Fmcdm Evaluation Of Teachers Performance

Mohamad.R.Sarmady[1], Mehran.Frajolahi[1] and Ardavan.Mirzaie[1]

[1]Departemant of Education, Payame Noor University,19395-4697,I.R.of IRAN
(aa_mirzaie@yahoo.com)

Abstract: One of the most important functions of management is to evaluate the performance of the organizations' employees (Stoner and Freeman, 1992).For increase efficiency and effectiveness education performance we must assessment it. Article purpose is determine and identified instructor's performance dimensions and indicator's performance. In this study,we have aggregated and identified five instructor's performance dimensions and 19 indicators of that performance. we use fuzzy logic for the measurement of performance and apply Analytical Hierarchy Process(AHP) in criteria weight and TOPSIS in ranking. A FMCDM(Fuzzy multi criteria decision making) is an approach for evaluating decision obtaining alternatives involving subjective judgments made by a group of decision makers. A pair wise comparison process is used to help individual decision makers make comparative judgments, and a linguistic rating method is used for making absolute judgments. An empirical study of instructors Performance evaluation in one of the branches of PNU (Payame Noor University) that is presented to illustrate the effectiveness of the approach.

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Introduction

Decision making in the public and private sectors often involves the evaluation and ranking of available courses of action or decision alternatives based on multiple criteria. Multi criteria decision making (MCDM) has proven to be an effective methodology for solving a large variety of multi criteria evaluation and ranking problems (Yen & Chang, 2009, p454).

Decision-making problems are the process of finding the best option from all of the feasible alternatives. In almost all such problems the multiplicity of criteria for judging the alternatives is pervasive. That is, for many such problems, the decision maker wants to solve a multiple criteria decision making (MCDM) problem (Chen, 2000, p1).

One of the most important functions of management is to evaluate the performance of the organizations' employees (Stoner and Freeman, 1992). Stoner and Freeman (1992) further stated that performance appraisals serve four primary purposes. These purposes included: ''(1) to let subordinates know formally how their current performance is being rated; (2) to identify subordinates who deserve merit raises; (3) to locate individuals who need additional training; and (4) to identify candidates for promotion''. Latham and Wexley (1994) define performance appraisal as ''. . . any personnel decision that affects an employee's retention, termination, promotion, demotion, transfer, salary increase or decrease, or admission into a training program'' (Schraeder&etal, 2006, p479). Also Eyres (1989) noted that using performance appraisals as a criterion for demotions, failure to promote someone, termination of employment, or for layoffs could prompt employee lawsuits (p59).

The objectives of universities are to provide in-depth knowledge, seek academic development, educate students, and coordinate national development demands. The core functions of a university are basically teaching, research and scholarship. Perkins (1973) pointed out that a university has three primary functions: education, research and service. Donald (1984) believed that universities should establish performance measure indicators based on these functions to evaluate performance of related to resource allocation (Chen et al., 2009a, p222).

Thus,performance appraisals or performance evaluation is an important issue for managers, since it can be used as a reference in decision making with regard to performance improvement, specially teaching performance improvement.

Since the judgments are usually vague rather than crisp, a judgment should be expressed by using fuzzy sets which has the capability of representing vague data. Some multi attribute evaluation methods such as AHP, ELECTRE, PROMETHEE, ORESTE, and TOPSIS can handle and solve this problem by integrating fuzzy set theory. Among these methods, AHP uses a hierarchy of attributes and alternatives while the others do not. (Kahraman et al., 2007)

This paper is organized as follows: In the second section, some information about Fuzzy MCDM methods (AHP- Fuzzy set - TOPSIS) is given. In the third section, an empirical study of instructors Performance evaluation in Payam-e-Noor University (PNU) is presented to illustrate the effectiveness of the approach.Finally, conclusions are given.

PNU is distance education in Iran.This university has about 1.2 million students right now and has 546 branches too.

Evaluation Framework Of Evaluating Instructors Performance

This study applied the fuzzy MCDM (multi criteria decision making) to evaluate the instructors' performance in universities as shown in Fig. 1. First, we identified the evaluating instructors' performance aspects and attributes, after constructing the evaluation criteria hierarchy; we calculated the criteria weights by applying Analytic Hierarchy Process (AHP) method. The measurement of performance corresponding to each criterion was conducted under the setting of fuzzy set theory. Finally, we conducted Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) to achieve the final ranking results. The descriptions detail of each step was elaborated in each of the following sub-section.

