



Neutrosophic statistics applied to demonstrate the importance of humanistic and higher education components in students of legal careers

Rogelio Meléndez Carballido¹, Hayk Paronyan², Marvelio Alfaro Matos³ and Alberto Leonel Santillán Molina⁴

¹ Lawyer, teacher-researcher, UNIANDES, Santo Domingo, Ecuador. E-mail: us.rogeliomelendez@uniandes.edu.ec

² PhD, teacher-researcher at UNIANDES University, Santo Domingo, Ecuador. E-mail: us.haykparonyan@uniandes.edu.ec

³ Lawyer, teacher-researcher, UNIANDES, Santo Domingo, Ecuador. E-mail: us.marvelioalfaro@uniandes.edu.ec

⁴ MSc. Teacher-researcher, UNIANDES, Santo Domingo. E-mail: us.albertosantillan@uniandes.edu.ec

Abstract. In this paper we carry out an analysis of the humanistic and higher education components in students of legal careers. Neutrosophic statistics are used to demonstrate the importance of these components. Thus, person's life is better, insofar as it is filled with meaning and continuous reflection during his (her) existence. For that reason this study aims to analyze humanistic and higher education components of Law School students for their inclusion into the practical activities from an integral perspective.

Keywords: humanistic education, higher education, Law school's students, neutrosophic statistics.

1 Introduction

The training of a highly qualified professional has been a challenge more than an aspiration, and one of the central objectives of any process of development in higher education. However, the accelerated advances in science and technology, along with other socioeconomic and political factors have been causing a gradual shift from classical training to competency-based training, increasingly focused on the development and acquisition of professional knowledge, to the detriment of the humanistic sense and the indispensable integral formation of human beings.

The humanistic training in higher education must be focused on an integral training, where the technical profile of each profession implies the development of the ethical and moral values inherent to the human being. This novel paradigm enables the graduation of professionals with a high humanistic sense, with an open mind in accordance with the multicultural, multiethnic and multilingual diversity of each region or country [1-2].

The bibliographical analysis made from studies which, from common perspectives, include as a center the humanistic training within higher education, upon the need to displace the partiality in the preparation of the university professional. In benefit of the integrity required in these times, makes an approach to the real and contextualized needs of any university training process and its indispensable transformation, from a dual perspective that favors the understanding of its importance in university teachers [3].

The real and contextualized necessities of the university education process and its indispensable transformation are responsible for making viable the promotion of this topic in the educational teaching process of Ecuadorian universities, as referred in [4]. On the basis of the aforementioned elements, it is worth mentioning the studies in [5], which describes the necessity to carry out transformations in the diverse access roads in terms of construction, production, transmission and distribution of knowledge, in full accordance with the call-out made.

On the other hand, according to [6-8] the higher education institutions and universities in particular, have the responsibility to carry out the revolution of thought, as a fundamental way to promote the rest of the necessary transformations. In line with these criteria, outstands the position assumed by Uribe in [9], who bases his work on the necessity to include in higher education, humanistic studies based on philosophical studies, in such a way that this branch does not remain in the field of the merely specialized and incorporates an integral approach, from the individual to the collective, towards a humanistic context as an aspiration to the total knowledge it refers.

Similarly, and for the wide and unquestionable path that Loret, Pino and Nordelo in [10] take in their studies, the aforesaid authors deepen into the humanistic education at university courses in general. Standing out, the systematization for the various theoretical and methodological conceptions supporting the humanistic education at universities, with the purpose to identify the qualities of the professional and the knowledge proposal, which are useful for the construction of the human intellect, characterized by the general performance of the professional.

However, the Constitution of the Republic of Ecuador in 2008 pays special attention to the treatment of education, establishing that education is a right of the people and a duty of the state and that it has the human being as its center of attention, based on a holistic approach, based on the respect for human rights. The Organic Law of Higher Education (LOES is the abbreviation in Spanish), in spite of defining the humanistic character of Higher Education, it highlights within its content what refers to academic and professional training, scientific research, transmission and dissemination of science, technique, technology and culture, without making explicit mention of the education of citizens for the benefit of citizen himself, or humanistic education, as an essential component of the necessary integrality that must be the objective of the university education process.

