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Decision Support System for Best Lecturer Selection using Analytical Network Process (ANP) and TOPSIS Method

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Abstract
Lecturer performance is influential in increasing student learning motivation. Each lecturer has a different character, nature and way of teaching. This causes students to choose and determine the best lecturer according to the students themselves. One of the Decision Support Systems (DSS) in assessing the best lecturers is using the ANP and TOPSIS methods. The Analytic Network Process (ANP) method is used to determine the weight of the criteria according to decision making, then the TOPSIS method is used to determine the rank / achievement of lecturers. This decision support system is expected to help and provide an alternative in assessing lecturer achievement. The results of this study will be in the form of an information system which is expected to assist in processing data by designing the best lecturer assessment information system using the ANP and TOPSIS methods

Keywords: DSS; Best Lecturer; ANP; TOPSIS

1.0 INTRODUCTION

The lecturer factor that most dominantly affects the quality of learning in a class is the performance of the lecturer. Lecturer performance is influential in increasing student learning motivation, one of which is the delivery of material in class learning. This is the case with Pelita Indonesia Higher Education (STIKOM) which is required to guarantee the quality of lecturers which will motivate students to learn.

The Analytic Network Process (ANP) method is one of the methods of decision making based on many criteria or Multiple Criteria which is an advanced development of the Analytic Hierarchy Process (AHP) method, which allows dependencies between criteria and alternatives that do not exist in the AHP method. With feedback (feedback), all alternatives can depend on the criteria, as well as interdependent among these alternatives (Gustriansyah 2016). There are standard assessment criteria to evaluate the best teacher performance and there is no appropriate method in determining the assessment.

The TOPSIS method is one method that is widely used to solve practical decision making. The concept of the alternative chosen by TOPSIS is the best alternative (Rahim et al. 2018). This is because the concept is simple and easy to understand, the computation is efficient and has the ability to measure the relative performance of decision alternatives, this problem is known as the multiple criteria decision making (MCDM) problem. MCDM can be called a decision making to choose the best alternative from a number of alternatives based on certain criteria (Balioti, Tzimopoulos, and Evangelides 2018).

In this study, the selection of the best lecturers at Pelita Indonesia (STIKOM) will be carried out according to predetermined criteria, so the ANP method is used and combined with the TOPSIS method in determining the criteria. The criteria used are Education and Teaching, Research, Community Service, Supporting Activities. For this reason, a method is needed to determine the student's preferred lecturer with their respective needs, including using multi-criteria decision-making techniques such as ANP and TOPSIS (Ballı and Korukoğlu 2009).

2.0 LITERATURE REVIEW

Literature Review is previous research that has a relationship with this research, so there is a comparison or a clearer source of how this study was made. Comparisons are made to find which method is better to apply. Table 1 consists of the comparisons of previous studies.

Table 1. Literature Review

No.	Author	Title	Method	Result
1	Christine Natalia, et al. (2020)	Integrated ANP and TOPSIS Method for Supplier Performance Assessment	ANP and TOPSIS	A supplier has become one of the main factors that influence the success of a company's supply chain activities. Supplier assessment is vital as suppliers have different performance. This study aims at assessing supplier performance using the integration of ANP and TOPSIS methods. Supplier performance assessment was based on supplier criteria indicators. Weighting criteria used ANP used to determine the most significant influence criteria of supplier performance. Furthermore, TOPSIS was also employed to obtain supplier preference. Eight criteria and twenty-five sub-criteria were used for the supplier performance assessment. The three highest sub-criteria were specification of quality, the flexibility of order changes, and production capacity. The priority results for suppliers were sorted from the highest to lowest ratio values.
2	Robbi Rahim, et al. (2018)	TOPSIS Method Application for Decision Support System in Internal Control for Selecting Best Employees	TOPSIS	In this research, the computational method of decision-making system used is Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). The criteria used in the selection of the best employees are: job responsibilities, work discipline, work quality, and behavior. The final result of the global priority value of the best employee candidates is used as the best employee selection decision making tool by top management.
3	Vasiliki Balioti, et al. (2018)	Multi-Criteria Decision Making Using TOPSIS Method Under Fuzzy Environment Application in Spillway Selection	TOPSIS	In this paper, the above method is used and especially the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method for the selection of a spillway for a dam in the district of Kilkis in Northern Greece—'Dam Pigi'. As the criteria were fuzzy and uncertain, the Fuzzy TOPSIS method is introduced together with the AHP (Analytic Hierarchy Process), which is used for the evaluation of criteria and weights. Five types of spillways were selected as alternatives and nine criteria. The criteria are expressed as triangular fuzzy numbers in order to formulate the problem. Finally, using the Fuzzy TOPSIS method, the alternatives were ranked and the optimum type of spillway was obtained.
4	Zha Shanshan, et al. (2018)	A Hybrid MCMD Approach Based on ANP and TOPSIS for Facility Layout Selection	ANP and TOPSIS	An application of a new aeronautic component assembly workshop facility layout selection is conducted. To further illustrate the advantage of the proposed approach, the difference between ANP-TOPSIS and AHP-TOPSIS methods are compared and discussed. Results have demonstrated the effectiveness and feasibility of the proposed method.

