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Student Competences and Neutrosophic Personality Operators in Law Students at the University of Chimborazo

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Abstract. The objective of this study was to demonstrate the usefulness of neutrosophic logic to determine the relationship between student competencies and certain personality traits in law students at the National University of Chimborazo. For this, the study was carried out on a sample of 20 students in the last year of their degree. The Analytic Hierarchy Process method was used to support the decision-making process. Using this method, the most desirable competencies in the distance learning process and those personality traits of interest to the researchers were selected. The results obtained made it possible to determine that, on average, there is indeterminacy in some of the pairs of personality traits in students with average or low performance. The students who, on average, presented high levels of performance in the competencies analyzed, showed greater tendencies towards the trait than towards the anti-trait or indeterminacy.

Keywords: neutrosophic operators, personality traits, student skills, Neutrosophy.

1 Introduction

Neutrosophy is a branch of philosophy, introduced by F. Smarandache in 1980, which studies the origin, nature, and scope of neutralities, as well as their interactions with different ideational spectra [1]. This science constitutes a general framework for the unification of many existing logics, such as fuzzy logic (especially intuitionistic fuzzy logic), paraconsistent logic, intuitionistic logic, etc. [2]. It deals with imprecise and vague situations where exact analysis is difficult or impossible [3].

The essential idea of Neutrosophic Logic is to characterize each logical statement in a 3D-Neutrosophic Space. In this framework, each dimension of the space represents, respectively, the truth (T), the falsehood (F), and the indeterminacy (I) of the statement under consideration. T, I, F are standard or non-standard real subsets of]-0, 1+[without necessarily any connection between them [4][5].

The origin of Neutrosophy has conceived the analysis of the trilogy made up of (<A>, <neutA>, <antiA>). This means the conception of a proposition, theory, event, concept, or entity <A> in relation to its opposite <antiA>, and to its neutral <neutA>. As the dynamic of opposites and their neutrals, it constitutes an extension of dialectics (which is the dynamic of opposites only) [6].

The introduction of new elements in this branch has allowed, over time, new advances to be made in the implementation of this science in various sectors of science, economy, and society [7][8]. The use of neutrosophic logic has manifested itself in industry, medicine, building sciences, communications, image processing, management, meteorology, and hundreds of other fields where the presence of indeterminacy or vagueness [7].

Recently, the use of this tool has reached the study and analysis of the human psyche. This extension to the branch of psychology has seen the birth of interesting applications of great interest to society in general. Personality traits, human behavior, and temperament analysis are some of the most interesting categories that have been studied so far [10]. The neutrosophic analysis of these interactions seeks an effective and real way to understand the extremely complex system of simultaneous interactions between pluri-underegos, pluriegos, and pluri-superegos [11].

Neutropsychic personality traits constitute a dynamic psychological system open to tendencies to feel, think and act in a very specific way in each individual. In this way, it can be established that the neutrosophic psychological theory studies the concepts of traditional psychology, from a triad of possible states (<A> <neutA> <antiA>) [12].

The specialists dedicated to the branch of legal sciences constitute a fundamental pillar of all modern society. From the university stage to the exercise of the profession, these professionals require the acquisition of tools that allow them to be effective during their future work. The appearance of the COVID-19 pandemic highlighted the need to promote self-study and distance learning, and with it, the ability to develop the necessary skills to facilitate it throughout the world.

Competency-based learning refers to systems of instruction, assessment, grading, and academic reporting, which are based on the knowledge and skills that students demonstrate they have learned and are expected to learn as they progress through their education. This type of educational system tries to promote a functional capacity for dynamic knowledge in students, beyond the traditional theoretical and rote pedagogy. Innovative aspects are incorporated into it, among them, the active participation of the student to achieve significant learning through the creation, use, and enhancement of their skills [13].

Among the fundamental professional skills in the training of jurists and lawyers are those that enhance interpretation, systematization, integration, argumentation, and application. Together with this, knowing how to reflect, identify, choose, dominate and integrate social problems allows us to interpret the principles, theories, norms, and axioms, in order to understand and apply the discipline of law.

In this sense, the present study seeks to demonstrate the usefulness of neutrosophic logic to determine the relationship between student competencies and certain personality traits in law students at the National University of Chimborazo. For this, the study is carried out in a sample of 20 law students.