In this panorama and in accordance with the diverse characteristics of our country, and the generalized globalization of the contemporary era, the approach to legal problems becomes increasingly complex. That is why the development of critical and humanistic thinking is required. Based on the attitude towards life and the search for new knowledge, which allows facing the current challenges of each society, from an ethical, responsible and committed position, to the current demands of a world where social devaluation has emerged and walks in giant steps, it is very important to think in the improvement of the humanistic training in Law university education and in particular at the Regional Autonomous University of the Andes (UNIANDES), Santo Domingo. For this aspect is the starting point to reach the educational standards, according to the demands of our times.

According to [11], a transformative knowledge from eminently technical positions, towards a general education that contemplates multi-ethnic and multicultural aspects, are the ones required for an adaptation of the aforementioned context. From the methodological point of view, the vision of a not so technical teaching, as the transmission of completed and formal knowledge, which places the political commitment in the educational practice, full of ethical and moral values and the development of the person in terms of collaboration among them, constitute the fundamental bases for the development of professional knowledge.

Based on such postulates, free Greeks and Romans cultivated rhetoric, grammar and logic, that is why they were called liberal arts in later humanistic studies, which made them a kind of prestige inherited from classical antiquity. The first approaches to the humanistic ideal were called *humanitas*, as one of the first classifications of the liberal arts, they contained the following arts: grammar, dialectics, rhetoric, geometry, arithmetic, astronomy, music, medicine and architecture [12-13].

In this sense, according to [14] the humanistic formation of Law school students in general, and just like in all sciences, arts, knowledge and techniques, should illuminate the life of persons, making it better, more livable, to the extent that it continuously fills his existence with meaning and meditation. That is, it is not given exclusively to cultivate concepts, knowledge, and techniques, but for the cultivation of the soul, for raising the dimensions of the person [15]. It means reflecting on his autonomy, capacity for self-realization, inviolable dignity and his openness to others and transcendence [16].

Based on the aforementioned elements, the use of neutrosophic statistics is required to measure the condition of humanistic and university education components in Law students of UNIANDES. With the use of classical statistics, the data are known, formed by sharp numbers. In the neutrosophic statistics, the data have certain indeterminacy. Data may be ambiguous, vague, imprecise, incomplete, even unknown. Instead of sharp numbers used in classical statistics, sets (which are respectively close to these sharp numbers) are used in neutrosophic statistics [17].

In addition, Smarandache refers that in neutrosophic statistics, the sample size may not be known exactly (for example, the sample size could be between 90 and 100, this may happen because, for example, the statistician is not sure of what they approximately refer, which are the individuals of the sample that belong or not to the population of interest, or because the individuals of the sample only belong partially to the population of interest, while they do not belong partially). Another approach would be to consider only partially the data provided by the individuals in the sample whose membership in the population of interest is only partial. Here, a group of experts or teachers evaluate a random sample of students, by using linguistic terms. Later neutrosophic hypothesis test is applied.

This paper is divided in a section called Materials and Methods, which is devoted to summarize the main concepts of neutrosophy theory, especially neutrosophic statistics, as well as other useful concepts. Next, the section of Results is dedicated to calculate and discuss the results obtained. The paper finishes with the section of Conclusions.

2 Materials and methods

In this study, Neutrosophy is used, because it is appropriate to demonstrate the importance of the humanistic and university education components in Law students since these components that are obtained require interpretability. In this sense, neutrosophic as a branch of philosophy which studies the origin, nature and scope of neutralities, created by [18] is used in this study.

