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Neutrosophic Study of Gender Identity Models in Teaching Practices

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Abstract. Sexual orientation and gender identity are essential aspects of a person's life and are under the protection framework of human rights. However, both categories continue to present themselves as a repeated reason for acts of discrimination, violence, and oppression, even through normative subjection. Education must highlight values such as coexistence, diversity, cooperative learning, and empathy to prevent heterosexism. Teachers must have training that guarantees safe, trustworthy, and safe learning spaces for all students, where they have the right to develop and socialize without exclusion. That is why the study is focused on analyzing the consensus and acceptance of experts on the factors that affect gender identity in the educational field based on the analysis of the neutrosophic statistical method. It was concluded that a reform of the current regulations should be carried out and training programs on human rights should be implemented to eliminate entrenched prejudices.

Keywords: discrimination, diversity, exclusion, human rights, neutrosophy.

1 Introduction

Gender roles are the set of roles and functions that make up the pre-established model of being a man or a woman in a given society. To speak of masculine and feminine in these societies, it is necessary to consider the specific political, economic, and territorial aspects and problems that the peoples and communities face. It is relevant to recognize and transform the different areas through which discrimination is manifested, two of them being of fundamental importance: the legal-regulatory field and the educational field.

In Ecuador, although the rights to equality and non-discrimination have been included in both domestic and international law, their effective fulfillment does not materialize in practice, which is reflected in many ways. There have been efforts by the state, but there are still practices, policies, and even regulations that become discriminatory based on sexual orientation. The foundation of these practices is associated with the persistence of cultural and ideological constructions based on heterosexism and heteronormativity.

With the Constitution of the year 2008, for the first time facets of the human personality, such as sexual orientation and gender identity, are called by their names in a series of articles. It is established not only that these human characteristics cannot be a reason for discrimination, but that the people who are part of the gender diversity have a series of rights that assist them. In this way, the contained legal discrimination ends, that which consists in not naming, avoiding the look, or passing sideways in front of reality [1].

Despite both conceptual and cultural advances regarding the recognition of sexual and gender diversity, there are still conservative positions against the possibility of having a sexual orientation other than heterosexual or constructing their gender identity outside of the pattern assigned to their biological sex. One of the difficulties that these families may encounter is the encounter with institutions or officers with conservative positions and who carry out discriminatory actions.

Gender discrimination also occurs in education, once inside the educational system it greatly affects especially women, but also men [2]. It is also related to other variables, such as ethnic, religious, social, or sexual orientation. Gender inequality in education can be considered a social problem that affects the world.

Initial education prioritizes the importance of the infant's first years of life. The environment where it develops is vital, here the boys and girls become active builders of their social world, a universe that reproduces the

defining characteristics of the adult framework that surrounds them. To facilitate gender-sensitive teaching, curricula and textbooks should be free from bias and promote equality in gender relations [3].

The elimination of gender violence in educational centers and their environments is a fundamental element to guarantee the human right to education and promote a safe and equitable learning environment for all people. The first step to improve interaction in the classroom is to reflect on one's gender stereotypes and recognize their role as educators and shapers of values. It is necessary to apply a methodology that is inclusive and representative.

It is education that promotes a pedagogical, training, critical, dynamic, participatory, and creative action plan. This is aimed at creating experiences and learning that cause an approximation between knowledge, reality, and the production of meaning of the educational subject. In addition, a series of knowledge and skills that affect their personal and citizen identity is expanded [4].

At the regional level, there continues to be little incorporation in national regulatory frameworks of protection against discrimination based on gender identity as an expressly recognized category and even more incipient in educational regulatory frameworks and public policies.

The school is the diffuser institution of the guidelines in terms of life regulations. If the school promulgated the values of inclusion, respect, and acceptance of difference, the results regarding positions that support the equal rights of gay, lesbian and trans people could vary more towards acceptance than rejection. Education must highlight values such as coexistence, diversity, cooperative learning, and empathy to prevent heterosexism. Promote training that guarantees safe, trustworthy and safe learning spaces for all students, where they have the right to develop and socialize without exclusion [3].