To achieve the study, the Analytic Hierarchy Process (AHP) method is used in its neutrosophic version, as support for the decision-making process. This model for solving multicriteria problems is an effective way to define comparison measures between its elements and use them to reach effective conclusions during the decision process [14].

In this way, in the present study, some basic concepts related to the Theory of Neutrosophic Psychology are firstly analyzed. Subsequently, the proposed decision method is analyzed. Consecutively, the bases on which the analysis is carried out are established, the results achieved are presented and, the conclusions derived from the study are presented.

2 Preliminaries

2.1 Preliminary Neutrosophic Psychological Theory

The triplet $(< A >, < neut\,A >, < antiA >)$ is extended to discrete refined neutrosophic memory, where $(< A > 1, < A > 2, \dots, < A > l; < neutA > 1, < neutA > 2, \dots, < neutA > m; < antiA > 1, < antiA > 2, \dots, < antiA > n)$ are defined based on refined neutrosophy.

Given a universe of discourse, subsets A, B, and C, then the crisp neutrosophic set satisfies the axioms: $A \cap B = \emptyset, B \cap C = \emptyset, C \cap A = \emptyset,$ and $A \cup B \cup C = U$. Therefore, A, B, C form a disjoint partition of the universe of discourse U.

The refined neutrosophic crisp set for type 2 (and similarly for types 1 and 3) is defined as: $A = A1 \cup A2 \cup \dots \cup Ap$, $B = B1 \cup B2 \cup \dots \cup Br$, $C = C1 \cup C2 \cup \dots \cup Cs$, with $A \cap B = B \cap C = C \cap A = \emptyset$, where p, r, s are integers ≥ 1, $p + r + s \geq 4$, and $Ai \cap Aj = \emptyset$ for $i, j \in \{1,2, \dots, p\}$, $i \neq j$; $Bk \cap Bl = \emptyset$ for $k, l \in \{1,2, \dots, r\}$, $k \neq l$; and $Cm \cap Cn = \emptyset$ for $m, n \in \{1,2, \dots, s\}, m \neq n$ [11].

Various experts and trait theorists have concluded that the position of the human being moves on the spectrum between two opposite traits, that is, it behaves dynamically. As an easy generalization of all trait models, any number n ≥ 1 of Traits $< Aj >$ and their corresponding antiTraits $< antiA\,j >$can be considered, for $1 \leq j \leq n$:

$< A\,1 > / < antiA1 >, < A\,2 > / < antiA2 >, \dots, < A\,n > / < antiAn >$.

If the degree of the Trait is greater than or equal to the Trait Threshold (ThT), then the individual is characterized by this Trait. Similarly, if the degree of antiTrait is less than or equal to the threshold of antiTrait (antiThr), then he is characterized by antiTrait. In a neighborhood of the midpoint [-ε, ε], it is the most confused (indeterminate) degree (almost half Trait and half antiTrait) or combination of Trait-antiTrait [15].

Personality traits are measurable by calculating the degree of <A> and the degree of <antiA>. Really, in the world, no individual fits completely (100%) to a personality trait since this is only possible idealistically. In this way, the constants: -antiThr, +Thr, and ε depend on each antiTrait/Trait pair, so they can be different from one antiTrait/Trait pair to another. These constants are generally determined by experts in psychology, depending on the research interests [16].

In this sense, let Trait/anti-Trait be any pair, and let x be an individual belonging to a group of people S, then it is defined that:

$dTrait : S \rightarrow [0, 1]$,

dTrait(x) = the degree of the Trait that characterizes the individual x, and

$dantiTrait: S \rightarrow [-1, 0]$,

dantiTrait(x) = the degree of the antiTrait that characterizes the individual x. The Neutrosophic Trait Operator, combining the opposites, is the cumulative degree of individual x with respect to both the Trait and the anti-Trait, and is defined as:

$dTrait\ and\ antiTrait: S \rightarrow [-1, 1]$,

$dTrait\ \&\ antiTrait(x) = dTrait(x) + dantiTrait(x)$.

