MADM Model for Evaluation of Non-permanent Teacher Performance using Fuzzy AHP and TOPSIS Methods

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Abstract: Teachers are a key element in the education system, especially non-permanent teachers in schools with the current condition is very apprehensive, starting from a less obvious future, sometimes receive honorarium after three months of duty even uncertain. This is because of the determination process for outstanding non-permanent teachers there are still obstacles encountered there is no assessment indicator for honorary teachers. As a result, non-permanent teachers who excel did not get an award from school. To meet these requirements required a model ie the model Multi-Attribute Decision Making (MADM) which aims from certain criteria is determined the best alternative from many existing criteria. In the process of MADM model AHP method is required to find the weight of the performance of non-permanent teachers and for ranking used TOPSIS method. All series of methods collaborate with fuzzy logic with the aim of minimizing uncertainty so hopefully, the results obtained more accurate. The aim of this research is to determine the performance of non-permanent teachers. The results of this study are 44.8% pedagogical criteria, personality criteria 26.1%, social criteria 16.5%, professional criteria 12.5%.

1 INTRODUCTION

Teachers are a key element in the education system, especially in schools. All other components, from the curriculum, infrastructures, costs, and so forth will not mean much if the teacher interaction with unqualified learners. Many experts claim that in school there will be no change or quality improvement without changes and improvements in teacher quality. Currently, most of the teachers' fate in Indonesia is getting better and there is a change. Although it cannot be equally perceived by the teachers especially teachers who teach in remote areas, village, outer islands, and inland areas. They are still difficult to enjoy the word prosperous let alone sufficient and still many teachers who have status as local Non-Permanent teachers. The condition of Non-Permanent teachers today is very alarming, starting from an unclear future, long service period, serving in underdeveloped regions, uncertain honorarium system, sometimes receive honorarium after three months of duty even uncertain. The most unique thing of Non-Permanent teachers is still carrying out its main task is that as a permanent teacher work, namely educating, teaching,

guiding, directing learners to be human beings who believe and cautious to Almighty God.

Teacher performance (Supiandi, 2016) has certain specifications/criteria. Teacher performance can be viewed and measured by specification/criteria the competencies each teacher must possess. Based on Regulation of the Minister of National Education of the Republic of Indonesia Number 16 the Year 2007 regarding Academic Qualification Standard and Teacher Competencies. It is explained that the Teacher Competency Standards are developed as a whole of the 4 major competencies, that is (1) pedagogic competence, (2) personality, (3) social, and (4) professional. The fourth competency integrated into teacher performance.

Central Lombok Regency is one of the districts located in the province of West Nusa Tenggara (NTB) with the number public high schools as many as 18 institutions with a fairly large number of Non-Permanent teachers. But the process of determining for teachers achievers still found obstacles faced ie none an assessment indicator for teachers. As a result, teachers who excel do not get an award from school, while the non-achievers are rewarded, this is due to

the selection process non-permanent teachers are still less effective. therefore it can have an impact on the learning process. From the problem, the researchers provide solutions that are performance evaluation of non-permanent teachers in high school teachers in central Lombok district.

Multi-Attribute Decision Making (MADM) decision-making models that utilize and define (Galankashi et al., 2016) the best alternative of many alternatives based on existing criteria. There are several methods that are often used in making the system, such methods are Simple Additive Weighting (SAW), Weighted Product (WP), Electre, Technique For Others Reference by Similarity to Ideal Solution (TOPSIS) and Analytical Hierarchy Process (AHP).

