Decision support system with TOPSIS method for lecturer appraisal in Universitas PGRI Madiun

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S Saifulloh*, R Pamungkas and M Lenawati

Universitas PGRI Madiun, Madiun, Indonesia

*saifulloh@unipma.ac.id

Abstract. Assessment of lecturer at university is a form of activity to evaluate the performance of each lecturer. PGRI University of Madiun (UNIPMA) always strives to improve accreditation by improving quality with other universities. Making a decision support system is one way to assist in determining lecturer's assessment in UNIPMA. This decision support system uses the TOPSIS method and will be developed using the Waterfall model. In this study to solve the problem of educator performance assessment that is UNIPMA lecturer. The assessment process includes qualifications of education, learning, research, and the number of community service activities that have been done. By using the TOPSIS method of counting process and giving the result of lecturer appraisal that has been roughed more efficient and precise. Based on the results of the research using lecturer data sampling of 10 educators obtained the highest value data is 0.75 (Very Good) where the range of decision assessment 1 - 0.65 (Very Good), 0.64 - 0.4 (Good), 0.39 - 0.25 (Enough) and 0.24 - 0 (Bad).

1. Introduction

Lecturer assessment in universities is a form of activity to evaluate the performance of each lecturer. One of the benefits of accreditation is to ensure the quality of study programs / activities in universities have met the standards set [1]. PGRI Madiun University (UNIPMA) is currently always trying to improve the status of accreditation by improving quality to compete with other universities. The assessment process includes educational qualifications, learning, research, and the many community service activities that have been carried out. The assessment of lecturers at UNIPMA is currently using a questionnaire and is done manually. So that it takes a long time and additional staff is needed for data input. This makes the lecturers' assessment process ineffective and inefficient. In addition, resulting in slow decisions taken due to the length of results obtained.

From this problem, a decision support system was built in the assessment of lecturers. The method used in the decision making of the Engineering Assessment for Order Preference method by Similarity to Ideal Solution (TOPSIS). In the evaluation of science and technology, TOPSIS has also been widely used [2]. Use the TOPSIS in multi criteria group decision-making in the study of research institutes [3]. Use TOPSIS to evaluate academic journals based on panel data [4]. Adopt Fuzzy TOPSIS in multicriteria groups decision-making in the study of research institutions output [5]. Study of characterization and differentiation under high power and applied in to academic journal evaluation. The proposed method determines the general weights associated with all ranking importance criteria, and then provides a comprehensive assessment scheme by collecting all ratings [6].

The purpose of this study was to use the TOPSIS Method because the concept is easy to understand and efficient [7], the ability to measure relative performance and alternative decisions [8] so as to solve the author's topic problem, namely decision making on lecturer performance appraisal at the research object of PGRI Madiun University. In addition, the general objective of this study is to determine the best lecturer performance at the University of PGRI Madiun based on alternative criteria including the classification of education, learning, research and community service. The calculation will be carried out according to the TOPSIS method of each lecturer to produce the highest to lowest ranking performance appraisal problem. So that the concept of a decision support system is taken so that it can reduce errors in data collection and produce a better process if it has many criteria [9].

2. Literature review

Table 1. Matrix literature review and research position.

No	Title	Publication & Year	State Of The Art/Originalitas	
			Literature	Author
1	Decision Support System for Determining Small and Medium Industry Development Priorities in Karo District uses TOPSIS Method	Sembiring, A.A, et all http://ejurnal.stmik-budidarma.ac.id/index.php/inti/article/view/694/pdf 2018	Using the TOPSIS Method to complete practical decision making and having a concept where the chosen alternative is the best alternative and has the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution, to prioritize the development of small and medium industries	Using the TOPSIS method in making the best lecturer performance decisions based on the assessment criteria
2	Comparative analysis of AHP, TOPSIS and AHP-TOPSIS methods in the initial selection stage at PT. XYZ	Nugroho, R.P.A Kusrini, Fatta, H.A http://voi.stmik-tasikmalaya.ac.id/index.php/voi/issue/view/14 2018	Using the TOPSIS method as a comparison to the decision system in completing employee selection assessments and looking for the right ranking method [10]	Using the TOPSIS method as a ranking determination to get the highest score, the average to the lowest value
3	Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) Method for Decision Support System in Top Management	Rahim, R, et all www.sciencepubco.com/index.php/IJET 2018	Using the TOPSIS method to determine which employees get priority to get bonuses based on predetermined criteria [11]	Using the TOPSIS method to determine which lecturer has good performance based on predetermined criteria.
4	Implementation of TOPSIS Technique for Supplier Selection	George, J., et all www.irjet.net June-2018	Develop a methodology for evaluating suppliers in the supply chain cycle based on Engineering for Order Preference by Similarity with the Ideal Solution method (TOPSIS) [12]	The use of the TOPSIS method in the study to evaluate the performance of lecturers in the cycle of improving the quality of quality assurance is an educational institution
5.	Multi-attribute comprehensive evaluation of individual research output based on published research papers	Jiuping Xu, Zongmin Li,Wenjing Shen,Benjamin Lev Knowledge-Based Systems May, 2013	TOPSIS method is used to conduct comprehensive IRO (individual research output) evaluation. The stages first determine the evaluation attributes and choose the appropriate bibliometric indicators using TOPSIS.	Use of TOPSIS to declare alternative criteria in performance appraisal
6.	A distance-based decision making method to improve multiple criteria supplier selection	Y. Fu et al. Intl. Trans. in Op. Res. 23 (2016) 969–978 DOI: 10.1111/itor.12193 June, 2015	The proposed method determines the general weights associated with all ranking importance criteria, and then provides a comprehensive assessment scheme by collecting all ratings	Using the TOPSIS method as a ranking based on the assessment of each criterion