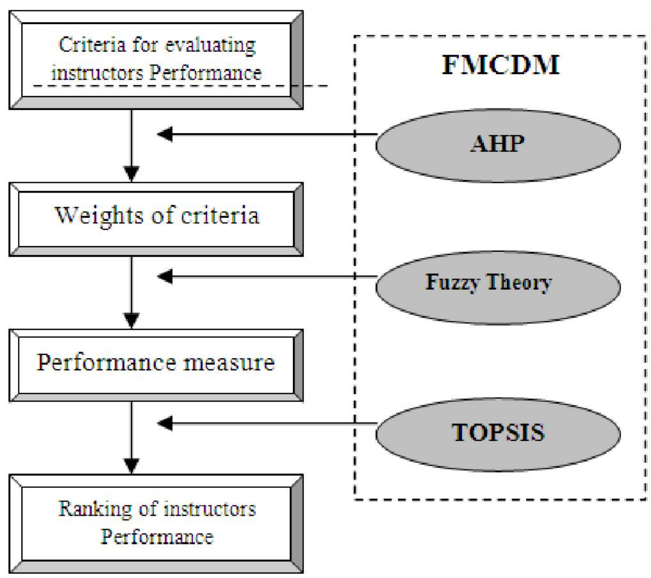

Figure1. Evaluation framework of evaluating instructors Performance

Identifying Performance Dimensions and Criteria

There are four kinds of universities in Iran: State, Azad, Payame Noor (distance education) and Non-benefit. In each kind, different questionnaires were used to evaluate the instructors' performance. The researchers in the present study combined the different questionnaires directed by expert and from specialist finally they have reached a single comprehensive questionnaire after identifying similarities and the differences. This questionnaire had five dimensions which were as follows: Teaching style, Individual features and social relation, Knowledge level, observance of educational regulations and Educational tools. Each dimension included a number of criteria resulting in nineteen criteria in all as shown in Table 1.

Table 1. The evaluation criteria for training performance of instructor

Dimensions	*Criteria*
Teaching style **D_1**	C1: Ability to explain concepts. C2: Ability to initiate motivation and interest in learning and research. C3: Initiation of suitable conditions for students' participation in class discussions. C4: Maintaining a lesson plan. C5: Homework for learning.
Individual features and social relation **D_2**	C6: preparation for answering students' scientific needs. C7: observance of individual differences among students. C8: availability of the instructor at non-class time. C9: patience of the instructor in interaction with the students. C10: instructors' social contact with the students. C11: interest of the instructor in helping the students with personal problems.
Knowledge level **D_3**	C12: mastery over topics of lessons. C13: presentation of new topics relevant to the field.
observance of educational regulations **D_4**	C14: optimal use of class time. C15: students' roll-call. C16: administration of entrance tests, quizzes, etc. C17: observance of discipline by the instructor.
Educational tools **D_5**	C18: use of facilities (pictures, graphs…) to teach. C19: use of scientific trips for teaching.

Analytic Hierarchy Process (AHP)

The analytic hierarchy process (AHP) is a popular technique which is often used to model subjective decision making processes based on multiple attributes. AHP technique is widely used in both individual and group decision making environments (Bolloju, 2001, p499).

The AHP weighting is determined by the evaluators who conduct pair-wise comparisons, by which the comparative importance of two criteria is shown. Furthermore, the relative importance derived from these pair-wise comparisons allows a certain degree of inconsistency within a domain. Saaty used the principal eigenvector of the pair-wise comparison matrix derived from the scaling ratio to determine the comparative weight among the criteria (Chiu, 2006, p1247).

In AHP, multiple pair wise comparisons are based on a standardized comparison scale of nine levels (Table 2) (Chen et al., 2009b, p8458; Yen & Chang, 2009, p465).

Table 2 . Nine-point intensity of importance scale and its description

Definition	intensity of importance
Equally important	1
Moderately more important	3
Strongly more important	5
Very Strongly more important	7
Extremely more important	9
Intermediate values	2,4,6,8

Let C = {Cj / j = 1, 2 . . . n} be the set of criteria. The result of the pair wise comparison on n criteria can be summarized in an (n- n) evaluation matrix A in which every element a_{ij} (i,j = 1,2, . . . ,n) is the quotient of weights of the criteria, as shown:

$$A = \begin{bmatrix} a_{11} \; a_{12} \ldots \; a_{1n} \\ a_{21} \; a_{22} \ldots \; a_{2n} \\ \vdots \quad \vdots \ddots \\ a_{n1} \; a_{n2} \ldots a_{nn} \end{bmatrix} \quad , a_{ii} = 1, aji = 1/aij, a_{ij} \neq 0$$

At the last step, the mathematical process commences to normalize and find the relative weights for each matrix. The relative weights are given by the right eigenvector (w) corresponding to the largest Eigen value ($\lambda_{\max}$), as: (Dag˘deviren & et al, 2009, p8143)

$$Aw = \lambda_{\max} w$$

If the pair wise comparisons are completely consistent, the matrix A has rank 1 and $\lambda_{\max}$ = n. In this case, weights can be obtained by normalizing any of the rows or columns of A (Wang and Yang, 2007)

Fuzzy Set Theory

To deal with vagueness of human thought, Zadeh (1965) first introduced the fuzzy set theory, which was oriented to the rationality of uncertainty due to imprecision or vagueness. A major contribution of fuzzy set theory is its capability of representing vague data (Kahraman et al., 2003, p385).