Fuzzy logic is a logic that has the value of vagueness (Keprate and Ratnayake, 2016) between two values. The fuzzy approach is particularly the approach triangular fuzzy number to scale AHP is expected to be able to minimize uncertainty (Junior et al., 2014) so hopefully, the results obtained more accurate. (Mohyeddin and Gharaee, 2014) (Salah and Saadi, 2016)

In this research method used is method FAHP and Topsis, FAHP used to look for weight (Taylan et al., 2014) (Yudatama and Sarno, 2015) of the performance of Non-Permanent teachers and for ranking using methods Topsis, this is because the combination of methods is the result is considered the most Valid.(Sudiatmika et al., 2017) (Alizadeh et al., 2016)

This study was conducted with the aim to determine the performance of Non-Permanent teachers using the method FAHP dan TOPSIS in order to assist the stakeholders, in this case, the Principal to determine whether the teacher deserves an award as an Achieving Teacher or not, thus for the future no longer errors occur in the assessment process of Non-Permanent teachers.

2 LITERATURE REVIEW

Currently, many researchers are doing research Non-Permanent teachers, from several studies are considered to be still related to the topic discussed so that it can be used as a reference source. The following are some of the previous studies that serve as a reference.

Research conducted by (Balkis and Masykur, 2017) about understanding subjective well-being Non-Permanent teachers, the results showed that the three subjects enjoy their profession today, work motivation that exists on the individual gives effect on job satisfaction, subjective well-being the three subjects are influenced by the perspective of his profession.

In research conducted by (Meiza, 2017) discusses

the difference of happiness to the teachers of civil servants and Non-Permanent status, with the result that there is no difference of happiness on teachers with civil servants and Non-Permanent status, the civil servant teacher has the empirical mean the happiness scale is in the high category, while the teacher of Non-Permanent status has the empirical mean of happiness that is in the high category.

In the study (Mahmudah et al., 2015) discusses the perception of Non-Permanent teachers against Law No. 5 of 2014 about the PPPK system, the results of his research indicators of understanding of Non-Permanent teachers to PPPK in the categories do not understand to be the most. Thus, PPPK in the dissemination of information is still poorly understood.

Research conducted by (Arfa et al., 2013) about the incidence and depression rates of Non-Permanent teachers in public primary schools, the results of the study there were no significant differences between the incidence and depression level of honorary teachers in public elementary schools in four sub-districts in Kota Kotamobagu, North Sulawesi Province.

In the study (HARIWIBOWO et al., 2015) work motivation of Non-Permanent teachers in terms of quality of work life. The results of his research that there is a significant influence quality of work life with work motivation of honorary teachers, the resulting influence is positive. This means that the higher the quality of work life of a teacher, the higher the motivation for his work.

3 METHODOLOGY

3.1 Data Collection

A combination of empirical and non-empirical methods was used for data collection in this study. An empirical study approach is used to collect primary data and non-empirical approaches are used to collect secondary data.

3.1.1 Primary Data

Primary data is data generated from questionnaires and interviews obtained from the supervisors who are incorporated in Musyawarah Kerja Pengawas Sekolah (MKPS) and headmaster. In this study, questionnaires were prepared based on the research model and used as a primary measuring tool.

3.1.2 Secondary Data

Secondary data is data collected from literature review such as books, journals, articles. To determine the concept relevant to this study and create a research framework.
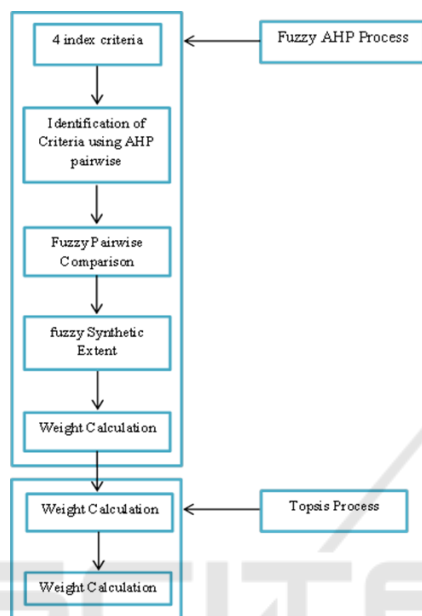