For each Trait - antiTrait pair, the degree of the Trait dTrait(x) that characterizes the individual x, and the degree of the antiTrait dantiTrait(x) is calculated. Subsequently, the Neutrosophic Trait Operator dTrait & antiTrait(x) is used and compared with the two thresholds, Thr and antiThr:

- If $dTrait\ \&\ antiTrait(x) \geq +Thr$, then the individual is categorized as definitely belonging to the Trait,
- If d$Trait\ \&\ antiTrait(x) \leq -antiThr$, then the individual is categorized as definitely belonging to the antiTrait.
- If $dTrait\ \&\ antiTrait(x) \in (-\varepsilon, +\varepsilon)$, then the individual is classified as being in a totally indeterminate state between Trait and antiTrait.
- If $dTrait\ y\ antiTrait\ (x) \in (\varepsilon, Thr)$, then the individual is classified as belonging mainly to the Trait.
- And finally, if $dTrait\ \&\ antiTrait(x) \in (-antiThr, -\varepsilon)$, then the individual is categorized as mostly belonging to the antiTrait.

2.2 AHP method

Definition 1: The Neutrosophic set N is characterized by three membership functions, which are the truth-membership function TA, indeterminacy-membership function IA, and falsehood-membership function FA, where U is the Universe of Discourse and $\forall x \in U$, TA(x), IA(x), FA(x) $\subseteq]-0, 1+[$, and $-0 \leq \inf TA(x) + \inf IA(x) + \inf FA(x) \leq \sup TA(x) + \sup IA(x) + \sup FA(x) \leq 3+$.

Notice that, according to the definition, $T_A(x)$, $I_A(x)$ and $F_A(x)$ are real standard or non-standard subsets of $]-0, 1+[$ and hence, TA(x), IA(x) and FA(x) can be subintervals of $[0, 1]$.

Definition 2: The Single-Valued Neutrosophic Set (SVNS) N over U is $A = \{< x; TA(x), IA(x), FA(x) > : x \in U\}c$, where $TA: U \rightarrow [0, 1]$, $IA: U \rightarrow [0, 1]$, and $FA: U \rightarrow [0, 1]$, $0 \leq TA(x) + IA(x) + FA(x) \leq 3$.

The Single-Valued Neutrosophic Number (SVNN) is represented by $N = (t, i, f)$, such that $0 \leq t, i, f \leq 1$ and $0 \leq t + i + f \leq 3$.

Definition 3: The single-valued trapezoidal neutrosophic number, $\tilde{a} = \langle (a_1, a_2. a_3, a_4); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$, is a neutrosophic set on $\mathbb{R}$, whose truth, indeterminacy, and falsehood membership functions are defined as follows, respectively:

$$T_{\tilde{a}}(x) \begin{cases} \alpha_{\tilde{a}}\left(\frac{x-a_1}{a_2-a_1}\right), & a_1 \leq x \leq a_2 \\ \alpha_{\tilde{a}}, & a_2 \leq x \leq a_3 \\ \alpha_{\tilde{a}}\left(\frac{a_3-x}{a_3-a_2}\right), & a_3 \leq x \leq a_4 \\ 0, & \text{otherwise} \end{cases} \quad (1)$$

$$I_{\tilde{a}}(x) = \begin{cases} \frac{(a_2-x+\beta_{\tilde{a}}(x-a_1))}{a_2-a_1}, & a_1 \leq x \leq a_2 \\ \beta_{\tilde{a}}, & a_2 \leq x \leq a_3 \\ \frac{(x-a_2+\beta_{\tilde{a}}(a_3-x))}{a_3-a_2}, & a_3 \leq x \leq a_4 \\ 1, & \text{otherwise} \end{cases} \quad (2)$$

$$F_{\tilde{a}}(x) = \begin{cases} \frac{(a_2-x+\gamma_{\tilde{a}}(x-a_1))}{a_2-a_1}, & a_1 \leq x \leq a_2 \\ \gamma_{\tilde{a}}, & a_2 \leq x \leq a_3 \\ \frac{(x-a_2+\gamma_{\tilde{a}}(a_3-x))}{a_3-a_2}, & a_3 \leq x \leq a_4 \\ 1, & \text{otherwise} \end{cases} \quad (3)$$

Where $\alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \in [0, 1]$, $a_1, a_2, a_3, a_4 \in \mathbb{R}$ and $a_1 \leq a_2 \leq a_3 \leq a_4$.

