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# A Multicriteria Approach to Calculate the Index of Promotion of Legal Culture using Neutrosophic Numbers

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**Abstract.** Educational institutions in Ecuador promote the receptive participation style of teachers in the classrooms. However, on many occasions teachers need training in the pedagogical discipline, which makes it impossible to incorporate technical knowledge, vocational training and the creation of legal awareness in students. This research proposes a solution to the problem raised from the development of a method to determine the index of promotion of legal culture. The method operates based on a multi-criteria approach with the use of neutrosophic numbers to model the uncertainty.

**Keywords:** Legal culture, pedagogical training, neutrosophic numbers.

## 1. Introduction

Nowadays, the legal pedagogical training of university teachers is very important to ensure the quality of the teaching-learning process in the educational system. It allows to improve the indicators established by the control organisms of Higher Education in Ecuador and to make improvements when necessary [1, 2].

As a way to materialize the legal culture, university teachers share experiences through congresses, scientific meetings, symposia, seminars, colloquia and other educational training activities. However, it is evident that it is not enough to achieve a good real performance, due to the lack of mastery of pedagogical strategies that facilitate their didactic performance [3, 4].

The teacher's task is complex and requires constant training, so the process of learning how to teach is necessary to better understand teaching and enjoy it. The implementation of a legal pedagogy center in higher level institutions with specialized personnel would strengthen proactivity in the learning-teaching process [5-8].

The control bodies, whose function is the institutional and academic evaluation, in relation to the quality of the university, are considered factors that drive higher institutions to provide better service, being highly demanding when selecting teachers to the academic function.

Teachers are not really aware of the role they perform and in various situations they must make emerging decisions in the classroom, since the teaching role of the lawyer who usually performs in free practice, or as a public official does not accredit him being a teacher for not having pedagogical training [9-11].

From the aforementioned analysis, the objective of this research is to develop a method to determine the index of promotion of legal culture through neutrosophic numbers. Seven evaluation criteria are proposed in the method.

The paper has the following structure: Preliminary concepts, which explains in more detail essential aspects of the pedagogy of university law teaching. Section 3 covers some specific concepts related to the neutrosophic method to be used. Section 4 shows the implementation of the method in a real case study. The paper ends with the conclusions.

## 2 Preliminaries

This section provides a description of the main elements associated with the domain of the modeled problem, in order to understand the main references of the addressed object of study. The bases that contribute to pedagogical training and the legal culture from the formative process are also presented.

## 2.1 Pedagogical training

Teachers are subject to teacher evaluations with the purpose of improving quality, in which it is evident that they clearly handle legal issues for the most part and that they personally try to teach the best way they can. But there is no constant support for this achievement, and they do not apply the adequate legal pedagogy, not due to lack of interest but due to the shortage of a department that provides accompaniment to the teachers of the law school [12, 13].

It is important that the experts in pedagogy carry out the accompaniment to the teachers of the law school, through constant advice and thus ensure that the trainers have the double training necessary to improve the teaching-learning process [14-16].

In the role of the legal trainer, the problem is that, as in any educational institution, the quality of the teacher impacts, to a greater or lesser extent, on the quality provided by the training center. Educational quality is an issue that has different interpretations, according to the scope in which it is evaluated. It is common in researches covering this topic that certain information is merited in relation to informational backgrounds, such as degrees and postgraduate degrees, among others [17, 18].

In the academic world of law, including judicial schools, this training is linked to disciplinary expertise. That is, the trainer's own terrain [19, 20], the professors of the law school obviously have their experience in the professional field, but they lack pedagogical and didactic knowledge. It is a situation that has caused a high impact, even in the universities of our country. The evaluators of the Higher Education control bodies have observed the lack of pedagogical knowledge. which is why the creation of a Legal Pedagogy center is considered pertinent to improve the level of Higher Education in the country [21] and the accreditation of universities since it is one of the indicators required by CACES [14].

## 2.2 Legal culture

Law school professors confront their professional activity through a characteristic system of knowledge, product of the personal elaboration of their ideas in a specific institutional and social context. Such knowledge is actually used by the teacher and "subjective, biographical and experiential factors come into play, as well as objective contextual aspects". The teacher is a subject who continually builds, elaborates and tests his personal theory of the world [22-25].