The use of neutrosophic was proposed by Smarandache [19] for the treatment of neutralities. It has settled the basis for a series of mathematical theories that generalize classical and fuzzy theories such as neutrosophic sets and neutrosophic logic as referred by [19]. The original definitions of neutrosophic logic are shown by Smarandache in [20], where he

expresses:

Definition 1 Let X be a universe of discourse, a space of points (objects) and x denotes a generic element of X . A *neutrosophic set* A in X is characterized by a truth-membership function $T_A(x)$, an indeterminacy-membership function $I_A(x)$, and a falsity-membership function $F_A(x)$. Where, $T_A(x), I_A(x), F_A(x) \subseteq]0, 1^+[$, i.e., they are real standard or nonstandard subsets of the interval $]0, 1^+[$. These functions do not satisfy any restriction, that is to say, the following inequalities hold:
 $0 \leq \inf T_A(x) + \inf I_A(x) + \inf F_A(x) \leq \sup T_A(x) + \sup I_A(x) + \sup F_A(x) \leq 3^+$.

Definition 2 Let X be a universe of discourse, a space of points (objects) and x denotes a generic element of X . A *Single Valued Neutrosophic Set (SVNS)* A in X is characterized by a truth-membership function $T_A(x)$, an indeterminacy-membership function $I_A(x)$, and a falsity-membership function $F_A(x)$. Where, $T_A(x), I_A(x), F_A(x): X \rightarrow [0, 1]$ such that: $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$. A *single valued neutrosophic number (SVNN)* is symbolized by $\langle T, I, F \rangle$ for convenience, where $T, I, F \in [0, 1]$ and $0 \leq T + I + F \leq 3$.

Therefore, $A = \{ \langle x, T_A(x), I_A(x), F_A(x) \rangle : x \in X \}$ or more simply $A = \langle T_A(x), I_A(x), F_A(x) \rangle$, for every $x \in X$.

Given A and B two SVNSs, they satisfy the following relationships:

13. $A \subseteq B$ if and only if $T_A(x) \leq T_B(x)$, $I_A(x) \geq I_B(x)$ and $F_A(x) \geq F_B(x)$. Particularly, $A = B$ if and only if $A \subseteq B$ and $B \subseteq A$.

14. $A \cup B = \langle \max(T_A(x), T_B(x)), \min(I_A(x), I_B(x)), \min(F_A(x), F_B(x)) \rangle$, for every $x \in X$.

15. $A \cap B = \langle \min(T_A(x), T_B(x)), \max(I_A(x), I_B(x)), \max(F_A(x), F_B(x)) \rangle$, for every $x \in X$.

Some important concepts of Neutrosophic Statistics are the following:

A *neutrosophic population* is a population where the membership of the individuals is not well defined and a level of indeterminacy could exist. A *neutrosophic sample* is a sample where indeterminacy is in some way present. The origin of indeterminacy can be due to the partial appurtenance of its members or because of the indeterminacy of this subset as a whole.

Example 1 Neutrosophic data can be a crisp value, like 1; an open, closed, semi-open, interval-valued data, like $[-1, 1]$, $(-1, 1)$, $[-1, 1)$ or $(-1, 1]$, moreover, it can be a discrete set like $\{-1, -0.5, 0, 1\}$.

Furthermore, the neutrosophic sample size can be an imprecise number.

Essential operations in neutrosophic statistics are based on interval-valued operations. In the following we summarize some of them. Given $I_1 = [a, b]$ and $I_2 = [c, d]$ two real valued intervals, then, see [21]:

17. $I_1 \leq I_2$ if and only if $a \leq c$ and $b \leq d$.

18. $I_1 + I_2 = [a+c, b+d]$.

19. $I_1 - I_2 = [a-d, b-c]$.

20. $I_1 \cdot I_2 = [\min(ac, ad, bc, bd), \max(ac, ad, bc, bd)]$.

21. $1/I_1 = [1/b, 1/a]$, always that $0 \notin I_1$.

22. $I_1/I_2 = I_1 \cdot (1/I_2)$.

23. $\sqrt{I_1} = [\sqrt{a}, \sqrt{b}]$, if and only if $a \geq 0$.

24. $I_1^n = \underbrace{I_1 \cdot I_1 \cdot \dots \cdot I_1}_{n \text{ times}}$, $n \in \mathbb{N}$.