Definition 4: Given $\tilde{a} = \langle (a_1, a_2, a_3, a_4); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$ and $\tilde{b} = \langle (b_1, b_2, b_3, b_4); \alpha_{\tilde{b}}, \beta_{\tilde{b}}, \gamma_{\tilde{b}} \rangle$ two single-valued trapezoidal neutrosophic numbers and λ any non-null number in the real line. Then, the following operations are defined:

$$\text{Addition: } \tilde{a} + \tilde{b} = \langle (a_1 + b_1, a_2 + b_2, a_3 + b_3, a_4 + b_4); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle \quad (4)$$

$$\text{Subtraction: } \tilde{a} - \tilde{b} = \langle (a_1 - b_4, a_2 - b_3, a_3 - b_2, a_4 - b_1); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle \quad (5)$$

$$\text{Inversion: } \tilde{a}^{-1} = \langle ({a_4}^{-1}, {a_3}^{-1}, {a_2}^{-1}, {a_1}^{-1}); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle, \text{ where } a_1, a_2, a_3, a_4 \neq 0 \quad (6)$$

$$\text{Multiplication by a scalar number: } \lambda\tilde{a} = \begin{cases} \langle (\lambda a_1, \lambda a_2, \lambda a_3, \lambda a_4); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle, & \lambda > 0 \\ \langle (\lambda a_4, \lambda a_3, \lambda a_2, \lambda a_1); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle, & \lambda < 0 \end{cases} \quad (7)$$

Definitions 3 and 4 refer to the single-valued triangular neutrosophic number when the condition $a_2 = a_3$. For simplicity, the linguistic scale of triangular neutrosophic numbers is used, see Table 1 and also compare with the scale defined in [14], [23], [24].

The Analytic Hierarchy Process was proposed by Thomas Saaty in 1980. This technique models the problem that leads to the formation of a hierarchy representative of the associated decision-making scheme. The formulation of the decision-making problem in a hierarchical structure is the first and main stage. This stage is where the decision maker must break down the problem into its relevant components. [26], [28], [29], [30]

The hierarchy is constructed so that the elements are of the same order of magnitude and can be related to some of the next levels. In a typical hierarchy, the highest level locates the problem of decision-making. The elements that affect decision-making are represented at the intermediate level, the criteria occupying the intermediate level. At the lowest level, the decision options are understood. The levels of importance or weighting of the criteria are estimated using paired comparisons between them. This comparison is carried out using a scale, as expressed in equation (8).

$$S = \left\{ \frac{1}{9}, \frac{1}{7}, \frac{1}{5}, \frac{1}{3}, 1,3,5,7,9 \right\} \quad (8)$$

We can find in [14] the theory of the AHP technique in a neutrosophic framework. Thus, the indeterminacy of decision-making can be modeled by applying neutrosophic AHP or NAHP for short. Equation 9 contains a generic neutrosophic pair-wise comparison matrix for NAHP.

$$\widetilde{A} = \begin{bmatrix} \tilde{1} & \tilde{a}_{12} & \cdots & \tilde{a}_{1n} \\ \vdots & & \ddots & \vdots \\ \tilde{a}_{n1} & \tilde{a}_{n2} & \cdots & \tilde{1} \end{bmatrix} \quad (9)$$

Matrix $\widetilde{A}$ must satisfy condition $\tilde{a}_{ji} = \tilde{a}_{ij}^{-1}$, based on the inversion operator of Definition 4.