Consistent with the current vision of teaching, considered as an activity of professional thinking in which conceptual change must be recognized as the center of teacher learning [26]. The teacher becomes the builder of knowledge based on the needs of the environment, so it is important to reinforce the solutions to the difficulties that arise on a daily basis in the legal pedagogical process [27-29].

The teacher must always be aware of their actions and how they relate to their students, always trying to be a guide and an advisor, trying to practice a different style of teaching that is closer and more stimulating. One of the processes that are fulfilled in most educational institutions is the tutoring or accompaniment that the teacher carries out to the student. It is the guide of the academic process and not leaving aside personal matters, stimulating the student to meet their goals and if necessary; in several cases they are referred for psychological assistance.

The teachers who attend the training activities are highly motivated by the quality of their teaching. Most of them are teachers who are constantly innovating in their teaching task and want to know how to do better what they are already doing well as assessed by teachers and students themselves. In the proposal section we will see what role this type of teachers can play in the pedagogical and didactic training of their classmates [30].

Each university could use these sensitized teachers with specific preparation for it as facilitators within their immediate context, departments, for the change of culture and values regarding the need and opportunity for pedagogical training. It would be a form of recognition of the teaching excellence of these teachers [31].

## 3 Design of the method for the determination of the index of promotion of legal culture

This section describes the operation of the method to determine the index of promotion of legal culture. The method is based on the neutrosophic logic to represent the uncertainty through the use of operators for the aggregation of information [32].

Figure 1 shows a general diagram of the proposed method.

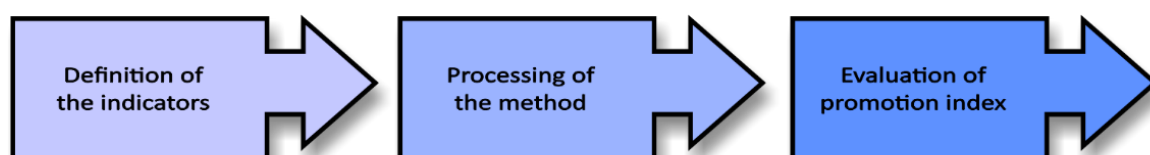


Figure 1: General diagram of the proposed method.

The proposed method is designed to ensure the management of the workflow on the determination of the index of promotion of legal culture. It uses a multi-expert multi-criteria approach where the inference is made based on evaluative indicators. It has a processing stage that executes the mathematical analysis of the solution and finally the evaluations of the promotion index are generated as an output parameter of the method [33, 34].

The process of determining the legal culture promotion index consist of four basic activities: definition of the evaluation indicators, determination of the weights associated with the indicators, aggregation of the information and generation of the evaluations, which are described below:

Activity 1. Definition of the evaluation indicators:

The activity of determining the evaluation indicators, which uses a multi-expert multi-criteria approach, consists of obtaining the evaluation indicators for the process of determining the promotion index of the legal culture from the opinion of experts who intervene in the process. The use of between 5 and 7 experts for the evaluation process is recommended.

Activity 2. Determination of the weights associated with the indicators:

From the indicators obtained from the previous activity, an assessment of these is carried out to determine the weights associated with each vector. The use of experts in the process is part of the development of the proposed activity.

Activity 3 Aggregation of information:

**Definition 1:** OWA operator. A function is an OWA operator of dimension n if it has an associated vector W of dimension n such that its components satisfy  $F: \mathbb{R}^n \rightarrow \mathbb{R}$ , [35, 36]:

- 1)  $w_j \in [0,1]$ ,
- 2)  $\sum_{j=1}^n w_j = 1, Y$
- 3)  $F(a_1, a_2, \dots, a_n) = \sum_{j=1}^n w_j b_j$

Where  $b_j$  is the j-th largest of the  $a_i$

The aggregation operator can be expressed using a vector notation as represented in equation 1:

$$F(a_1, a_2, \dots, a_n) = W^t B \tag{1}$$

Where:

W: is the OWA weight vector associated with the aggregation.