Based on the analysis referred to in the study and the level of indeterminacy existing in the neutrosophic statistical data, this study focuses on:

- The problem situation: discrimination based on gender identity in education.
- Main objective: to analyze the consensus and acceptance of experts on the factors that affect gender identity in the educational field.
- Specific objectives:
  - ✓ Determine the factors and degrees of recommendations for preventive practices by teachers
  - ✓ Carry out the measurement and modeling of the neutrosophic variable
  - ✓ Present potential alternatives, by evaluating the existing uncertainties of the analyzed variable.

Structure of the study:

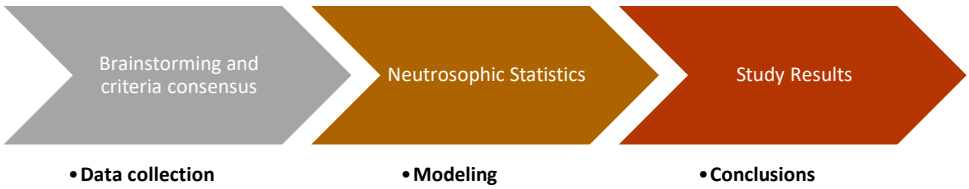

Figure 1: Study structure. Source: own elaboration.

2 Materials and methods

2.1 Neutrosophic statistics

Neutrosophic Statistics is the analysis of neutrosophic events and deals with neutrosophic numbers, neutrosophic probability distribution, neutrosophic estimation, neutrosophic regression, etc. It refers to a set of data, which is formed totally or partially by data with some degree of indeterminacy and to the methods to analyze them. Neutrosophic statistical methods allow neutrosophic data (data that may be ambiguous, vague, imprecise, incomplete, or even unknown) to be interpreted and organized to reveal underlying patterns [5,6, 20].

Neutrosophic logic is an addition or advancement of fuzzy logic, intuitionistic logic, paraconsistent logic, and tri-valued logic that uses imprecise values. In neutrosophic logic, the entire logical variable (x) is defined by the ordered triplet denoted by x= (t, i, f), (t) the degree of truth, (f) the degree of untruth, and (i) be the degree of indeterminacy. The Indeterminate (I) is classified in contradiction and uncertainty and obtains an addition of Belnap's four-valued logic. Also, (I) is contradictory, not true, and not known and gets the five value logic [7].

In a refined general neutrosophic logic, (T) can be divided into subcomponents (T1, T2, ..., Tp) and (I) into (I1, I2, ..., Ir) and (F) into (F1, F2,...,Fs) where [$p + r + s = n \geq 1$]. Furthermore: T, I, and/or F (or any of their

subcomponents Tj, Ik, and/or Fl) can be countable or uncountable infinite sets. As an example: a statement can be between [0.4, 0.6] true, {0.1} or between (0.15, 0.25) indeterminate and 0.4 or 0.6 false.

Neutrosophic probabilities and statistics are a generalization of classical and imprecise probabilities and statistics [8]. The neutrosophic probability of event E is the probability that event E occurs, the probability that event E does not occur, and the probability of indeterminacy (not knowing whether event E occurs or not). In classical probability nsup≤1, while in neutrosophic probability nsup≤3+.

The function that models the neutrosophic probability of a random variable x is called the neutrosophic distribution: $NP(x) = (T(x), I(x), F(x))$, where T(x) represents the probability that value x occurs, F(x) represents the probability that value x does not occur, and I(x) represents the undetermined or unknown probability of value x.

Neutrosophic logic [9], neutrosophic sets, and neutrosophic probabilities and statistics have a wide application in various research fields and constitute a novel study reference in full development. Neutrosophic Descriptive Statistics comprises all the techniques for summarizing and describing the characteristics of neutrosophic numerical data [10], [11], [12], [17], [21], [24].