Definition 3 A *Neutrosophic Normal Distribution* is a normal distribution of the random variable X , where either the median μ or the variance σ^2 (standard deviation σ) or both of them are imprecise.

A *neutrosophic hypothesis* satisfies that the statistics of the variables used to describe the population characteristics are neutrosophic or at least one value which describes a population characteristic is neutrosophic.

The *Neutrosophic Null Hypothesis*, denoted by NH_0 , is the one which we have to prove it is true; also, the *Neutrosophic Alternative Hypothesis* is defined and denoted as NH_a .

Example 2 Neutrosophic hypotheses can be the following:

$\{ NH_0: \mu \in [4, 5] \} \{ NH_0: \sigma \in [0.5, 1] \} \{ NH_0: \mu \in [4, 5] \}$
 $\{ NH_a: \mu \notin [4, 5] \} \{ NH_a: \sigma \notin [0.5, 1] \} \text{ or } \{ NH_a: \mu > 5 \}$

There exists two neutrosophic type of errors, they are:

5. A *Neutrosophic Type I Error*, is the error of rejecting NH_0 when NH_0 is true.

6. A *Neutrosophic Type II Error*, is the error of not rejecting NH_0 when NH_0 is false.

A *Neutrosophic Level of Significance* α can be a set, in this framework α can be defined like an interval.

A *Neutrosophic P-Value* p is the smallest level of significance such that NH_0 is rejected.

See that the Neutrosophic P-Value is not necessarily a crisp value.

The limits of the *Neutrosophic Confidence Interval for the Population Mean* μ is defined in Equation 1.

$$\bar{x} \pm z_{\text{critical value}} \cdot \frac{\hat{S}}{\sqrt{n}} \tag{1}$$

Where n is the sample size, which can be an interval, \hat{S} is the sample standard deviation and \bar{x} is the sample mean. Other approaches to neutrosophic distributions can be consulted in [22-24]. The hypothesis test can be naturally extended to neutrosophic hypothesis test. Also, normality tests can be applied, taking into account the new definitions. A formula to calculate the statistically representative sample size is given in Equation 2.

$$n = \frac{k^2 N p q}{e^2 (N-1) + k^2 p q} \tag{2}$$

Where:

n = sample size

N = population size.

p = probability that the event will occur (0.5).

q = probability that the event will not occur (0.5).

e = 0.05 or 5%. Maximum error accepted.

k = 1.96. For which the level of confidence is 95%.

Linguistic terms can be associated to SVNNs according to Table 1, defined in [25].

Linguistic Term	SVNN
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 (MDG)	(0.60,0.35,0.40)
Average(M)	(0.50,0.50,0.50)
Medium Bad (MDB)	(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 1: Linguistic terms and the associated SVNN, see [25].

The *Weighted Average* operator (WA), is an aggregation operator defined in Equation 3.

$$WA(a_1, a_2, \dots, a_n) = \sum_{i=1}^n w_i a_i \tag{3}$$

Where, $a_i = (T_i, I_i, F_i)$ are SVNNs and $w_i \in [0, 1]$ for every $i = 1, 2, \dots, n$; which satisfy the condition $\sum_{i=1}^n w_i = 1$. The a_i s are the values obtained for the i^{th} alternative assessment, and w_i denotes the weight which represents the importance given to the alternative a_i .

An adapted scoring function [26] is used to sort alternatives, see Equation 4.

$$s(a_j) = 2 + T_j - F_j - I_j \tag{4}$$

Here a_j is an alternative evaluated with the SVNN (T_j, I_j, F_j) . Let us note that $s: [0, 1]^3 \rightarrow [0, 3]$.

The definition of precision function is given in Equation 5.

$$a(a_j) = T_j - F_j \tag{5}$$

See that $a: [0, 1]^3 \rightarrow [-1, 1]$.