Figure 1: Research Steps

AHP displayed in the form of a hierarchical model of purpose, criteria and some level subcriteria. This method is built on three principles namely principles for building hierarchy, principles for setting priorities and a principle of logical consistency. AHP framework that is flexible and effective can help a person in making decisions. Because all parts of the hierarchy are interconnected, then it can look related, one factor may affect other factors. Hierarchy is an efficient way of solving complex systems a linear structure in which the influence is distributed from top to bottom. efficient because the problem will be more structured, organized, and functional in controlling and reducing information into the system.
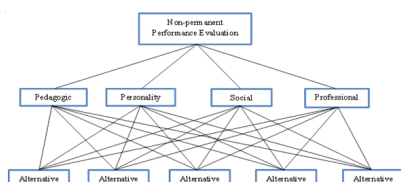

Figure 2: Hierarchical Structure of Performance Evaluation of Non-Permanent Teachers

3.2 Multiple Criteria Decision Making (MCDM)

Multiple Criteria Decision Making (MCDM)(Hanine et al., 2016) is a method of decision making to determine the best alternative from a number of alternatives based on certain criteria.(Vinodh et al., 2014) Criteria are usually sizes, rules or standards used in decision making. Based on the purpose, MCDM can be divided into 2 models (Khademolqorani and Hamadani, 2013): Multi-Attribute Decision Making (MADM), and Multi-Objective Decision Making (MODM). MADM used to solve problems in discrete space. Therefore, in MADM is usually used to perform the assessment or selection of several alternatives in limited quantities. While MODM used to solve problems in continuous space. In general, it can be said that MADM selects the best alternative from a number of alternatives, while MODM designed the best alternative. Basically, the MADM process is done through 3 stages the preparation of the components of the situation, analysis, and synthesis of information. At the component compilation stage, a component of the situation will be formed table containing the estimates identification of alternatives and objectives specifications, criteria and attributes.

3.3 Teacher Performance Evaluation

Teacher performance evaluation is a process that aims to know or understand teacher performance levels one with another teacher performance level or compared to predefined standards. Teacher performance evaluation has benefits for schools because this assessment will provide the level of achievement of the standard, the size or criteria set by the school. So the weaknesses that exist in a teacher can be addressed and will provide feedback to the teacher. Teacher performance evaluation is not meant to criticize and find fault, but as an incentive for teachers to develop themselves become more professional and eventually later will improve the quality of education of learners.

3.4 Metode Analythic Hierarchy Process (AHP)

Analytical Hierarchy Process (AHP) is a decision support model developed by Thomas L. Saaty,(Prakash and Barua, 2015). the concept of changing qualitative values into quantitative values so that the decisions taken can be more objective. Basically, the AHP method breaks down a complex situation and unstructured into its component parts. Then

organize this part or variable in a hierarchical arrangement and gives numerical values on subjective considerations about the relative importance of each variable which one has the highest priority and acts for the effect the outcome of the situation. AHP is used to solve problems by changing them in the form of hierarchy and defining all of the problems. The process of developing a hierarchy of problems with AHP depends on experience, knowledge, logic, and imagination to give consideration.

Level of Interest	Definition
1	Just as important
3	Slightly more important
5	More important
7	Very important
9	Absolutely more important
2,4,6,8	The value between two adjacent options

Figure 3: AHP Comparative Assessment Scale (Source: Saaty(1994)).

Suppose criterion X has some elements below it, ie C1, C2, ..., Cn. Table matrix pairwise comparison based on criterion C as follows:

X	C_1	C_2	...	C_n
C_1	1	c_{12}	...	c_{1n}
C_2	c_{21}	1	...	c_{2n}
...	...	...	1	...
C_n	c_{n1}	c_{n2}	...	1

Figure 4: Matched Comparison Matrices.