Neutrosophic Numbers are numbers of the form $N = a + bI$ where a and b are real or complex numbers [5], while "I" is the indeterminacy part of the neutrosophic number N [11], [16], [22], [23]. Here $I_N \in [I_L, I_U]$ & $X_N \in [X_L, X_U]$ is a neutrosophic random variables of size $n_N \in [n_L, n_U]$. The variable $X_{iN} \in [X_{iL}, X_{iU}]$ has two parts: the lower value X_{iL} a classical part, and the upper-value $X_{iU}I_N$ an indeterminate part having an interval of indeterminacy $X_{iU}I_N$. Similarly, the mean neutrosophic $X_N \in [X_L, X_U]$ is defined as follows:

$$X_N = X_l + X_u I_N;\ I_N \in [I_l, I_u] \tag{1}$$

Where $X_U = \sum_{i=1}^{nL}(X_{il}/nl)$ and $X_L = \sum_{i=1}^{n_U}(X_{iu/}\, n_u)$ (2)

is a neutrosophic random sample. However, for the calculation of neutral squares (NNS) it can be calculated as follows:

$$\sum_{i=1}^{n} N(X_i - \bar{X}_{iN})^2 = \sum_{i=1}^{n} N\left[\begin{matrix}\min\left(\begin{matrix}(a_i + b_i I_L)(\bar{a} + \bar{b} I_L), (a_i + b_i I_L)(\bar{a} + \bar{b} I_U) \\ (a_i + b_i I_U)(\bar{a} + \bar{b} I_L), (a_i + b_i I_U)(\bar{a} + \bar{b} I_U)\end{matrix}\right) \\ \max\left(\begin{matrix}(a_i + b_i I_L)(\bar{a} + \bar{b} I_L), (a_i + b_i I_L)(\bar{a} + \bar{b} I_U) \\ (a_i + b_i I_U)(\bar{a} + \bar{b} I_L), (a_i + b_i I_U)(\bar{a} + \bar{b} I_U)\end{matrix}\right)\end{matrix}\right], I \in [I_L, I_U] \tag{3}$$

Where $a_i = X_l b_i = X_u$. The variance of the neutrosophic sample can be calculated by

$$\boldsymbol{S_N^2 = \frac{\sum_{i=1}^{n_N}(X_i - \bar{X}_{iN})^2}{n_N};\ S_N^2 \in \left[S_L^2, S_U^2\right]} \tag{4}$$

The neutrosophic coefficient (NCV) measures the consistency of the variable. The lower the value of the NCV, the more consistent the performance of the factor is than that of the other factors. The NCV can be calculated as follows.

$$\boldsymbol{CV_N = \frac{\sqrt{S_N^2}}{\bar{X}_N} \times 100;\ CV_N \in [CV_L, CV_U]} \tag{5}$$

3 Results

To determine the level of integration, a neutrosophic statistical analysis is performed for gender identity. The techniques described above are applied as follows.

From the processing of the information and the consensus of the experts, then it is proceeded to define the variable to be modeled (Table 1) and determine the factors that most affect gender identity (Table 2).

Variable	Coding	Sample	Scale
Analyze the factors that affect gender identity in the educational field	IIG	100	$[0;\ 1], \forall\ F_n$ IIG = 0 (false) IGI = 1 (True) $0 \leq IIG \geq 1$(Indetermination of IIG level)

Table 1. Variable Characteristics IIG. Source: own elaboration.

Code	Factors Affecting Gender Identity
a	Gender stereotypes
b	Equality and non-discrimination
c	Teacher Perspectives
d	Discriminatory or violent behavior
e	Legal-regulatory frameworks and educational public policies

Table 2. Determining factors in gender identity. Source: own elaboration

When modeling the variable with the use of neutrosophic statistics, the relative frequencies are obtained to determine the level of IIG in the factors, $F_n = \{F_a, F_b, F_c, F_d, F_e\}$ in the sample analyzed (Table 3). It is observed that for F_e there is a higher incidence of occurrence of 77%, in the lack of regulations on gender equality and educational policies.

Days	Cumulative Absolute Neutrosophic Frequencies				
	a	b	c	d	e
0-100	[0 , 10]	[0 , 2]	[0, 3]	[0, 8]	[0.77]

Table 3. Accumulated absolute neutrosophic frequencies of the level of IIG. Source: own elaboration.

To obtain the level of IIG in each factor, as the measure of indeterminacy for each investigation on a scale of $0 \leq \text{IIG} \geq 1$, it was decided to analyze the variable from the relative neutrosophic frequency $F_n = \{F_a, F_b, F_c, F_d, F_e\}$ (Table 4).