There are two main characteristics of fuzzy systems that give them better performance for specific applications:

1. Fuzzy systems are suitable for uncertain or approximate reasoning, especially for the system with a mathematical model that is difficult to derive; and
2. Fuzzy logic allows decision-making with estimated values under incomplete or uncertain information (Kahraman et al, 2007).

Fuzzy set theory has developed as an alternative to ordinary (crisp) set theory and is used to describe fuzzy sets. For example, the set of 30-year-old men is a crisp set. The boundaries are definite and a particular person is either in the set or not, is either a 30-year-old man, or is not. In contrast, a fuzzy set does not have clear boundaries. Membership in a fuzzy set is a matter of degree (Friedlob& Schleifer, 1999, p133).

Let X denotes a universal set. Then a fuzzy subset of X is defined by its membership function: $\mu_{\overline{A}} : x \rightarrow [0,1]$ which is assigned to each element $x \in X$ a real number $\mu_{\overline{A}}(x)$ in the interval [0, 1], where the value, of $\mu_{\overline{A}}(x)$ at x represents the grade of membership of x in $\overline{A}$ Thus, the nearer the value of $\mu_{\overline{A}}(x)$ is unity, the higher the grade of membership of x in $\overline{A}$ (Sakawa, 2002, p196).

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Triangular fuzzy numbers and Linguistic variables

TFN is a special type of fuzzy number with three parameters, each representing the linguistic variable associated with a degree of membership of 0 or 1. Since it is shown to be very convenient and easily implemented in arithmetic operations, the TFN is also commonly used in practice (Liou & Chen, 2006, p931)

A triangular fuzzy number $\widetilde{m}$ is defined by a triplet (a, b, c). The membership function μ_m of $\overline{M}$ is given by (Chamodrakas & et al, 2009, p7410):

$$\mu_{\overline{m}} = \begin{cases} \dfrac{x-a}{b-a} & (a \le x \le b) \\ \dfrac{c-x}{c-b} & (b \le x \le c) \end{cases}$$

The algebraic operation for the triangular fuzzy number can be displayed as follows: (Chiu, 2006, p1248; Abdolvand et al., 2008, p374)

- Addition of a fuzzy number $\oplus$

$$(L_1, M_1, U_1) \oplus (L_2, M_2, U_2) = (L_1 + L_2, M_1 + M_2, U_1 + U_2) \quad (1)$$

- Multiplication of a fuzzy number : $\otimes$

$$(L_1, M_1, U_1) \otimes (L_2, M_2, U_2) = (L_1 L_2, M_1 M_2, U_1 U_2) \quad (2)$$

- Any real number k:

$$K(L, M, U) = (KL, KM, KU) \quad (3)$$

- Subtraction of a fuzzy number Θ

$$(L_1, M_1, U_1)\Theta(L_2, M_2, U_2) = (L_1 - L_2, M_1 - M_2, U_1 - U_2) \quad (4)$$

- Division of a fuzzy number

$$(L_1, M_1, U_1)(L_2, M_2, U_2) = (L_1 / L_2, M_1 / M_2, U_1 / U_2) \quad (5)$$

- Average of fuzzy number :

$$\begin{aligned} A_{ave} &= (A_1 + A_2 + \ldots.. + A_n) \\ A_{ave} &= [(L_1 + \ldots\ldots + L_n) + (M_1 + \ldots.. + M_n) + (U_1 + \ldots. + U_n)/n \end{aligned} \quad (6)$$

The concept of a fuzzy number plays a fundamental role in formulating quantitative fuzzy variables. These are variables whose states are fuzzy numbers. When, in addition, the fuzzy numbers represent linguistic concepts, such as very small, small, medium, and so on, as interpreted in a particular context, the resulting constructs are usually called linguistic variables (Klir & Yuan, 1995, p102).

Fuzzy sets have vague boundaries and are therefore well suited for discussing such concepts as linguistic terms (such as “very” or “somewhat”) or natural phenomena (temperatures) (Friedlob & Schleifer, 1999, p133).

Variables, whose values are given in linguistic terms, i.e. words, sentences, etc, are called linguistic variables (Chen, 2001; Lin & Chang, 2008).