3.0 METHODOLOGY

Analysis of data selection starts from processing input data into useful information for decision makers. The process includes stages. It begins with determining the criteria needed in selecting outstanding lecturers. After obtaining the required criteria, then determine the interdependence relationship between the existing criteria. Next is to calculate the priority weight of the criteria by considering the effect of dependence between criteria using the ANP method (Natalia, Surbakti, and Oktavia 2020). After obtaining the priority weighting of the dependency criteria, the next step is to rank outstanding lecturers using the TOPSIS method in order to obtain a recommendation order of outstanding lecturers.

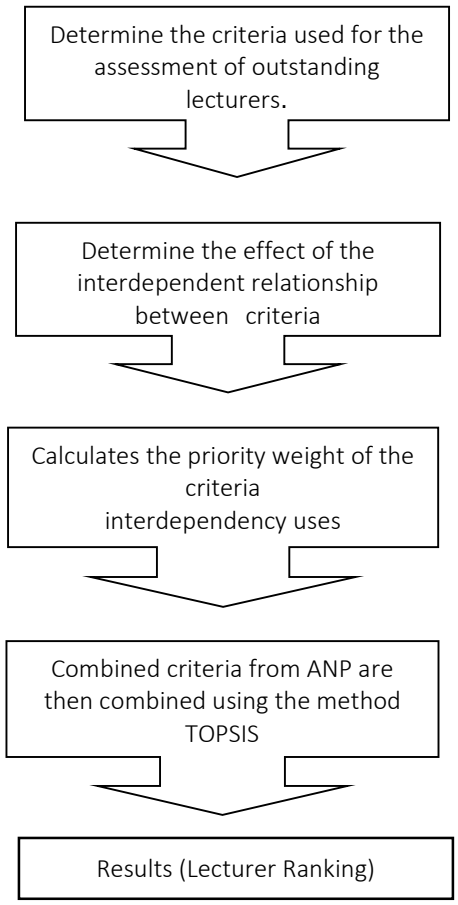

Figure 1. Stages of Data Analysis to the Decision Making Process

Decision Support System (DSS)

A system that is able to provide problem-solving abilities and communication skills for problems with semi-structured and unstructured conditions. This system is used to assist decision making in semi-structured and unstructured situations, where no one knows exactly how decisions should be made (Yohanes and Hajjah 2019). Basically a decision support system is a further development of a computerized management system designed in such a way as to be interactive user. This interactive nature is intended to facilitate integration the ratio between the various components in decision making process (Andra and Hajjah 2020).

Analitycal Network Process (ANP)

Analytic Network Process (ANP) is one of the methods of decision making based on many criteria or Multiple Criteria for Decision Making (MCDM) developed by Thomas L. Saaty. This method is a new approach to qualitative methods which is an advanced development of the Analytic Hierarchy Process (AHP) method (Alfian, Sandy, and Fathurahman 2013).

Weighting with ANP requires a model that represents the interrelationship between the criteria and its sub-criteria. There are 2 controls that need to be considered in modeling the system for which we want to know

the weight. The first control is a hierarchical control that shows how the criteria and sub-criteria are related (Kadoić, Ređep, and Divjak 2017). This control does not require a hierarchical structure like the AHP method. Another control is linkage control which shows the interrelationship between criteria and clusters(Govindaraju et al. 2015). This method is a development of the AHP method, which allows dependencies between criteria and alternatives that do not exist in the AHP method. With feedback (feedback), all alternatives can depend on the criteria, or interdependent among these alternatives (Zare et al. 2018).