3. Research method

3.1. Method of collecting data
In collecting research data the method used is the triangulation process, namely [13] :

3.1.1. Interview. The interview stage is also called an interview. The interview method is a dialogue conducted by two or more people who are done face to face (face to face). In this study the interview stages were carried out to the employment bureau to obtain valid and accurate data based on the assessment criteria.

3.1.2. Observation. At the stage of observation will be carried out observations in the data obtained in the real data source to match the written data and the real.

3.1.3. Documentation. The documentation stage is the final collection in the triangulation process, meaning that it records the data that is already available in [14]. The documentation in this study is in the form of lecturer data drafts, the classification of lecturers' education, the number of lecturers' research and the number of lecturers' services.

3.2. Application development method
Assessment decision support system for lecturers at UNIPMA uses the TOPSIS method. Waterfall method is a method that suggests a systematic approach in the form of sequential, linear or sequential, the waterfall method is the classic SDLC life flow. The most appropriate method is used for the development of SPL with simple specifications that are not too strong and not much [15]. The stages of software system design include:

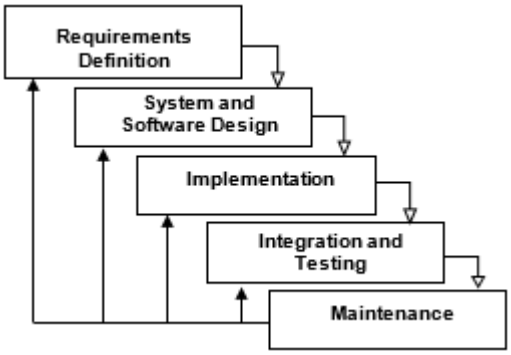

Figure 1. Waterfall method.

3.2.1. Requirements definition. In Figure 1, the Requirements Definition is the initial stage that is carried out where to analyze the needs of a system, namely the data input requirements (input), the output data needs (output), and the display needs.

3.2.2. System and software design. The next step in Figure 1 is System and Software Design. This stage is the system design and software that must be estimated before starting the programming process (coding).

3.2.3. Implementation. At the implementation stage in Figure 1 is the system design stage, where the program design will be translated into a programming language that can be recognized by the computer. On the system that will be built will use the PHP programming language and MySQL for the database.

3.2.4. Integration and testing. The next stage is the stage of Integration and Testing or the System Testing stage. Testing of the system carried out is executing the program to find errors or errors contained in the system.

3.2.5. Maintenance. At the last stage, the software has been used by the user and carried out maintenance during the use of the system.

4. Results and discussion

4.1. Assessment criteria

In the journal that we have created, the criteria for making decisions on the performance of lecturers are based on predetermined criteria, as follows:

K1: Educational Qualification
K2: Learning
K3: Number of Researches
K4: The amount of community service

From the criteria described above, it will have a weight value that has been determined into fuzzy numbers. And each alternative has a rating of the following values:

Value 1: Very Less (VL); **Value 2**: Less (L); **Value 3**: Enough (E); **Value 4**: Good (G); **Value 5**: Very Good (VG)

Based on the suitability rating above, then the translation of the weight of each criterion that has been converted with fuzzy numbers:

4.1.1. Educational qualification criteria. Educational Qualification Criteria are the first criteria needed for decision making, based on educational qualifications with a 20% rating. Criteria value data are presented in figure 2 which is the interval of educational qualifications as follows.

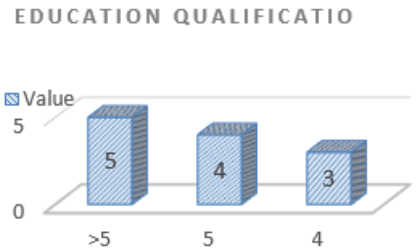

Figure 2. Education qualification.