To convert neutrosophic triangular numbers into crisp numbers, there are two indexes defined [14], [22], which are the so-called score and accuracy indexes, respectively, see Equations 10 and 11:

$$S(\tilde{a}) = \frac{1}{8}[a_1 + a_2 + a_3](2 + \alpha_{\tilde{a}} - \beta_{\tilde{a}} - \gamma_{\tilde{a}}) \quad (10)$$

$$A(\tilde{a}) = \frac{1}{8}[a_1 + a_2 + a_3](2 + \alpha_{\tilde{a}} - \beta_{\tilde{a}} + \gamma_{\tilde{a}}) \quad (11)$$

Saaty's scale	Definition	Neutrosophic Triangular Scale
1	Equally influential	$\tilde{1} = \langle (1,1,1); 0.50, 0.50, 0.50 \rangle$
3	Slightly influential	$\tilde{3} = \langle (2,3,4); 0.30, 0.75, 0.70 \rangle$
5	Strongly influential	$\tilde{5} = \langle (4,5,6); 0.80, 0.15, 0.20 \rangle$
7	Very strongly influential	$\tilde{7} = \langle (6,7,8); 0.90, 0.10, 0.10 \rangle$
9	Absolutely influential	$\tilde{9} = \langle (9,9,9); 1.00, 1.00, 1.00 \rangle$
2, 4, 6, 8	Sporadic values between two close scales	$\tilde{2} = \langle (1,2,3); 0.40, 0.65, 0.60 \rangle$ $\tilde{4} = \langle (3,4,5); 0.60, 0.35, 0.40 \rangle$ $\tilde{6} = \langle (5,6,7); 0.70, 0.25, 0.30 \rangle$ $\tilde{8} = \langle (7,8,9); 0.85, 0.10, 0.15 \rangle$

Table 1: Saaty's scale translated to a neutrosophic triangular scale. Source: [14]

Step 1 Select a group of experts.

Step 2 The neutrosophic pair-wise comparison matrix of factors, sub-factors, and strategies, through the linguistic terms shown in Table 1.

The neutrosophic scale is attained according to expert opinions. The neutrosophic pair-wise comparison matrix of factors, sub-factors, and strategies are as described in Equation 9.

Step 3 Check the consistency of experts' judgments.

If the pair-wise comparison matrix has a transitive relation, i.e., $a_{ik} = a_{ij}a_{jk}$ for all i,j and k, then the comparison matrix is consistent, focusing only on the lower, median and upper values of the triangular neutrosophic number of the comparison matrix.

Step 4 Calculate the weight of the factors from the neutrosophic pair-wise comparison matrix, by transforming it into a deterministic matrix using Equations 12 and 13. To get the score and the accuracy degree of $\tilde{a}_{ji}$, the following equations are used:

$$S(\tilde{a}_{ji}) = {}^{1}\Big/_{S(\tilde{a}_{ij})} \tag{12}$$

$$A(\tilde{a}_{ji}) = {}^{1}\Big/_{A(\tilde{a}_{ij})} \tag{13}$$

With compensation by the accuracy degree of each triangular neutrosophic number in the neutrosophic pair-wise comparison matrix, the following deterministic matrix is derived:

$$A = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ \vdots & & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & 1 \end{bmatrix}$$

Determine the ranking of priorities, namely the Eigen Vector X, from the previous matrix:

1. Normalize the column entries by dividing each entry by the sum of the column.
2. Take the total of the row averages.

Note that Step 3 refers to the use of the calculus of the Consistency Index (CI) when applying this technique, which is a function depending on λ_{max}, the maximum eigenvalue of the matrix. Saaty establishes that the consistency of the evaluations can be determined by the equation $CI = \frac{\lambda_{max} - n}{n-1}$, where n is the order of the matrix. In addition, the Consistency Ratio (CR) is defined by the equation CR = CI/RI, where RI is given in Table 2.

Order (n)	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

Table 2: RI associated with every order.

If CR≤0.1 It can be considered that the expert's evaluation is sufficiently consistent and hence proceed to use NAHP. This procedure is applied to matrix A.

3 Methodology

The present study was carried out taking into account the students in the last year of the Law degree at the National University of Chimborazo, Ecuador. For this, a sample of 20 students was randomly selected. The sample consisted of members of both sexes, with similar ages, belonging to the same study group.

The study carried out was based on the selection, through the use of the NAHP method, of the elements to be studied in the selected sample of students. This means that, in order to better delve into the analyzes to be carried out, the selection of a set of both traits and competencies to be analyzed in accordance with the stated objective was proposed. [17], [18], [21], [25]

In this sense, the analysis of a set of student competencies is carried out to select those that offer a greater impact on the adequate distance learning process. Likewise, the same method (NAHP) is used to determine the main personality traits that students must have for academic achievement under these conditions, as well as future professional development during the exercise of the degree.