Each linguistic variable the states of which are expressed by linguistic terms interpreted as specific fuzzy numbers is defined in terms of a base variable, the values of which are real numbers within a specific range. A base variable is a variable in the classical sense, exemplified by any physical variable (e.g., temperature, pressure, speed, voltage, humidity, etc.) as well as any other numerical variable, (e.g., age, interest rate, performance, salary, probability, reliability, etc.). In a linguistic variable, linguistic terms representing approximate values of a base variable, germane to a particular application, are captured by appropriate fuzzy numbers (Klir & Yuan, 1995, p102)

Defuzzification

The result of fuzzy synthetic decision of each alternative is a fuzzy number. Therefore, it is necessary that the nonfuzzy ranking method for fuzzy numbers be employed during service quality comparison for each alternative. In other words, Defuzzification is a technique to convert the fuzzy number into crisp real numbers; the procedure of defuzzification is to locate the Best Nonfuzzy Performance (BNP) value (Tsuar et al., 2002, p110). There are several available methods to serve this purpose. Mean-of-Maximum, Center-of-Area, and a-cut Method are the most common approaches. This study utilizes the Center-of-Area method due to its simplicity and does not require analyst's personal judgment (Abdolvand et al., 2008, p375).

The defuzzified value of fuzzy number can be obtained from Equation (7).

$$TFN = (L, M, U)$$
$$BNF = [(U - L) + (M - L)]/3 + L \tag{7}$$

TOPSIS

The TOPSIS (technique for order performance by similarity to ideal solution) was first developed by Hwang & Yoon (1981). According to this technique, the best alternative would be the one that is nearest to the positive-ideal solution and farthest from the negative ideal solution (Ertugrul & Karakasoglu, 2007). The positive- ideal solution is a solution that maximizes the benefit criteria and minimizes the cost criteria, whereas the negative ideal solution maximizes the cost criteria and minimizes the benefit criteria (Wang & Elhag, 2006). In short, the positive-ideal solution is composed of all best values attainable from the criteria, whereas the negative ideal solution consists of all worst values attainable from the criteria (Wang, 2007). There have been lots of studies in the literature using TOPSIS for the solution of MCDM problems. (Chen, 2000; Chu & Lin, 2002; Wang et al., 2009; Boran et al., 2009).

The calculation processes of the method are as following: (Tsuar et al, 2002, p111)

- _Step 1:_ Establish the normalized performance matrix:

The purpose of normalizing the performance matrix is to unify the unit of matrix entries. Assume the original performance matrix is

$$x = (x_{ij}) \qquad \forall_{i,j} \tag{8}$$

Where x_{ij} is the performance of alternative *i* to criterion *j*.

- _Step2:_ Create the weighted normalized performance matrix

TOPSIS defines the weighted normalized performance matrix as:

$$V = (V_{ij}) \qquad \forall_{i,j}$$
$$V_{ij} = w_{ij} \times r_{ij} \quad \forall_{i,j} \tag{9}$$

where w_j is the weight of criterion *j*.

- _Step3:_ Determine the ideal solution and negative ideal solution

The ideal solution is computed based on the following equations:

$$A^{+} = \{(\max V_{ij} / j \in J), (\min V_{ij} / j \in J'), i = 1,2,....,m\} \tag{10a}$$
$$A \;\; = \{(\min V_{ij} / j), (\min V_{ij} / j \in J'), i = 1,2,....,m\} \tag{10b}$$

Where

j = {j = 1, 2,…, *n*/ *j* belongs to benefit criteria}; j = {j = 1, 2,… *n/j* belongs to cost criteria}:

- _Step4:_ Calculate the distance between idea solution and negative ideal solution for each alternative:

$$S_i^+ = \sqrt{\sum_{j=1}^{n}(Vij - V_j^+)^2} \quad i = 1,2,......,m \tag{11}$$

$$S_i^- = \sqrt{\sum_{j=1}^{n}(Vij - V_j^-)^2} \quad i = 1,2,......,m \tag{12}$$

- *Step5:* Calculate the relative closeness to the ideal solution of each alternative

$$C_i^+ = \frac{S_i^-}{S_i^+ + S_i^-} \qquad i = 1,2,......,m \tag{13}$$

where $0 \le c_i^* \le 1$ that is, an alternative i is closer to A_i^* as C_i^* approaches to 1.

- *Step6:* Rank the preference order

A set of alternatives can be preference ranked according to the descending order of C_i^*

Empirical Study Of Instructors Performance

Survey & Measurement Instrument

In an effort of conducting the survey, 170 questionnaires were distributed to students in PNU. Out of the 170 surveys, all of them had been returned , 17 of them (10%) weren't completed and 153 0f them were completed that were ready for analyzing a rate equal with 90% which is a very good rate. The other demographic statistics were: all of them were at their age of less than 30 and were students of B.A education that consisted of 45.22 % men and 54.75 % women.

The questionnaire of instructors' performance evaluation was composed based on four parts: first section was related to properties of population, second section was about questions for evaluating the relative importance of criteria and airline's performance corresponding to each criterion. AHP method was used in obtaining the relative weight of criteria. In order to establish the membership function (third section) associated with each linguistic expression term, we asked respondents to specify the range from 1 to 100 corresponding to linguistic term 'Strongly Disagree (SD) ', 'Disagree', 'Middle (M)', 'Agree' and 'Strongly Agree' and in the fourth section there were 19 questions about 5 dimensions of instructors' performance.