Days	Neutrosophic Frequencies				
	a	b	c	d	e
1	[0 ; 0]	[0.02 ; 0.04]	[0.03 ; 0.03]	[0.08 ; 0.16]	[0 ; 0.77]
2	[0 ; 0.1]	[0 ; 0.02]	[0.03 ; 0.03]	[0.08 ; 0.16]	[0.77 ; 0.77]
3	[0 ; 0]	[0 ; 0]	[0.03 ; 0.06]	[0.08 ; 0.16]	[0 ; 0.77]
4	[0 ; 0]	[0.02 ; 0.02]	[0 ; 0]	[0.08 ; 0.08]	[0.77 ; 0.77]
5	[0 ; 0]	[0 ; 0.02]	[0.03 ; 0.03]	[0.08 ; 0.08]	[0 ; 0.77]
6	[0 ; 0]	[0 ; 0]	[0.03 ; 0.03]	[0 ; 0]	[0.77 ; 0.77]
7	[0 ; 0]	[0.02 ; 0.04]	[0 ; 0.03]	[0 ; 0]	[0.77 ; 1.54]
8	[0 ; 0.1]	[0 ; 0]	[0 ; 0.03]	[0.08 ; 0.08]	[0 ; 0]
9	[0.1 ; 0.2]	[0 ; 0.02]	[0.03 ; 0.03]	[0.08 ; 0.08]	[0.77 ; 1.54]
10	[0.1 ; 0.1]	[0 ; 0.02]	[0 ; 0.03]	[0 ; 0]	[0 ; 0]
11	[0 ; 0]	[0 ; 0.02]	[0.03 ; 0.06]	[0 ; 0.08]	[0.77 ; 1.54]
12	[0.1 ; 0.2]	[0 ; 0]	[0.03 ; 0.03]	[0.08 ; 0.16]	[0 ; 0.77]
13	[0 ; 0.1]	[0 ; 0.02]	[0.03 ; 0.06]	[0 ; 0]	[0.77 ; 1.54]
14	[0 ; 0]	[0.02 ; 0.02]	[0.03 ; 0.06]	[0.08 ; 0.08]	[0.77 ; 0.77]
15	[0.1 ; 0.2]	[0 ; 0]	[0 ; 0]	[0 ; 0.08]	[0.77 ; 1.54]

Days	Neutrosophic Frequencies				
	a	**b**	**c**	**d**	**e**
16	[0 ; 0.1]	[0 ; 0]	[0 ; 0]	[0 ; 0]	[0.77 ; 0.77]
17	[0.1 ; 0.1]	[0.02 ; 0.04]	[0 ; 0.03]	[0.08 ; 0.08]	[0.77 ; 1.54]
18	[0 ; 0]	[0.02 ; 0.04]	[0.03 ; 0.06]	[0.08 ; 0.08]	[0.77 ; 0.77]
19	[0.1 ; 0.2]	[0 ; 0]	[0 ; 0]	[0 ; 0.08]	[0 ; 0]
20	[0 ; 0]	[0.02 ; 0.04]	[0 ; 0.03]	[0 ; 0]	[0.77 ; 1.54]
0-100	[4.9; 10]	[0.84 ; 2]	[1.5 ; 3]	[3.84; 8]	[36.96 ; 77]

Table 4. Neutrosophic relative frequencies. Source: own elaboration.

Of the relative neutrosophic frequencies observed for IIG, it is found that for 100 days there is a level of total indeterminacy of $a = 5.1, b = 1.16, c = 1.5, d = 4.16, e = 40.04$, with a level of representativeness [50%; 58%], on the days that are registered 1.54 relatively, with a higher incidence of 52% for the lack of normativity in gender equality and educational policies.

4 Neutrosophic Statistical Analysis

In the first stage, for the modeling results, the IIG level is observed for the study of new phenomena with low reference information (table 5).
For the analysis of the representative mean based on the values of $\bar{x} = \in [\bar{x}_L; \bar{x}_U]$, the neutrosophic means are calculated and for the study of the variations of IIG, they are determined by the values of the neutrosophic standard deviation $S_N \in [S_L; S_U]$, to determine in which factor there is a greater IIG consistency and accuracy in gender identity for each $CV_N \in [CV_L\ ;\ CV_U]$.