4.1.2. Learning criteria. Learning Criteria is the second criterion needed for decision making based on academic performance for Thesis Supervisors, Final Assistants (TA), Practical Work Guidance (KP) and Student Creativity Program (PKM) supervisors. Mapping the value of the learning criteria is presented on figure 3 where the explanation of the learning interval is explained as follows.

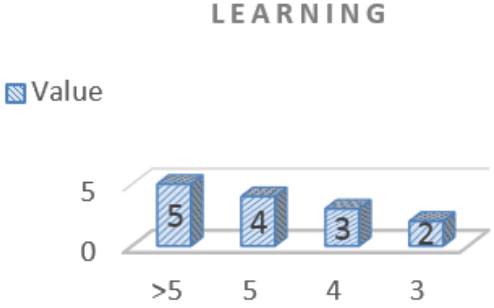

Figure 3. Learning criteria.

4.1.3. Research criteria. Research criteria that have been carried out since being determined as permanent lecturers are the third requirement needed for decision making based on the amount of research that has been done since it was determined as a permanent lecturer. The criterion value data is presented in figure 4 which is the interval of research that has been carried out since it was determined as a lecturer as follows:

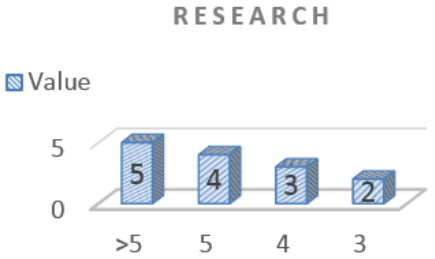

Figure 4. Lecturer research.

4.1.4. Criteria for the number of services to the community. The next requirement is needed for decision making based on the large number of activities in the community service since it was determined as a permanent lecturer at UNIPMA. The criterion value data is presented in figure 5 where the description of the community service interval is as follows

Figure 5. Devotion of the community.

4.1.5. Calculating lecturer assessment. After all the criteria and weight values have been determined, then the next step is to survey the lecturers at UNIPMA. Based on the survey we conducted, in table 2 the results data from the lecturer assessment are based on the criteria we have previously determined. the data sample uses 10 names of lecturers so that the assessment is more accurate

Table 2. Assessment of lecturers.

Lecturer	Name Lecturer	Educational Qualifications	Learning	Research	Community service
Lecturer 1	Bayu	S2	KP	4	4
Lecturer 2	Agus	S2	KP	5	3
Lecturer 3	Bagas	S1	TA	7	5
Lecturer 4	Sri	S2	TA	3	7
Lecturer 5	Anita	S3	TESIS	5	3
Lecturer 6	Agung	S1	PKM	1	4
Lecturer 7	Sari	S2	KP	4	4
Lecturer 8	Ningsih	S3	TESIS	5	3
Lecturer 9	Dimas	S3	TESIS	3	2
Lecturer 10	Indra	S1	TA	4	4

4.1.6. Convert credit analysis data above into fuzzy. The results in table 3 are the stages of converting the above credit analysis data into fuzzy. The following is a table of results of the conversion of credit analysis based on the benchmark values that have been considered.

Table 3. Value analysis conversion.

Lecturer	Criteria			
	K1	K2	K3	K4
Lecturer 1	4	3	3	3
Lecturer 2	4	3	4	2
Lecturer 3	3	4	5	4
Lecturer 4	4	4	2	5
Lecturer 5	5	5	4	2
Lecturer 6	3	2	1	3
Lecturer 7	4	3	3	3
Lecturer 8	5	5	4	4
Lecturer 9	5	5	2	3
Lecturer 10	3	4	3	4

4.1.7. Normalized matrix calculations (R). Calculating the Normalized Matrix (R). Previously made a normalized decision matrix. The element rij is the result of normalizing the decision matrix R with the length of the method equivalent to a vector. In searching for normalized matrices, the results of the calculations presented in table 4 use the following formula:

$$r_{ij} = \frac{Xij}{\sqrt{\sum_{m=}^{i} Xij^2}} \quad (1)$$

Table 4. Matrix ternormalization.

Matrix Results (R)			
K1	K2	K3	K4
0,310	0,242	0,287	0,297
0,310	0,242	0,383	0,198
0,233	0,322	0,479	0,396
0,310	0,322	0,192	0,495
0,388	0,403	0,383	0,198
0,233	0,161	0,096	0,297
0,310	0,242	0,287	0,297
0,388	0,403	0,383	0,396
0,388	0,403	0,192	0,099
0,233	0,322	0,287	0,297

4.1.8. Calculating the normalized weighted matrix (Y). Where the normalized decision matrix for each normalization of rij value can be done by calculating using the formula ***Vij = Wi * rij.*** The value of the normalization matrix calculation can be seen in table 5 by using four criteria in its determination.