For determining the reliability of this questionnaire from in this research Cronbach's Alpha has been used. Values of final for each of the 5 dimensions of instructors' performance with similar questions were in Table 3. According to Saharan's opinion, Cronbach's coefficient less than 0.6 is weak, 0.7 is acceptable and more than 0.8 is very good (Abdolvand et al., 2008, p 376). Therefore the result of this research for four dimensions are acceptable and for one dimension are good and whole questionnaire from have acceptable reliability.

Table 3. Instructors' performance evaluation scores: Cronbach's alpha.

	S_1	S_2	S_3	S_4	S_5	Total
Items	5	6	2	4	2	19
Questions	1 – 5	6 - 11	12 – 13	14 – 17	18 - 19	1 – 19
Cronbach's Alpha	.701	.723	.763	.80	.735	.712

Determine Fuzzy Number

In this study, five spectrums are used that have been said already: Strongly Disagree (SD), Disagree (D), Middle (M), Agree (A), and Strongly Agree (SA).

For gaining each of the linguistic variables' fuzzy numbers, responders' opinions were used, so each responder were asked to determine linguistic variables' spectrum from 0 to 100 (Abdolvand et al., 2008, p372).

The sample of these opinions is shown in Table 4.

Table 4. Scale of linguistic variables by responders

	Scale of linguistic variables(0-100)				
Responder	SD	D	M	A	SA
1	0- 5	5 - 20	20- 40	40- 65	65 - 100
2	0-10	10-25	25-50	50-80	80-100
3	0 - 15	15 - 30	30 - 60	60 - 80	80- 100
4	0 - 10	10 - 25	25 - 40	40 - 70	70 - 100
5	0 - 10	10 - 30	30 - 50	50 - 70	70 - 100
6	0 - 15	15- 30	30-60	60-85	85-100
……….	....	....	....	....	....
153	0 - 20	20 - 30	30 - 40	40 - 60	60 - 100

After achieving responders' opinion by evaluation of these 30 experts in linguistic variables scale, we determine triangular fuzzy numbers (TFN) of each linguistic variable.

According to the above mentioned, now TFN of each linguistic variables were consist of:

- “Strongly Disagree” linguistic variable (SD) :

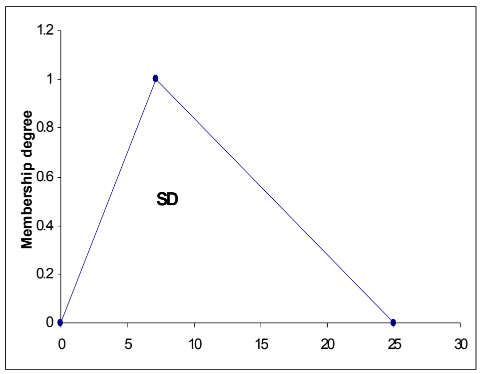

Figure 2. Triangular membership function of fuzzy number for “Strongly Disagree”

Table 5. TFN for SD linguistic variable

	L	M=(L+U)/2	U
1	0	2.5	5
2	0	5	10
3	0	7.5	15
4	0	5	10
5	0	5	10
6	0	7.5	15
…..	…	....	.....
….	…..	…	…
153	0	10	20
TFN(SD)	0	7.15	25
	min	average	max

As it was mentioned, we could obtain TFN for SD linguistic variables by responders’ opinion, and other linguistic variables’ fuzzy numbers are obtained in this way. These numbers with their membership function are as follows:

Table 6. Linguistic variables and Triangular fuzzy number (TFN)

linguistic variables	TFN
Strongly Disagree (SD)	(0 ,7.15 ,25)
Disagree (D)	(5 ,22.15 ,40)
Middle (M)	(15 ,41.36 ,60)
Agree (A)	(45 ,65.56 ,85)
Strongly Agree (SA)	(70 ,89.2 ,100)