In this regard, taking into account the most used neutrosophic Trait-antiTrait personality pairs according to [19], [20], [27]:

- Extraversion – Introversion
- Conscientiousness – unconsciousness
- Perfectionism – Imperfectionism
- Sensitivism – Insensitivism
- Innovative – Conservative
- Self-esteem – Low self-esteem
- Kindness – Dislike
- Openness to intellect and experience – Closeness to intellect and experience

- Inhibition – Disinhibition
- Flexibility – Stiffness
- Emotivism – Not Emotivism
- obsessiveness – No obsessiveness
- Caution – Impulsiveness
- Timidity – Audacity
- Honesty – Dishonesty
- Hostility – No hostility.

The analysis of the competencies selected for the study is carried out with the support of Law school professors, and through self-inspections carried out by the students involved in the study. It is executed by obtaining the average of the evaluations obtained from both the teachers and the students, but greater weight is given to the opinion of the teachers. The evaluations of each of the competencies are considered in a range between high, medium, and low.

The analysis of the personality traits of the students is supported by 5 experts in the field of psychology. In order to guarantee reliable results, 3 sessions of interviews are carried out, in which the neutrosophic questionnaire is used. This questionnaire is constituted to obtain answers in a convenient format (degree of truth (t), degree of indeterminacy (uncertainty, lack of clarity), and degree of falsehood (f)) for each question. The processing of these data allows the subsequent obtaining of evaluations of the personality traits of the students analyzed.

4 Results

This section shows the results obtained after carrying out the study. For reasons of space, some of the steps to obtain them are omitted.

Table 3 shows the results of the application of the method for the selection of student competencies focused on distance learning. According to the experts' criteria, the most significant competencies in relation to the restrictions raised are the proper handling of ICT, as well as responsibility in learning.

Competencies	Eigenvalues	Weights Vector	Consistency Index
ICT Handling	25.56	0.103	
Communication skills	23.94	0.017	
Effective information management	27.66	0.134	
Critical and creative thinking	24.91	0.092	
Knowledge of self, task and strategies	22.98	0.028	
Planning, organization and time management	25.67	0.071	
Self-assessment, control, self-regulation	24.78	0.023	
Problem resolution	25.10	0.102	
Motivation and positive attitude towards learning and improvement	25.12	0.082	
Attributions	23.77	0.012	0.09
Self-concept, self-esteem, self-sufficiency	23.85	0.044	
Physical and emotional well-being	22.62	0.034	
Emotional self-regulation and anxiety control	24.30	0.063	
Social values	21.31	0.018	
Attitudes of cooperation and solidarity; relationships	21.84	0.018	
Teamwork	24.17	0.01	
Control of environmental conditions	22.35	0.01	
Responsibility in learning	28,030	0.123	
Civic and moral attitudes and values	23.31	0.008	
Respect to the ethical and deontological codes	22.91	0.008	

Table 3: Skills analyzed; eigenvalues and vector of weights related to the analysis of student competencies. Source: own elaboration.

On the other hand, Table 4 shows the results of the application of the method for determining the personality traits to be analyzed. According to the analysis carried out, the most prominent traits are focused on Perfectionism - Imperfectionism, Openness to intellect and experience - Closeness to intellect and experience, and Flexibility - Rigidity. These results turned out to be the basis for the analysis and comparison of the data collected in the study group.

Personality traits analyzed	Eigenvalues	Weights vector	Consistency Index
Extraversion – Introversion	18,356	0.019	0.08
Conscientiousness – unconsciousness	18,601	0.013	
Perfectionism – Imperfectionism	25,593	0.154	
Sensitivism – Insensitivism	21,429	0.107	
Innovative – Conservative	16,058	0.033	
Self-esteem – Low self-esteem	22,555	0.083	
Kindness – Dislike	19,142	0.027	
Openess to intellect and experience – Closeness to intellect and experience	21,376	0.113	
Inhibition – Disinhibition	21,696	0.095	
Flexibility – Stiffness	26,438	0.139	
Emotivism – Not Emotivism	19,590	0.053	
Obsessiveness – No obsessiveness	16,784	0.039	
Caution – Impulsiveness	20,381	0.072	
Timidity – Audacity	12,564	0.021	
Honesty – Dishonesty	14,886	0.020	
Hostility – Non-hostility	21,650	0.012	

Table 4: Skills analyzed; eigenvalues and vector of weights related to the analysis of personality traits. Source: own elaboration.