A poll shall help us to determine the main components of humanistic education, they are:

1. Teaching-learning environment
2. Role of the teacher and the student

3. Use of humanistic training in the exercise of the Law profession
4. Fundamental values that a legal professional must have

The procedure that shall be applied in this research is summarized in the following:

1. A group of teachers or experts of the Law School evaluate every one of the interviewed on the four precedent points, based on the linguistic terms in Table 1. The sample size of interviewed students is calculated with Equation 2.
2. For every interviewed student there exist four evaluations per expert according to the mentioned aspects. The equivalent SVNNS assessments are aggregated per expert using the weighted average aggregator with $w_1 = w_2 = w_3 = w_4 = 1/4$. Later the results are aggregated per student using the weighted average aggregator with $w_1 = w_2 = \dots = w_n$, where n is the number of experts (teachers), preferably $n = 3$.
3. The value of the scoring function is calculated for every one of the precedent SVNNS. They form the sample set.
4. The normality of the sample is proved applying a test, e.g., Kolmogorov-Smirnov. In case the hypothesis of normality is rejected, then, if the sample size is bigger than 30, quasi-normality shall be assumed.
5. In this step many hypothesis test can be applied, for example: $\begin{cases} NH_0: \mu \in [1.5, 3] \\ NH_a: \mu < 1.5 \end{cases}$, taking into account that $s(1, 0, 0) = 3$ and $s(0.5, 0.5, 0.5) = 1.5$, see Equation 4, we are testing that the sample can be evaluated between "Average" and "Extremely good".

3 Results

To demonstrate the importance of humanistic and university education components in Law students, we obtained information from the initial analysis, focused on determining the population and sample to investigate. The study target group was the evening section of Law school students. Human resources, documents in general and written documents in particular were used, also infrastructure and, finally, research techniques and financial resources.

The sample investigated has as a common characteristic: the fact that they are all Law school students, presential mode, of the evening section of UNIANDES, Santo Domingo. For the gathering of field information, we used the poll to explore reality. The selection of the sample was made according to the objective of the research and its viability. In this sense the probabilistic criterion was assumed. We studied a population of 378 students from the evening section of the UNIANDES Law School, Santo Domingo; total respondents 191. This sample size was calculated applying Equation 2, where $n = 190.78 \approx 191$.

Subsequently, the hypothesis of the importance of humanistic and university education components in Law students is demonstrated, to prove that the life of man will be better, insofar as it continuously fills his existence with meaning and meditation. For this, we used a neutrosophic hypothesis, which is a statement about the neutrosophic values of one or several characteristics of the population under study.

Next, second and third points of the procedure were applied. In the fourth point, according to the Kolmogorov-Smirnov proof, normality is rejected, nevertheless, we assume that the distribution is quasi-normal, because the $n \gg 30$.

Then, the following neurosophic hypothesis is study according to the fifth point:

$$\begin{cases} NH_0: \mu \in [1.5, 3] \\ NH_a: \mu < 1.5 \end{cases}$$

$$\text{We have } \bar{x} = 1.2961, \hat{s} = 0.94697, \text{ then, } z = \frac{\bar{x} - \mu}{(\hat{s}/\sqrt{n})} = \frac{[1.2961, 1.2961] - [1.5, 3]}{(0.94697/\sqrt{191})} = [-24.8671 \quad -2.9758] < -1.96.$$

Therefore, the neutrosophic null hypothesis is rejected, which means that we expect the results of the population is qualified like under Average.

The result of the analysis of the components was alarming because of the low level of knowledge that Law school students have in terms of humanistic components and in particular, in the conception of integrality demanded by higher education, in order to distinguish the scope of both ethical and moral values, required from the individual perspective as university students, until their future professional life.

From the foregoing, the minimum values of importance given to humanistic education are inferred, as an indispensable component in the professional practice of Law, also expressing the low number of teachers who refer to this aspect. However, most of the students analyzed think it is necessary to receive talks that contribute to their humanistic education during the progress of their academic preparation.

The main reason for the low and very low level of knowledge, is enclosed in the lack of theoretical knowledge, caused by the little treatment that humanistic education gets in pre-university education, exposing also the need to attend to lectures, practical experiences, a greater participation of teachers and other actions that contribute to promoting this training within the teaching-learning process of the course.