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

The TOPSIS method is a multi-criteria decision-making method that was first introduced by Yoon and Hwang in 1981. This method is one of the most widely used methods for practical decision-making. The concept of the alternative chosen by TOPSIS is the best alternative which has the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution (Riandari, Hasugian, and Taufik 2017).

The more factors that must be considered in the decision-making process, the more difficult it will be to make a decision on an issue. Especially if the decision making of a particular problem involves several decision makers, besides considering various factors / various criteria (Muzakkir 2017). Such a problem is known as the Multiple Criteria Decision Making (MCDM) problem. In other words, MCDM can be called a decision making to choose the best alternative from a number of alternatives based on certain criteria (Sumiyatun and Wardoyo 2016).

The TOPSIS method steps are as follows (Zha et al. 2018):

a. Making an alternative decision matrix Ai on each criterion Fi, then normalized to a matrix R (rij) using Equation (1).

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}$$,i=1,2,.,m, and j=1,2,3, . . .,

n (1)

where:

r_{ij} = normalized matrix

x_{ij} = decision matrix

b. Calculating a weighted normalized decision matrix using Equation (2)

$$v_{ij} = W_j * r_{ij}$$

(2)

where wij is the weight of the j-criteria.

c. Determine the positive ideal solution (Sj +) and the negative ideal solution (Sj^-) with Equations (3) and (4)

$S_j^+ = \{(\max V_{ij} \mid j \in J), (\min V_{ij} \mid j \in J'), i=1,2,3,...m\} = \{V_1^+, V_2^+,..., V_n^+\}$

(3)

$S_j^- = \{(\min V_{ij} \mid j \in J), (\max Vij \mid j \in J'), i=1,2,3,...m\} = \{ V_1^-, V_2^-...., V_n^-\}$

(4)

J = {j = 1,2,3, ..., n and j are benefit criteria}

J = {j = 1,2,3, ..., n and j are cost criteria}

d. Determine the distance between each alternative Vi with the ideal positive solution and the ideal solution negative with Equations (5) and (6).

$$Si^+ = \sqrt{\sum_{j=1}^{n} (V_{ij} - V_j^+)^2},$$ with

i=1,2,3,...,m

(5)

$Si^{-} = \sqrt{\sum_{j=1}^{n}(V_{ij} - V_j^{-})^2}$, whit

i=1,2,3,...,m

(6)

e. Calculating the value of closeness

$$C_i^{+} = \frac{Si-}{S_i^{+} + S_i^{-}}$$

(7)

where $0 \leq Ci+ \leq 1$ and i = 1,2,3,....,m

f. Sort the closeness coefficient value

3.0 RESULTS AND DISCUSSION

Criteria

One of the most important parts of the DSS is determining criteria and measuring indicators. Therefore, the design and selection of indexes as input of the decision making model have a direct impact on the efficiency of the model (Shahroudi, K., Rouydel, H., Assimi, S., & Eyvazi, 2011) [5]. The criteria and sub criteria are as follows:

a. (K1) Education and Teaching, with sub criteria: (E11) Lectures, (E12) Evaluators.
b. (K2) Research, with sub criteria: (E21) Scientific Publications, (E22) Model.
c. (K3) Community Service, with sub criteria: (E31) Consultation, (E32) Education and Research Development.
d. (K4) Supporting Activities, with sub criteria: (E41) Committee, (E42) Seminar Participants.

Calculating the Criteria Priority Vector with Interference

Criteria pairwise comparison matrix serves to obtain eigenvalues and see the consistency of the ratio of comparisons (CR), where the requirement for CR ≤ 0.1. This comparison value is obtained from the decision maker.