As can be seen in Figure 1, on average, those students who presented a higher level of information management showed greater tendencies towards intellectuality and lower tendencies towards rigidity. Students who presented medium levels in this competence showed greater perfectionism and flexibility than students with high levels in information management. On the other hand, students who showed the lowest levels of information management ability were found to be more prone to imperfectionism, less intellectual, and more rigid than their peers.

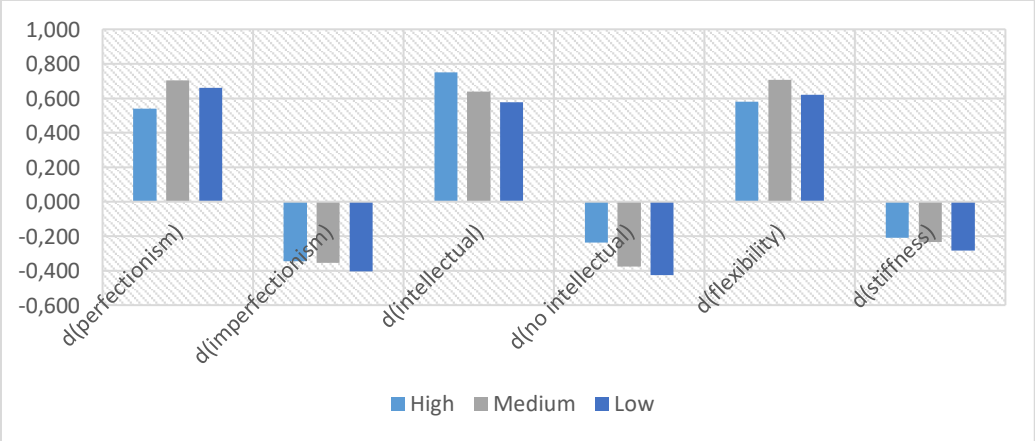

Figure 1: Average results of personality traits according to the level of competence in Efficient information management. Source: own elaboration.

On the other hand, when analyzing the results of the study taking into account the competence related to responsibility in learning, it can be observed that, in general, the students with high levels of this competence, on average, showed lower levels in the trait related to improvement, than the students with average results. In this sense, it was shown that this group of students was more intellectual and flexible than the rest of the groups.

In the case of students with medium levels of responsibility in learning, the high level of perfectionism trait achieved stands out. On the other hand, the students who showed less responsibility in learning were those who showed lower levels of perfectionism and greater rigidity.