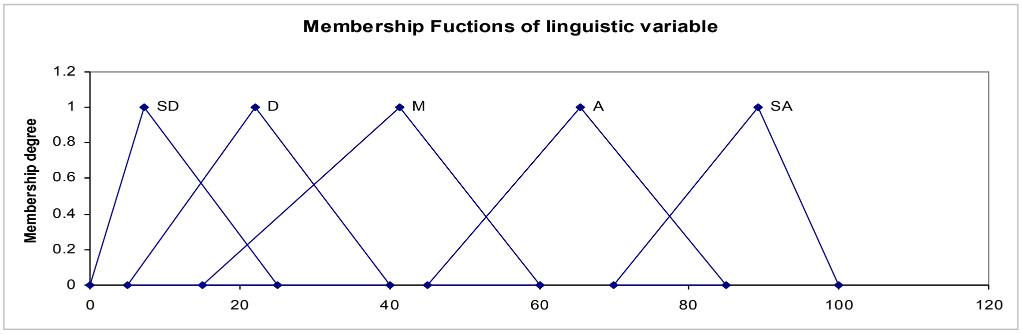

Figure 3. Membership functions of linguistic variables

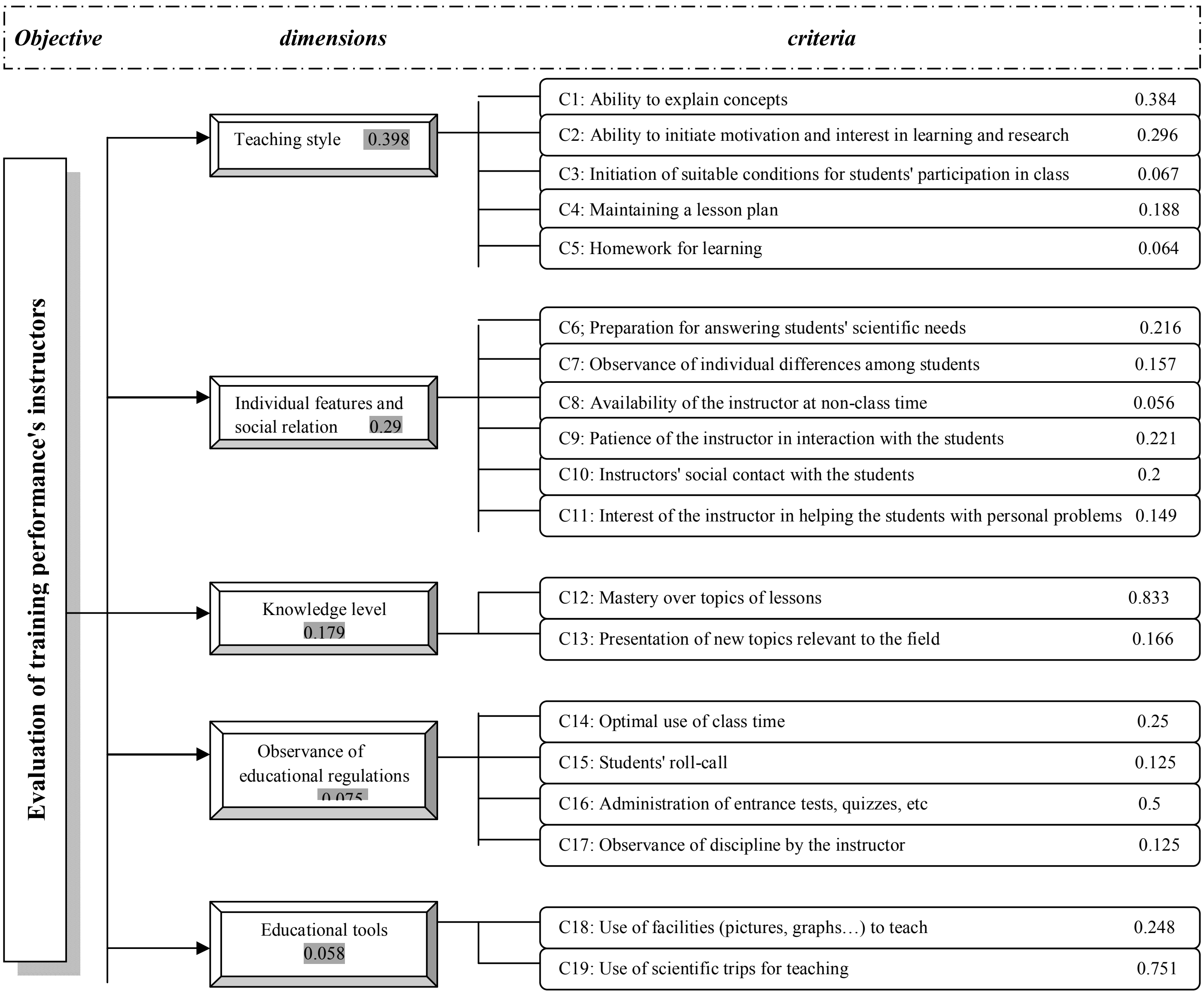

Figure 4. Weights of the nineteen criteria.