B: is the sorted aggregate vector, where the j-th largest component of B is being the j-th largest of the  $b_j a_i$  Neutrosophic numbers can be expressed in neutrosophic logic as shown in [32, 37-39]:

$$N = \{(T, I, F) : T, I, F \subseteq [0, 1]\},$$

A neutrosophic value is a mapping of a group of formulas associated with N, from each proposition p we have [34, 40, 41]:

$$v(p) = (T, I, F) \tag{2}$$

Where:

T: represents the truth value,

I: represents the value of indeterminacy,

F: represents the falsehood value.

Mathematically, a Neutrosophic OWA operator can be defined as a 2-tuple (W, B) as represented by equation 3.

$$F(a_1, a_2, \dots, a_n) = W_{(T,I,F)} {}^t B_{(T,I,F)} \tag{3}$$

Where:

W: is the OWA weight vector associated with the aggregation that has a space of truth, indeterminacy, and falsehood, respectively. (T, I, F)

B: is the sorted aggregate vector, where the j-th largest component of B is  $b_j$  being the largest j-th of the  $a_i$ , which has a space of truth, indeterminacy, and falsehood (T, I, F)[42, 43].

The proposed method bases the aggregation process using the OWA operator for neutrosophic numbers [44-47].

Additionally, in order to compare two neutrosophic numbers, the following formula is used:

$$s(\tilde{a}) = \frac{1}{3}(2 + T - I - F) \tag{4}$$

For a neutrosophic number.  $\tilde{a} = (T, I, F)$

Activity 4 Generation of evaluations:

Once the information is aggregated, the evaluations derived from the process are obtained as a result; they represent the output information of the method.

Specifically, the method includes the following 7 evaluation criteria:

Criteria	Description
C1	Domain with experience and suitability in the work specialty
C2	Possession or access to consistent pedagogical training that enables them to understand and facilitate training
C3	Knowledge of teaching strategies
C4	Training in the style of many of the teacher training programs in law schools.
C5	Inclusion of fundamental elements of institutional insertion
C6	Management of realistic strategies adaptable to changing circumstances and events
C7	Teacher evaluations

**Table 1.** Evaluation indicators.

These criteria are the ones we recommend to measure. Each institution may include new ones or exclude some of those proposed.

The method consists of the following:

1. The experts that we will denote by  $\{e_1, e_2, \dots, e_n\}$  are selected
2. Each expert evaluates the importance of each criterion using the linguistic scale shown below in Table 2.

Linguistic term	Neutrosophic number
Extremely good (EG)	(1,0,0)
Very very good (VVG)	(0.9, 0.1, 0.1)
Very good (VG)	(0.8,0.15,0.20)
Good (G)	(0.70,0.25,0.30)
Medium good (MG)	(0.60,0.35,0.40)
Medium (M)	(0.50,0.50,0.50)
Medium bad (MB)	(0.40,0.65,0.60)
Bad (B)	(0.30,0.75,0.70)
Very bad (VB)	(0.20,0.85,0.80)
Very very bad (VVB)	(0.10,0.90,0.90)
Extremely bad (EB)	(0,1,1)

**Table 2.**Linguistic terms used.

Let us call  $x_{ij}$  the value of the neutrosophic number that appears to the right of Table 2, corresponding to the linguistic term that appears in the left column, which means the opinion of the  $i$ -th expert on the  $j$ -th criterion. Where  $i = 1, 2, \dots, n$  and  $j = 1, 2, \dots, 7$

3. To obtain the weights, the linguistic terms that appear in Table 3 are used.

Linguistic term	Value
Not important	(0.10,0.90,0.90)
Less important	(0.20,0.85,0.80)
Slightly important	(0.30,0.75,0.70)
Somewhat important	(0.40,0.65,0.60)
Average importance	(0.50,0.50,0.50)
Important	(0.60,0.35,0.40)
Very important	(0.70,0.25,0.30)
Strongly important	(0.8,0,15,0.20)
Very strongly important	(0.9, 0.1, 0.1)
Extremely important	(1,0,0)