Table 1. Matrix of Pairwise Comparison of Criteria for Education and Teaching

	K2	K3	K4	Total	Ev
K2	1	3	2	6	0.49
K3	0.33	1	3	4.33	0.36
K4	0.5	0.33	1	1.83	0.15
Total	1.83	4.33	6	12.17	1.00

Table 2. Paired Matrix for Lecture Sub-Criteria for Research

	E21	E22	Total	Ev
E21	1	0.33	1.33	0.25
E22	3	1	4	0.75
Total	4	1.33	5.33	1.00

Table 3. Unweight Supermatriks

		K1		K2		K3		K4	
		E11	E12	E21	E22	E31	E32	E41	E42
K1	E11	0	0	0,25	0,75	0,2	0,8	0,17	0,83
	E12	0	0	0,17	0,83	0,25	0,75	0,2	0,8
K2	E21	0,25	0,75	0	0	0,33	0,67	0	0
	E22	0,17	0,83	0	0	0,13	0,87	0	0
K3	E31	0,2	0,8	0,2	0,8	0	0	0	0
	E32	0,17	0,83	0,13	0,87	0	0	0	0
K4	E41	0,13	0,87	0	0	0	0	0	0
	E42	0,33	0,67	0	0	0	0	0	0

Table 4. Weight Supermatrix

		K1		K2		K3		K4	
		E11	E12	E21	E22	E31	E32	E41	E42
K1	E11	0	0	0,0833	0,2500	0,0500	0,2000	0,0333	0,1667
	E12	0	0	0,0333	0,1667	0,0833	0,2500	0,0500	0,2000
K2	E21	0,0833	0,2500	0	0	0,1667	0,3333	0	0
	E22	0,0333	0,1667	0	0	0,0179	0,1250	0	0
K3	E31	0,0500	0,2000	0,0500	0,2000	0	0	0	0
	E32	0,0333	0,1667	0,0179	0,1250	0	0	0	0
K4	E41	0,0179	0,1250	0	0	0	0	0	0
	E42	0,1667	0,3333	0	0	0	0	0	0

Table 5. Limit Supermatrix

		K1		K2		K3		K4	
		E11	E12	E21	E22	E31	E32	E41	E42
K1	E11	0,0528	0,0528	0,0528	0,0528	0,0528	0,0528	0,0528	0,0528
	E12	0,0551	0,0551	0,0551	0,0551	0,0551	0,0551	0,0551	0,0551
K2	E21	0,0194	0,0194	0,0194	0,0194	0,0194	0,0194	0,0194	0,0194
	E22	0,0051	0,0051	0,0051	0,0051	0,0051	0,0051	0,0051	0,0051
K3	E31	0,0108	0,0108	0,0108	0,0108	0,0108	0,0108	0,0108	0,0108
	E32	0,0057	0,0057	0,0057	0,0057	0,0057	0,0057	0,0057	0,0057
K4	E41	0,0057	0,0057	0,0057	0,0057	0,0057	0,0057	0,0057	0,0057
	E42	0,0250	0,0250	0,0250	0,0250	0,0250	0,0250	0,0250	0,0250

Table 6. Weights of Interdependency Criteria Priority

	C1	C2	C3	C4	C5	C6	C7	C8
Weight	0.0528	0.0551	0.0194	0.0061	0.0108	0.0057	0.0067	0.0250

Lecturers' Ranking Using the TOPSIS Method

Table 7. Value of Positive Ideal Solution and Negative Ideal Solution

	C1	C2	C3	C4	C5	C6	C7	C8
A^+	0.0062	0.0063	0.0028	0.007	0.0013	0.0007	0.0006	0.0027
A^-	0.0037	0.0061	0.0011	0.0003	0.0010	0.0006	0.0005	0.0021

Table 8. Final Result of Selection

No	Name	D^+	D^-	V	Rank
1	L1	0.0021	0.0024	0.4643	4
2	L2	0.0015	0.0023	0.3907	8
3	L3	0.0009	0.0026	0.2651	10
4	L4	0.0018	0.0022	0.4506	5

5	L5	0.0016	0.0026	0.3901	9
6	L6	0.0024	0.0018	0.5751	2
7	L7	0.0027	0.0013	0.6697	1
8	L8	0.0018	0.0018	0.5012	3
9	L9	0.0016	0.0022	0.4286	7
10	L10	0.0017	0.0020	0.4490	6

4.0 CONCLUSION

The web-based information system built on STIKOM Pelita Indonesia can facilitate the selection of the best lecturers and the methods used in selecting the best lecturers can be carried out effectively and easier because GKM is required to process the questionnaire as a requirement to proceed to the next stage, questionnaire filling is done through the website, so it's not done manually anymore.

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