Table 7. Fuzzy performance measures of instructors

Performance evaluation criteria	instructor A	instructor B	instructor C	instructor D
C1	(57.50, 77.40, 92.50)	(52.01, 71.89, 88.98)	(35.00, 54.70, 73.75)	(31.25, 53.46, 73.75)
C2	(63.75, 83.30, 96.25)	(63.75, 83.29, 96.25)	(40.00, 60.47, 75.00)	(32.45, 55.27, 72.57)
C3	(51.25, 71.50, 88.75)	(57.23, 77.14, 91.24)	(20.00, 42.60, 61.25)	(21.45, 43.01, 61.25)
C4	(50.00, 71.30, 86.25)	(57.50, 77.38, 92.50)	(17.50,37.81, 56.25)	(32.45, 53.78, 72.75)
C5	(55.50, 74.20, 89.78)	(58.21, 78.65, 92.58)	(27.50, 48.65, 67.50)	(27.41, 48.39, 67.50)
C1 -C5	**(55.60, 75.50, 90.71)**	**(57.74, 77.67, 92.31)**	**(28.00, 48.85, 66.75)**	**(29.00, 50.78, 65.56)**
C6	(49.24, 69.50, 84.23)	(58.67, 78.59, 93.02)	(33.75, 54.56, 71.25)	(34.98, 54.95, 71.02)
C7	(50.02, 72.00, 86.25)	(50.01, 70.89, 87.95)	(21.02, 43.25, 62.39)	(27.98, 48.66, 67.94)
C8	(36.25, 59.40, 76.25)	(33.75, 54.59, 75.00)	(17.01, 36.56, 55.78)	(28.27, 49.24, 68.31)
C9	(63.50, 84.20, 96.25)	(62.98, 82.59, 96.20)	(32.78, 53.69, 70.58)	(28.75, 53.32, 70.00)
C10	(63.04, 83.80, 96.01)	(58.21, 77.95,92.50)	(25.00, 43.86, 62.50)	(43.75, 65.42, 82.50)
C11	(50.85, 71.50, 87.54)	(28.75, 53.23, 70.00)	(16.75, 36.25, 56.86)	(17.54, 37.64, 55.89)
C6-C11	**(52.15, 73.40, 87.76)**	**(48.73, 69.64, 85.78)**	**(24.39, 44.70, 63.23)**	**(30.21, 51.54, 69.27)**
C12	(56.20, 76.20, 90.12)	(64.35, 85.27, 96.07)	(27.46, 48.02, 66.27)	(34.56, 52.19, 71.25)
C13	(35.49, 58.90, 75.46)	(43.75, 63.42, 82.50)	(19.64, 40.25, 60.35)	(26.25, 45.27, 64.57)
C12 - C13	**(45.85, 67.60, 82.79)**	**(54.05, 74.35, 89.29)**	**(23.55, 44.14, 63.31)**	**(30.41, 48.73, 67.91)**
C14	(42.50, 65.30, 80.00)	(50.89, 70.95, 88.26)	(42.58, 65.27, 81.98)	(43.89, 66.84, 83.75)
C15	(40.00, 60.50, 75.00)	(58.63, 78.32, 92.47)	(58.25, 76.45, 91.68)	(56.19, 68.34, 89.79)
C16	(37.10, 59.40, 76.08)	(56.25, 77.24, 90.00)	(40.25, 60.48, 74.65)	(31.25, 49.77, 66.25)
C17	(58.01, 78.30, 93.12)	(62.45, 83.21, 96.43)	(76.25, 77.85, 91.28)	(56.38, 75.28, 88.61)
C14 - C17	**(44.40, 65.80, 81.05)**	**(57.06, 77.43, 91.79)**	**(54.33, 70.01, 84.90)**	**(46.93, 65.06, 82.10)**
C18	(52.36, 72.20, 89.05)	(58.12, 76.89, 91.84)	(33.97, 53.89, 72.07)	(38.59, 60.25, 79.85)
C19	(49.87, 70.30, 86.16)	(50.00, 71.33, 86.25)	(22.13, 39.57, 55.39)	(28.52, 51.02, 67.34)
C18 - C19	**(51.12, 71.20, 87.61)**	**(54.06, 74.11, 89.05)**	**(28.05, 46.73, 63.73)**	**(33.56, 55.64, 73.59)**

Table 8. Overall performance measures of instructors - * Is the best performance out of the four instructors.

Performance evaluation criteria	instructor A	instructor B	instructor C	instructor D
C1	75.79*	70.96	54.48	52.82
C2	81.10*	81.10*	58.49	53.43
C3	70.49	75.20*	41.28	41.90
C4	69.19	75.79*	37.19	52.99
C5	73.16	76.48*	47.88	47.77
C1- C5	**73.95**	**75.91***	**47.87**	**49.78**
C6	67.66	76.76*	53.19	53.65
C7	69.43	69.62*	42.22	48.19
C8	57.29*	54.45	36.45	48.61
C9	81.32*	80.59	52.35	50.69
C10	80.94*	76.22	43.76	63.89
C11	69.95*	50.66	36.62	37.02
C6 - C11	**71.10***	**68.05**	**44.10**	**50.34**
C12	74.18	81.90*	47.25	52.67
C13	56.61	63.22*	40.08	45.36
C12 - C13	**65.40**	**72.56***	**43.67**	**49.02**
C14	62.59	70.03*	63.28	64.83
C15	58.49	76.47*	75.46	71.44
C16	57.52	74.50*	58.46	49.09
C17	76.46	80.70	81.79*	73.42
C14 - C17	**63.77**	**75.43***	**69.75**	**64.70**
C18	71.19	75.62*	53.31	59.56
C19	68.76	69.19*	39.03	48.96
C18 - C19	**69.97**	**72.41***	**46.17**	**54.26**