On the other hand, the low levels of knowledge of the foundations of the humanistic education of Law students, are combined with a certain dissatisfaction as for the work of the university in this direction. Students express rational proposals on how to optimize humanistic education.

These results represent a confirmation of the theory of a holistic pedagogical process, according to which the

development of the legal culture of the graduate is provided by the entire educational process, the scientific and methodological level of teaching legal issues, as well as non-traditional ways and extracurricular and extracurricular work methods.

Responsibility outstands among the priority humanistic values Law students have. Most students define the responsibility as a concrete concept of the relationship between a person, a collective or society from the point of view of the conscious realization of the mutual demands that are presented to them.

Emphasis is also placed on honesty, procedural loyalty, among others, as fundamental values that a Law professional must have, according to the characteristics and content of the activities of the various professional participants in the judicial process.

To prove the importance of humanistic and university education components in law students, an experiment is carried out to analyze the aforementioned components, measuring the fundamental indicators in four groups of students with different levels of humanistic orientation.

- Group 1 (low level): students who lack a humanistic approach or are in the initial training stage, characterized by a vague idea of the humanistic aspect of the goals and objectives of the legal activity; indifferent attitude to their professional growth.
- Group 2 (low level) - students with low humanistic orientation, characterized by the understanding of certain aspects of the goals and objectives of the humanist plan and the weak expression of the humanistic motives of the activity. This group has attitudes towards the legal profession, but they show little independence and activity in the teaching process. The professional interests and inclinations of students in this category can be classified as inactive and unstable.
- Group 3 (middle level) - students, for whom a disrespectful attitude towards disciplines that are not part of professional training is possible. They show initiative and independence in the process of educational activity, they have firm attitudes toward the profession. The professional constancy in them is characterized by initiative, sustainability and efficiency, but with a small sample of creativity. They observe the comprehension and desire to achieve the basic humanistic goals and objectives in the learning process. They made a special emphasis on efficiency and purpose. The main socially motivated reasons are the desire to deeply dominate the profession and to achieve material welfare with its help. This group of students is characterized by an internal semantic aspiration to the appropriation of values in the process of cognition, activity and communication.
- Group 4 (high level) of students is characterized by the understanding and orientation towards the completion of humanistic ideas, the tasks of professional activity and a marked desire for their professional growth, self-development, and personal improvement. Very typical of them is the manifestation of initiative and independence, purpose and creativity. For this category of students, the presence of a positive ideal clearly defined is especially characteristic, which is, the idea of who or what their model will be for them. This group of students is characterized by an internal semantic aspiration to appropriation, the creation of values in the process of cognition, activity and communication.

In order to the results of the poll, we calculated that 28.206% of the respondents belong to Group 4, 27.713% belong to Group 3, 22.890% belong to Group 1 and 21.192% belong to Group 1. We expect that these percents are valid to the whole population with an error of $\pm 5\%$.

4 Conclusions

In this study, we analyzed the humanistic and university education components in Law students, standing out the teaching-learning environment, the role of the teacher and the student, the use of humanistic training in the exercise of the legal profession and the fundamental values that a Law professional must have.

The effectiveness in the humanistic education of Law professionals is also analyzed, constituting this a point of reference to treat Law students. This efficiency is in accordance with the psychological and pedagogical conditions enclosed in the teaching - educational process of the university. It was included in the analysis of the humanistic components, the contents of the theoretical and practical-oriented courses, the introduction of humanistic approaches to teaching and the orientation of learning on the development of semantic values, the cooperation of teachers and students, the creation of individual trajectories of professional development for the students.

To demonstrate the significance that these components have in four groups of students with different characteristics, a neutrosophic hypothesis was used. Based on this, it was detected that a competency - oriented approach is necessary in the teaching - learning process of law students for the training of qualified personnel given the modern social conditions. The problem arises from the creation of general cultural competences and its important component.

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