What is measured in AHP is the ratio of consistency by looking at the consistency index. The expected consistency is near perfect in order to produce decisions that are close to valid. Although it is difficult to achieve perfect, the consistency ratio is expected to be less than or equal to 10 %. (Saaty, 2002) :

$$CI = \frac{\lambda max - n}{n - 1} \quad (1)$$

Where CI = Index consistency, λ Maks = The biggest eigenvalues are obtained by adding up the result of multiplying the number of columns with the main vector eigen. CR = consistency ratio, that is data that has less than or equal CR 10% which is considered consistent.

$$CR = \frac{CI}{RI} \quad (2)$$

The following table Random Index (RI)

n	1,2	3	4	5	6	7	8	9
RI	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45

Figure 5: Random Index (RI).

3.5 Triangular Fuzzy Number (TFN)

F-AHP is a combination of AHP method with fuzzy concept approach. F-AHP includes weaknesses found in AHP, namely problems with more subjective criteria. Number uncertainty is represented by a sequence of scales (Keprate and Ratnayake, 2016), (Salah and Saadi, 2016). To determine the level of membership in F-AHP, function rules are used in Triangular Fuzzy Numbers (TFN) which are arranged based on linguistic sets (Mohyeddin and Gharaee, 2014), (Junior et al., 2014). So, the number at the level of intensity of interest in AHP is changed to the specified TFN scale. So, the numbers at the level of interest intensity are presented by Saaty (1980), changed to the specified TFN scale

Intensity of Interest	Definition	Fuzzy Scale	Reciprocal
1	just equal	(1, 1, 1)	(1, 1, 1)
2	Intermediate	(1/2, 1, 3/2)	(2/3, 1, 2)
3	Moderately important	(1, 3/2, 2)	(1/2, 2/3, 1)
4	Intermediate	(3/2, 2, 5/2)	(2/5,1/2, 2/3)
5	Strongly important	(2, 5/2, 3)	(1/3,2/5, 1/2)
6	Intermediate	(5/2, 3, 7/2)	(2/7,1/3, 2/5)
7	Very Strong	(3, 7/2, 4)	(1/4,2/7, 1/3)
8	Intermediate	(7/2, 4, 9/2)	(2/9,1/4, 2/7)
9	extremely strong	(9/2, 9/2, 9/2)	(2/9,2/9, 2/9)

Figure 6: Function of Fuzzy Scale Membership (Source: Chang, D.Y. (1992)).

Furthermore, given the rules of operation commonly used triangular fuzzy number arithmetic. Suppose there are 2 TFNs : M1 = (l1, m1, u1) and M2 = (l2, m2, u2), apply

$$M1 \oplus M2 = (l1 + l2, m1 + m2, u1 + u2) \quad (3)$$

$$M1 \ominus M2 = (l1 - l2, m1 - m2, u1 - u2) \quad (4)$$

$$M1 \otimes M2 = (l1.l2, m1.m2, u1.u2) \quad (5)$$

$$\lambda \otimes M2 = (\lambda.l2, \lambda.m2, \lambda.u2) \quad (6)$$

$$M1 - 1 = (1/u1, 1/m1, 1/l1) \quad (7)$$

From the fuzzy triangular matrix determined the value fuzzy synthetic extents for each criteria (Chang, D. Y. 1996).

$$S_i = \oplus_{j=1}^{m} M_{gi}^{j} \otimes [\oplus_{i=1}^{n} \oplus_{j=1}^{m} M_{gi}^{j}]^{-1} \quad (8)$$

To get the value of each priority criterion, it is obtained by calculating the normalization of the weight vector and the minimum value d'l = min V (Si≥Sk) which compares the value of fuzzy synthetic extent (Si≥Sk).

$$W = (d1, d2, ..., dn)T \qquad (9)$$

With the formulation of normalization is :

$$d_l = \frac{d'l}{\Sigma_{i=1}^{n} d'l} \qquad (10)$$

for l = 1,2,3...,n .