- Step 1:

Table 9. Normalized performance matrix

	1	2	3	4	5
A	73.95	71.10	65.40	63.77	69.97
B	75.91	68.08	72.56	75.43	72.41
C	47.87	44.10	43.67	69.75	46.17
D	49.78	50.34	49.02	64.70	54.29
w	0.40	0.29	0.18	0.08	0.06

→

	1	2	3	4	5
A	0.584	0.597	0.555	0.462	0.567
B	0.600	0.571	0.616	0.547	0.586
C	0.378	0.370	0.371	0.505	0.374
D	0.393	0.422	0.416	0.429	0.440

- Step2:

Table 10. Weighted normalized performance matrix

	1	2	3	4	5
A	0.232	0.173	0.099	0.034	0.032
B	0.238	0.166	0.110	0.041	0.033
C	0.150	0.107	0.066	0.037	0.021
D	0.156	0.122	0.074	0.035	0.025

- *Step3:* Determine the ideal solution and negative ideal solution

$$\begin{cases} A^{+}_{i} = \{0.238, 0.173, 0.11, 0.041, 0.033\} \\ A^{-}_{i} = \{0.15, 0.107, 0.066, 0.034, 0.021\} \end{cases}$$

- *Step4:*

Table 11. Distance between idea solution and negative ideal solution

	A	B	C	D
S^+	0.023	0.007	0.118	0.102
S^-	0.111	0.114	0.003	0.228

- Step5-6:

Table 12. Final ranking of instructors

Instructor	Rank	Similarity to ideal solution(C^+)
B	1	0.942
A	2	0.828
D	3	0.690
C	4	0.024

The Weights of Evaluation Dimensions and Criteria

Figure 4 shows the relative weights of the five dimensions of instructor's performance, which were obtained by applying AHP. The weights for each of the aspect were: Teaching style (0.398), Individual features and social relation (0.29), Knowledge level (0.179), Observance of educational regulations (0.075) and Educational tools (0.058). The weights were described generally was that students were more concerned on the instructors feature rather than the regulations or tools aspects.

Performance Measure of Instructors

After obtaining the criteria weights from AHP (Fig. 4), by using fuzzy number and fuzzy average is measured performance of four instructors .Table 2 lists the fuzzy performance measure for the four instructors. After obtaining the performance measure in terms of fuzzy number, we defuzzify the fuzzy numbers into crisp numbers so as to conduct TOPSIS ranking procedure. We used Center-of-Area method (as Eq. (7)) to defuzzify the fuzzy numbers, which are as shown in Table 3. In general overview, instructor B performs better in all of aspects except Individual features and social relation that instructor A has better.

Final Ranking

In this paper, we use AHP method in obtaining criteria weight, and apply TFN to assess the linguistic ratings given by the evaluators. By using TOPSIS, we aggregate the weight of evaluate criteria and the matrix of performance to evaluate the four instructors' performance, the results of evaluation can be seen in table 8.

Conclusions And Implications

In this study, we have aggregated and identified five instructor's performance dimensions and 19 indicators of that performance. The five performance dimensions were: Teaching style, Individual features and social relation, Knowledge level, observance of educational regulations, Educational tools. For determining reliability of this questionnaire from Cronbach's Alpha has been used that Values of final were the table (3) and had acceptable reliability.

For evaluating the instructors' performance, we applied the fuzzy MCDM. So, we calculated the criteria weights by AHP and then for measuring instructors' performance, we used fuzzy set theory and TFN to assess the linguistic ratings given by the evaluators. Finally, we conducted Technique for TOPSIS to achieve the final ranking results.

In an effort of conducting the survey, 170 questionnaires were distributed to students in PNU that all of them were at their age of less than 30 years old and they were students of B.A education in this group 45.22 percent was men and 54.75 percent women.

Weights results show that students are more concern about the instructors feature than the regulations or tools because of weights for each of the dimensions were: [Teaching style (0.398), Individual features and social relation (0.29), Knowledge level (0.179), Observance of educational regulations (0.075) and Educational tools (0.058)]. For measuring four instructors' performance, TFN's performance showed in Table 2 and BNF shown table 3 which in general overview, instructor B performed better in all of aspects except Individual features and social relation that instructor A performed better. Then final ranking, after applying six steps from Topsis, instructor a higher rank than another instructor.

In general, performance evaluation is an important issue for managers, since it can be used as a reference in decision making with regard to performance improvement, specially teaching performance improvement so, in this study we applied the fuzzy MCDM to evaluate the instructors Performance in universities because we believe that judgments are usually vague rather than crisp, a judgment should be expressed by using fuzzy sets which have the capability of representing in vague data.

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