**Table 3.** Domain of values to assign weight to the criteria.

- 3.1. Each expert proposes a weight for each criterion, using the scale that appears in Table 3, let's call  $\tilde{w}_{ij}$  the weight assigned by the i-th expert to the j-th criterion.
- 3.2. We obtained  $\hat{w}_j = \frac{1}{n} \sum_{i=1}^n \tilde{w}_{ij}$  The weight of the j-th criterion is calculated as  $w_j = \frac{s(\hat{w}_j)}{\sum_{j=1}^7 s(\hat{w}_j)}$ , where  $s(\cdot)$  is the operator that appears in formula 4.
4. The results are aggregated using the calculated weights and the evaluations using formula 3, where for each evaluation,  $b_j = \frac{\sum_{i=1}^n x_{ij}}{n}$  ( $j = 1, 2, \dots, 7$ ).

#### 4 Method implementation for the determination of the index of promotion of legal culture

This section describes a case study for the exemplification of the results in which it is possible to apply the proposed method. The study is carried out on an institution of higher education at Universidad Autónoma Regional de los Andes, Ecuador. The example presents the fundamental elements synthesized to facilitate the understanding of the readers.

The main elements of the implemented method are described below.

Stage 1: Definition of the evaluation indicators.

During the process of obtaining information for the definition of the evaluation indicators, we concluded that the criteria in Table 1 are adequate to carry out the evaluations.

Activity 2 Determination of the weights associated with the indicators:

Using a multi-expert approach, the weights attributed to each criteria are determined. Five experts were consulted for the process, and they issued their assessments. As a result, the weight vectors associated with each indicator were obtained. Table 4 shows the results after the aggregation of the results issued by the experts.

Criterion	$\tilde{W}$ (T, I, F)	W
C1	[0.97, 0.25, 0.15]	0.15279
C2	[0.75, 0.15, 0.10]	0.14863
C3	[0.85, 0.12, 0.10]	0.15636
C4	[0.97, 0.25, 0.10]	0.15577
C5	[0.65, 0.30, 0.25]	0.12485
C6	[0.55, 0.25, 0.25]	0.12188
C7	[0.80, 0.25, 0.20]	0.13971

Table 4. Weights vectors associated with the indicators.

Stage 2: Implementation of the static analysis.

Activity 3 Aggregation of information:

From the processing of the vectors of associated weights of the indicators and the preferences obtained from the institution used in the case study, the information aggregation process is carried out based on what is expressed in Equation 3. For the process of aggregation, a sorting of the evaluative indicators is carried out.

Table 5 presents the result of the values obtained during the aggregation process.

Criterion	Weights	Preferences
C1	0.15279	[0.95, 0.10, 0.15]
C2	0.14863	[0.85, 0.10, 0.10]
C3	0.15636	[0.75, 0.12, 0.10]
C4	0.15577	[0.75, 0.10, 0.10]
C5	0.12485	[0.55, 0.15, 0.10]
C6	0.12188	[0.75, 0.20, 0.15]
C7	0.13971	[0.25, 0.25, 0.10]
Aggregated Value.		[0.70059, 0.14251, 0.11373]

Table 5. Result of the aggregation process.

The crisp value of the aggregated value is 0.81478.

Activity 4 Generation of evaluations:

From the aforementioned analysis of the data in Table 5, an evaluation is generated where an incidence rate of promotion of the legal culture of 0.81478 is identified; representing a high implementation rate from what it is possible to define that this area is a fundamental line of work for the training of teachers.

## Conclusions

This paper presented a method for determining the index of promotion of legal culture through a multi-criteria approach. The performance used the representation of neutrosophic numbers to model the uncertainty.

The method also included the use of the OWA operator with neutrosophic numbers to represent the uncertainty about the promotion of legal culture. Through its evaluation, it was possible to make an analysis of the promotion of legal culture. The use of linguistic labels is recommended to improve the interpretability of the analyzed data.

From the identification of the limitations and weaknesses found in the universities under study, due to legal professionals who do not have a good pedagogical training, we must take into account a series of considerations in order to overcome the obstacles that affect the training of the professional future.

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