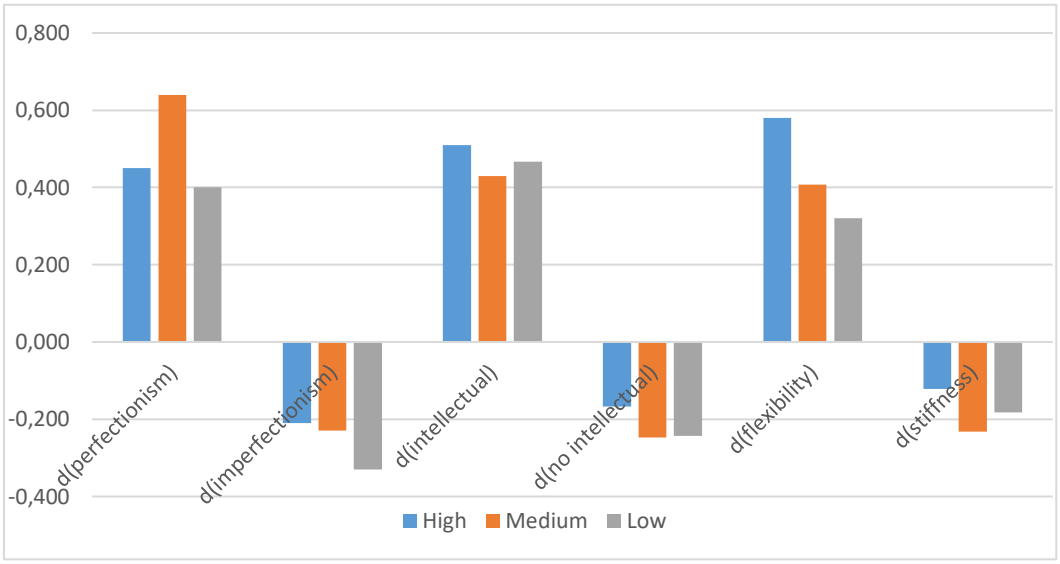

Figure 2: Average results of the personality traits according to the level of competence Responsibility in learning. Source: own elaboration.

Finally, when determining the personality operators for each of the analyzed traits, it can be observed that, in general, the students who obtained high levels of information management, on average, show that they are totally in an indeterminate state between the perfectionism and imperfectionism, while they presented greater traits of intellectuality than the rest of the groups analyzed. On the other hand, students with average levels in terms of information management, in all personality traits, remained in a range that indicates that most of them belong to that indicated trait. The students who presented lower levels in this competition are in a total state of indeterminacy between intellectuality and its opposite. See Figure 2.

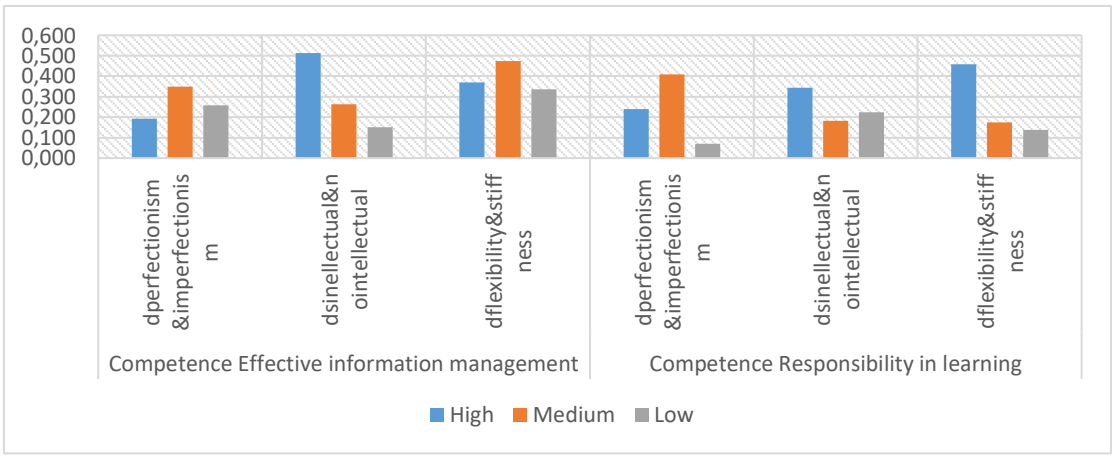

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Figure 2: Average personality operators for each of the selected competencies. Source: own elaboration.

On the other hand, when analyzing the personality neutrosophic operators related to the responsibility in learning competence, it was observed that in all cases, students with a high level of this competence showed tendencies to the three traits analyzed. The students with medium performance, although they showed a tendency to perfectionism, also revealed the existence of indeterminacy between the trait of intellectuality and its opposite, and flexibility and rigidity. Students with lower performance in this competition were found in a similar situation. In them, indeterminacy was found in the perfectionism operator and its opposite, as well as in the operator related to flexibility-stiffness.

Conclusions

The study of psychology in all its forms is a field of study riddled with inaccuracies/indeterminacies for data collection and analysis of results. Neutrosophy, as a science dedicated to the study of indeterminacies, is a tool of

great value for deepening various branches of it. This study made it possible to demonstrate the usefulness of neutrosophic logic to determine the relationship between student competencies and operators of personality traits in law students under certain conditions. The NAHP method was used, with the support of experts to determine those elements of greatest interest for the study. The results obtained allowed us to determine that, on average, there is indeterminacy in some of the pairs of personality traits in students with medium or low performance in the skills analyzed. The students who, on average, presented high levels of performance in the competencies analyzed showed greater tendencies towards the trait than towards the anti-trait or indeterminacy.

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