Table 5. Totormalized matrix matrices.

Calculating Matrices			
Dynamized Weighted (Y)			
K1	K2	K3	K4
1,242	0,725	0,862	0,891
1,242	0,725	1,533	0,396
0,699	1,289	2,395	1,584
1,242	1,289	0,383	2,475
1,940	2,015	1,533	0,396
0,699	0,322	0,096	0,891
1,242	0,725	0,862	0,891
1,940	2,015	1,533	1,584
1,940	2,015	0,383	0,099
0,699	1,289	0,862	0,891

4.1.9. The next stage is determining Ideal Positive Solutions (A+) and the Ideal Negative Matrix (A-). The results of table 6 are calculated results of the value of Ideal Positive Solutions (A +) and the Ideal Negative Matrix (A-) using the calculated formula:

A^{+}={(max V_{ij}) (min V_{ij} | j ∈ j')$_2$; i = 1,2,3,…, m} = {V_1^+, V_2^+, …, V_m^+}; A^{-}= {(max V_{ij}) (min V_{ij} | j ∈ j')$_2$ i = 1,2,3,…, m} = {V_1^-, V_2^-, …, V_m^-}

Table 6. Positive and negative ideal solutions.

Determining the Ideal Solution				
A+	1,940	2,015	2,395	2,475
A-	0,699	0,322	0,096	0,099

4.1.10. Calculating the Distance of the Positive Ideal Solution (D +) and the Negative Ideal Solution (D-). The results of table 7 and table 8 are produce a range of positive and negative ideal solutions as follows.

Table 7. Distance of positive ideal solutions (D +).

Calculating distance	
Positive Ideal Solution (D +)	
D+1	2,647
D+2	2,283
D+3	1,692
D+4	2,249
D+5	2,251
D+6	3,493
D+7	2,647
D+8	1,240
D+9	3,113
D+10	2,632

Table 8. Distance of negative ideal solutions (D +).

Calculating distance	
Negative Ideal Solution (D-)	
D-1	1,293
D-2	1,616
D-3	2,903
D-4	2,638
D-5	2,561
D-6	0,792
D-7	1,293
D-8	2,945
D-9	2,119
D-10	1,466

The next stage can be seen in table 9, the calculation results of preference values for each lecturer. At this stage can be calculated using the formula : $C_i = \frac{S_i^-}{S_i^- + S_i^+}$, with $0<C_i^+<1$ dan i = 1,2,3,…,m

Table 9. Preference value results.

Calculate Preference Value		
Name Lecturer	Result Value	Information
Lecturer 1	0,328	Bad
Lecturer 2	0,376	Bad
Lecturer 3	0,632	Good
Lecturer4	0,540	Good
Lecturer5	0,532	Good
Lecturer6	0,185	Very Bad
Lecturer7	0,328	Bad
Lecturer8	0,704	Very Good
Lecturer9	0,405	Good
Lecturer10	0,358	Bad

From the calculation of preference values in table 9, a ranking of some of the lecturers' assessment criteria is obtained based on the highest decision count value can be seen in table 10. In ranking later, the grades can also be seen in table 11. With this the results of the calculation of performance using the TOPSIS method obtained the highest value of 0.704 where based on all criteria including the classification of education, learning, research and community service showed the greatest

accumulation. The performance limit with a good predicate is at the calculated score of 0.405 and the worst performance limit covers all the criteria that are applied, namely at the score threshold of 0.185.

Table 10. Results of devicesdose assessment.

Name Lecturer	Result Value	Grade
Lecturer 8	0,704	Very Good
Lecturer 3	0,632	Good
Lecturer 4	0,540	Good
Lecturer 5	0,532	Good
Lecturer 2	0,414	Good
Lecturer 9	0,405	Good
Lecturer 10	0,358	Bad
Lecturer 7	0,328	Bad
Lecturer 1	0,328	Bad
Lecturer 6	0,185	Very Bad

Table 11. Decision range table.

Decision Range	Information
1 - 0,65	Very Good
0,64 – 0,4	Good
0,39 – 0.25	Bad
0,24 – 0	Very Bad

5. Conclusion

Based on the results of the research on the analysis of Decision Support System using the TOPSIS method to assess the performance of lecturers, the following conclusions are obtained: The object of research is the assessment of lecturer performance, using the TOPSIS method the output obtained is ranking based on the highest calculation value in lecturer decision making with the best performance with Assessment criteria include educational qualifications, learning, the amount of research and the amount of service performed. Using the TOPSIS method the criteria will be classified into 5 stages to obtain the final calculation results, this stage makes the difference by manually applying excel calculations. Besides that, the purpose of this study is to sharpen the science of decision support systems that are applied in the industrial era 4.0

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