboratory assistant is a student who has been selected through several admission phases. This assistant's duty is to assist other students in learning, supervising and assisting processes and to carry out other tasks related to the practicum class conducted in the computer laboratory.

Registration process for the IBI Darmajaya laboratory assistant candidate was still use manual process. The candidate submitted the requirement to the laboratory administrative division. Moreover, the assessment process for the assistant candidate was also still subjective due to a lack of the consideration on the weight criteria. Furthermore, the assessment process also had different assessment standards and difficulties to determine the selected candidate due to the candidates' similar skills. To optimize the assessment process, a decision making system had to be built and it was based on the weight criteria which had been prepared through TOPSIS fuzzy method. Previously done research [1] build decision support system computer laboratory assistant recommendation using fuzzy Simple Additive Weight based offline. The research entitled the implementation of TOPSIS fuzzy method for the selection of employee acceptance builds a system that can provide recommendations as a consideration for proper decision making in selection of employee [2]. Previous research [3] implemented fuzzy inference system Mamdani to help the management decision in appropriateness

financing to apply for goods credit. While the research conducted [4] builds a multi-dimensional data-driven Decision Support System using Fuzzy TOPSIS as a recommendation against evaluation of supply on Electronic Government Procurement System (SPSE).

Based on the background of the problem, the formulation of the problem was build the decision making system through the TOPSIS fuzzy method for the admission of the laboratory assistant candidate based on each the weighting of any predefined criteria web-based.

2. Theoretical review

2.1. Admission of assistant candidate

Admission of laboratory assistant candidate is the routine activity conducted in every academic year. The admission of laboratory assistant candidate is done by selecting the candidate based on the predetermined criteria e.g., semesters, practicum course scores, written tests, competency tests, and interview tests. They are used to optimize the actual learning process. In the admission of the laboratory assistant candidate, there is a work instruction which is used as a reference for the laboratory manager to implement the admission of a new laboratory assistant involving all IBI Darmajaya academic communities.

2.2. Decision support system

The decision support system concept uses Management Decision System [5]. Decision-making is basically a form of selection from a variety of alternative actions which have been chosen through a certain mechanism for creating the best decision. The decision support process begins with the intelligence, design, selection, and implementation.

2.3. Fuzzy Multiple Attribute Decision Making (FMADM)

Fuzzy Multiple Attribute Decision Making (FMADM) is the method used to find the optimal alternative of a number of alternatives with the certain criteria. The essence of FMADM is to determine the weight score for each attribute and to determine the ranking process used to select the provided alternatives. Several methods which can be used to solve FMADM problems are Simple Additive Weighting Method (SAW), Weighted Product (WP), ELECTRE, Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), and Analytic Hierarchy Process (AHP). These methods are used to take a conversion from fuzzy to crisp data by determine the ranking process.

2.4. Fuzzy TOPSIS (*Technique for Order Preference by Similarity to Ideal Solution*)

Fuzzy TOPSIS is the method that can assist the systematic evaluation chosen from several alternatives based on the certain criteria by which each criterion has a fuzzy score. The TOPSIS fuzzy method is simple and easy to understand. Moreover, the computation is efficient, and has the ability to measure a relative performance of the decision alternatives in simple mathematical form [6]. The TOPSIS fuzzy method procedures are as follows [6]:

a) To determine the criteria related to the case study.
b) To determine the weight and important rate of each criterion.
c) To determine the membership degree of each criterion on each alternative.
d) To convert fuzzy numbers of a decision matrix into crisp numbers.
e) To determine the normalized decision matrix (R).
f) TOPSIS requires a performance rating on each prospective employee at any normalized criteria or sub criteria. The normalized matrix is formed from the equation (1).

$$Rij = \frac{Xij}{\sqrt{\sum_{i=1}^{n} x_{ij}{}^{2}}} \quad (1)$$

g) To calculate a weighted normalized decision matrix (Y)