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

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is a multicriteria decision-making method (Primasari and Setyohadi, 2017) which was first introduced by Yoon and Hwang in 1981. The basic idea of this method is that the alternative is chosen have the closest distance to a positive ideal solution and the furthest from the negative ideal solution (Sudiatmika et al., 2017). TOPSIS pays attention to the distance to positive ideal solutions or the distance to the negative ideal solution by taking a close relationship to an ideal solution. Alternatives that have been ranked can be used as a reference for decision-makers to choose the best solution

Here are the steps of the TOPSIS method (Source: Hwang and Yoon 1981):

3.6.1 Build a Normalized Decision Matrix

Elemen rij the result of the normalization of decision matrix R with the Euclidean length of a vector method:

$$R_{ij} = \frac{x_{ij}}{\sqrt{\Sigma_{i=1}^{m} x_{ij}^2}}; with\, i = 1,2,3,...m; and\, j = 1,2,3,...n.$$

$$(11)$$

3.6.2 Build a Weighted Normalized Decision Matrix

The ideal solution positif A+ and ideal negative solutions A- can be determined by a normalized weighted rating (yij) as:

$$yij = wirij; with\, i = 1,2,3,...m; and = 1,2,3,...n$$

$$(12)$$

3.6.3 Determine the ideal Solution Matrix and the Ideal Negative Solution Matrix

The positive ideal solution (A+)is calculated on the basis of:

$$A^+ = (E1^+, Y2^+, Y3^+, ..., Yn^+) \qquad (13)$$

The ideal solution (A-) is calculated on the basis of:

$$A^- = (E1^-, Y2^-, Y3^-, ..., Yn^-) \qquad (14)$$

3.6.4 Determine the Distance between the Values of Each Alternative with a Matrix of positive Ideal Solutions and a Negative Ideal Matrix

The distance between Ai alternatives with positive ideal solutions is defined as:

$$D_i^+ = \sqrt{\Sigma_{j=1}^{n}(y_{ij} - y_i^+)^2}; i = 1,2,3,...,m. \qquad (15)$$

The distance between alternatives Ai with the ideal solution is defined as:

$$D_i^- = \sqrt{\Sigma_{j=1}^{n}(y_{ij} - y_i^-)^2}; i = 1,2,3,...,m. \qquad (16)$$

3.6.5 Determine the Preference Value for Each Alternative

The proximity of each alternative to the ideal solution is calculated based on the formula:

$$V = \frac{Di^-}{Di^- + Di^+}; i = 1,2,3,...,m. \qquad (17)$$

4 RESEARCH FINDINGS AND DISCUSSIONS

4.1 Matched Comparison Matrix among the Main Criteria

At this stage the superintendent fills out the questionnaire by choosing numbers 1 through 9 to find which criteria are the most important of the four criteria, after which the principal filled out a questionnaire of grades 1 to 4 for the overall value earned by non permanent teachers which are ranked among teachers, with respondents in this activity are respondents who are considered experts in this field. Respondents who fill this data are 12 supervisors from

Musyawarah Kerja Pengawas Sekolah (MKPS) and 18 Principals. Based on data obtained from the School and Musyawarah Kerja Pengawas Sekolah (MKPS), there are four main criteria, namely pedagogic criteria, personality criteria, social criteria, professional criteria. So there are four elements to be compared. Calculation and determination of consistency for the main comparison.

	Pedagogic	Personality	Social	Professional
Pedagogic	1.000	3.000	3.000	2.000
Personality	0.333	1.000	2.000	3.000
Social	0.333	0.500	1.000	2.000
Professional	0.500	0.333	0.500	1.000

Figure 7: Comparison Matrix Under Criteria.

	Pedagogic	Personality	Social	Professional
Pedagogic	0.462	0.621	0.462	0.250
Personality	0.154	0.207	0.308	0.375
Social	0.154	0.103	0.154	0.250
Professional	0.231	0.069	0.077	0.125

Figure 8: Normalization of Matrices.