To calculate the normalized matrix by (Y_{ij}), the W weight is firstly determined to represent the absolute preferences of the decision maker. The weight value preference indicates the relative important rate of each criterion or sub criteria in the equation (2):

$$Yij = Wij \,.\, Rij \qquad \text{where } W = \{W1, W2, \ldots, Wn\} \tag{2}$$

h) To calculate the positive and negative ideal solution matrix (A- and A +)
The positive and negative ideal solution can be determined by a normalized weight rating. The requirement to calculate the ideal solution score which is used to determine whether it is beneficial or costly is needed using equation (3) and (4).

$$A^+ = \{Y_1^+, Y_2^+, \ldots, Y_n^+\} \tag{3}$$
$$A^- = \{Y_1^-, Y_2^-, \ldots, Y_n^-\} \tag{4}$$

With the requirement that: $y_j^+ = \begin{cases} \max y_{ij}; & If\ j\ is\ benefit\ attribute \\ \min y_{ij}; & If\ j\ is\ cost\ attribute \end{cases}$

$$y_j^- = \begin{cases} \min y_{ij}; & If\ j\ is\ benefit\ attribute \\ \max y_{ij}; & If\ j\ is\ cost\ attribute \end{cases}$$

i) To calculate the distance between each alternative score and the ideal positive and negative solution matrix (Di^+ and Di^-). Through an equation (5) and (6).

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

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

j) To calculate the preference score for each alternative **(Vi)**
The preference value **(Vi)**for each alternative is formulated using equation (7).

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \tag{7}$$

3. Result and discussion

3.1. Data Source Analysis

The data used in this research was the data of registrants as IBI Darmajaya computer laboratory assistant candidate in the academic year of 2015/2016. Moreover, the assistant candidate came from Informatics Engineering Study Program seen on table 1.

Table 1. Registrant data.

No	Student Number	Candidates	SEMESTER	GPA
1	1311010046	Indra Sahari	5	2.80
2	1311010059	Ahmad Farhan Afifi	5	3.44
3	1311010062	Yogi Maulana	5	1.93
4	1311010102	Irvan Rimhot Sijabat	5	3.15
5	1311010126	Nina Mutmainah	5	3.33
6	1111010017	Robby Muksin	9	3.12
7	1311010134	Mandaleka Saputri	5	2.93

No	Student Number	Candidates	SEMESTER	GPA
8	1411010024	Teddy Pratama	3	3.39
9	1411010048	Firdaus	3	3.72
10	1411010073	Ananda Dharmayana Rani	3	3.22
11	1311010081	Paksia Margono, S.Pd	5	3.63
12	1411010029	Muhammad Harisuddin	3	2.79

3.2. Fuzzy TOPSIS analysis

The calculation process of this research used TOPSIS fuzzy method. This method was used to rank the assistant candidates based on predetermined criteria. The alternative candidate data could be seen on table 2.

Table 2. Alternative candidate.

Alternative Candidates	Criteria					
	Semester	GPA	Practicum Course Score	Written Test	Competency Test	Interview Test
Farhan	5	3.44	81.2	65	40	90
Irvan	5	3.15	79.2	25	40	55
Nina	5	3.33	76.1	70	42	65
Paksia	5	3.39	85.4	30	41	65
Teddy	3	3.39	80.0	70	64	95
Firdaus	3	3.72	80.0	80	65	90
Ananda	3	3.22	80.0	75	66	90

Criteria used as a reference in the admission process can be seen on the table 3. Each criterion had the important weight rate. In addition, all criteria had the benefit attribute. This was because the highest score of each criterion was the best one so it was beneficial.

Table 3. Important rate criteria.

No	Name	Important Rate	Weight	Attribute
1	Semester (C_1)	Important	10%	*Benefit*
2	GPA (C_2)	Important	10%	*Benefit*
3	Practicum Course Score (C_3)	Important	10%	*Benefit*
4	Written Test (C_4)	Very Important	30%	*Benefit*
5	Competency Test (C_5)	Very Important	30%	*Benefit*
6	Interview (C_6)	Important	10%	*Benefit*

The score given for each criterion based on the specified fuzzy numbers could be seen in table 4 to table 9.