From the comparison matrix table above, obtained value CI = 0.087, RI = 0.90, and value CR = 0.097. According to Saaty, if CR$\leq$10% then the pairwise comparison matrix is consistent. Consistent means that all elements have been grouped homogeneously and the relation between criteria mutually justifies logically.

4.2 Weight with Fuzzy

	Pedagogic	Personality	Social	Professional
Pedagogic	(1, 1, 1)	(1, 1.5, 2)	(1, 1.5, 2)	(1, 1.5, 2)
Personality	(0.5, 0.66, 1)	(1, 1, 1)	(0.5,1, 1.5)	(1, 1.5, 2)
Social	(0.5, 0.66, 1)	(0.66, 1, 2)	(1, 1, 1)	(0.5, 1, 1.5)
Professional	(0.66, 1, 2)	(0.5, 0.66, 1)	(0.66, 1, 2)	(1, 1, 1)

Figure 9: Weighting with Fuzzy AHP.

The next step is to normalize on fuzzy synthetic extends are listed in Figure 10.

	l	m	u
Pedagogic	0.149	0.303	0.542
Personality	0.128	0.253	0.458
Social	0.113	0.222	0.458
Professional	0.121	0.222	0.500

Figure 10: Normalization of Fuzzy Synthetic Extend.

Then calculated the weight and normalization of weight vector so that we know the value of the weight of the main criterion. W' = (1, 1, 0.792, 0.812)

After the normalization, the final weight of the main criteria is as follows.
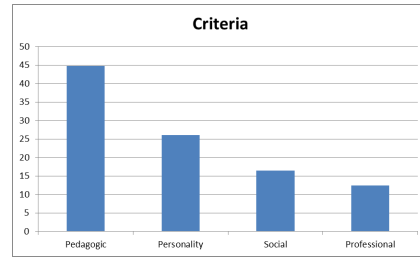W = (0.277, 0.277, 0.219, 0.225)

Figure 11: Level of interest Criteria

From the results of priority weighting analysis on the main criteria using FAHP obtained criteria pedagogic has a weight of 44.8%, personality criteria 26.1%, social criteria 16.5% and professional criteria 12.5%.

4.3 Alternative Ranking

In this research, determining the ranking of each candidate's alternative non-permanent teacher using TOPSIS method calculation. So get the ranking as follows:

Candidate	Distance Solutions & Preference & Rank Values			
	Positif	Negatif	Preference	Rank
A1	0,1188	0,2310	0,6603	1
A2	0,2079	0,1329	0,3901	5
A3	0,1809	0,1474	0,4489	4
A4	0,1472	0,2140	0,5925	2
A5	0,1792	0,1493	0,4545	3

Figure 12: Ranking Alternative With TOPSIS.

$$ManualResult = \frac{Value}{\Sigma Criteria} x100\% \qquad (18)$$

Candidate	Manual results		
	Value	Manual results	Rank
A1	51	12,75	1
A2	49	12,25	2
A3	47	11,75	3
A4	49	12,25	2
A5	49	12,25	2

Figure 13: Ranking Alternative With Manual.

5 CONCLUSIONS

Based on the results of manual calculations and calculation using FAHP and TOPSIS methods with the same value obtained the difference in results is 12.75 and 66.03.

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The results of this study can be summarized by using method FAHP and TOPSIS can be used as an indicator and is expected to solve the existing problems in the performance assessment of non-permanent teachers. The results of this calculation serve as a reference by principals in determining the performance of non-permanent teachers and the final decision remains on the principal.

In the decision-making process involving many criteria, the Fuzzy AHP method can be used to determine the priority weight on each of the criteria on which the appropriate decision analysis is based. From the results of priority weighting analysis on the main criteria with Fuzzy AHP, pedagogic criteria have a weight of 44.8%, personality criteria 26.1%, social criteria 16.5%, and professional criteria 12.5%. The use of the TOPSIS method is used for determining the weight of each alternative ranking of candidate non-permanent teachers

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