Table 4. Semester Criteria (C1).

Semester	Fuzzy Numbers	Crisp Numbers
Semester < 3 or Semester > 8	Limited (K)	0.00
3 – 4	Sufficient (S)	0.25
5 – 6	Good (G)	0.50
7 – 8	Very Good (VG)	0.75

Table 5. GPA Criteria (C2).

IPK	Fuzzy Numbers	Crisp Numbers
GPA< 3	Limited (K)	0.00
3	Sufficient (S)	0.25
3 >GPA< 3,5	Good (G)	0.50
GPA> 3,5	Very Good (VG)	0.75

Table 6. Practicum Course Score Criteria (C3).

Practicum Course Score	Fuzzy Numbers	Crisp Numbers
< 56	Limited (K)	0.00
56 – 69	Sufficient (S)	0.25
70 – 79	Good (G)	0.50
≥ 80	Very Good (VG)	0.75

Table 7. Written Test Criteria (C4).

Written Test Score	Fuzzy Numbers	Crisp Numbers
< 50	Limited (K)	0.00
50 – 59	Sufficient (S)	0.25
60 – 69	Good (G)	0.50
≥ 70	Very Good (VG)	0.75

Table 8. Competency Test (C5).

Competency Test Score	Fuzzy Numbers	Crisp Numbers
< 50	Limited (K)	0.00
50 – 59	Sufficient (S)	0.25
60 – 69	Good (G)	0.50
≥ 70	Very Good (VG)	0.75

Table 9. Interview Criteria (C6).

Interview Test Score	Fuzzy Numbers	Crisp Numbers
< 50	Limited (K)	0.00
50 – 59	Sufficient (S)	0.25
60 – 69	Good (G)	0.50
≥ 70	Very Good (VG)	0.75

Score given to each alternative on each criterion could be seen on table 10.

Table 10. Alternative score on each criteria.

Alternative (A)	Variable					
	C1	C2	C3	C4	C5	C6
A1	0.50	0.50	0.75	0.50	0.0	0.75
A2	0.50	0.50	0.50	0.00	0.0	0.25
A3	0.50	0.50	0.50	0.75	0.0	0.50
A4	0.50	0.50	0.75	0.00	0.0	0.50

Alternative (A)	Variable					
	C1	C2	C3	C4	C5	C6
A5	0.25	0.50	0.75	0.75	0.5	0.75
A6	0.50	0.75	0.75	0.75	0.5	0.75
A7	0.25	0.50	0.75	0.75	0.5	0.75

According to the fuzzy TOPSIS procedure and equation (1) – (7), Alternative Preference Score was obtained on the table 11.

Table 11. Alternative preference score.

Alternative	Preference (V)	Graduation Result
Firdauss	0.9083	Passed
Teddy	0.8872	Passed
Ananda	0.8872	Passed
Nina	0.4272	Unpassed
Farhan	0.3634	Unpassed
Paksia	0.1196	Unpassed
Irvan	0.0917	Unpassed

A result of the calculation on the rank process by using TOPSIS fuzzy method showed that there were 3 candidates who were passed with the highest score. It meant that there was a feasibility score on the laboratory assistant candidate.

3.3. Discussion

The advantages of TOPSIS fuzzy system is to facilitate the computer laboratory in recruitment process prospective assistant because registration is online. Disadvantages of this system is the absence of login system for the registrant, so it is less secure, the system has not been able to directly manage the value of the assistant candidate so that the recapitulation process of the assistant candidate data value is still calculated manually.

4. Conclusion

TOPSIS fuzzy method can be used in the admission process for assistant candidate, so that it can produce the ranking about computer laboratory assistant candidate. Thus, the admission process for this assistant candidate is more objective and related to the specified criteria. Based on the data of candidate assistant (alternative) that has been calculated using TOPSIS fuzzy method there are 3 candidates who pass the selection and occupy the top ranking is Firdaus (with value = 0.9899) followed by Teddy and Ananda (with value = 0.9840).

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