Factors	$\bar{x}_N$	S_N	CV_N
a	0.049 + 0.1I	0.001 + 0.108 I	0.02 + 1.08 I
b	0.008 + 0.02 I	0 + 0.021 I	0 + 1.05 I
c	0.015 + 0.03 I	0 + 0.032 I	0 + 1.067 I
d	0.038 + 0.08 I	0.001 + 0.078 I	0.026 + 0.975 I
e	0.37 + 0.77 I	0.074 + 0.763 I	0.2 + 0.991 I

Table 5. Neutrosophic statistical analysis of the level of IIG in gender identity. Source: own elaboration.

Table 5 shows the level of incidence of gender identity and teaching practices. It should be borne in mind that the factor of Legal-regulatory frameworks and educational public policies is dominant for the right to gender equality, however, it is necessary to know in the IIG neutrosophic set what level of representation and indeterminacy in the condition $\forall\ F_n,\ [1 - F_e]$. This means that for the given condition, the factor is, on average, the one that most affects the right to equality of gender identity, more than the other factors analyzed. About the CV value, it can be expressed that for $CV_{Ne}\ and\ CV_{Nd}$, the corresponding factors, are lower compared to the rest. This represents that the result provided implies reforming the current regulations. (Figure 2).

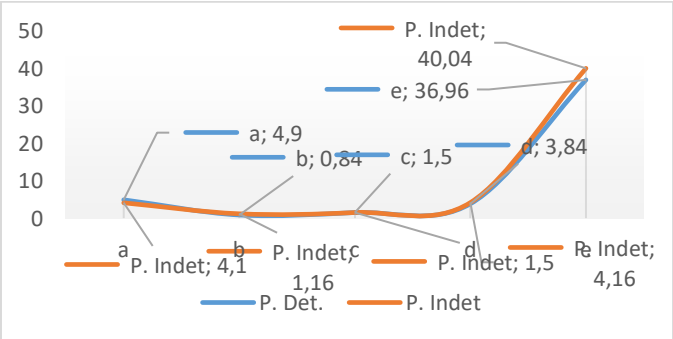

Figure 2. IIG level neutrosophic bubble chart. Source: own elaboration.

5 Comparative Analysis

To determine the associated referent indeterminacy measure for para $\overline{x} = \in [\overline{x}_L; \overline{x}_U]$, $S_N \in [S_L; S_U]$ and $CV_N \in [CV_L\ ;\ CV_U]$ to the form of neutrosophic numbers (Table 6). In the results obtained, it is observed that for the values CV_N range from 0 to 0.20 with an uncertainty measure of 79.8%, generated by factor (a) and 97.3% in factor (d). Although CV_Nneeds to use the lowest percentage level of uncertainty to obtain more precise and more homogeneous results, in this case, it would be to reform current regulations to achieve stronger results. [13], [15], [18]

However, experts need to know the best option for indeterminacy in the condition $\forall\ F_n,\ [1 - F_e]$, the analysis focuses on the factor of discriminatory or violent behavior with 97.3%.

Factors	$\bar{x}_N$	S_N	CV_N
a	0.049 + 0.1I;I ∈ [0; 51.0]	0.001 + 0.108 I;I ∈ [0; 99.1]	0.02 + 1.08 I;I ∈ [0; 98.1]
b	0.008 + 0.02I;I ∈ [0; 60.0]	0 + 0.021 I;I ∈ [0; 100]	0 + 1.05 I; I ∈ [0; 100]
c	0.015 + 0.03I;I ∈ [0; 50.0]	0 + 0.032I;I ∈ [0; 100]	0 + 1067 I; I ∈ [0; 100]
d	0.038 + 0.08 I;I ∈ [0; 52.5]	0.001 + 0.078 I;I ∈ [0; 98.7]	0.026 + 0.975 I;I ∈ [0; 97.3]
e	0.37 + 0.77 I;I ∈ [0; 51.9]	0.074 + 0.763 I;I ∈ [0; 90.3]	0.2 + 0.991 I;I ∈ [0; 79.8]

Table 6. Neutrosophic forms with a measure of indeterminacy for IIG in investigations. Source: own elaboration.

4 discussion

The result defines to modify the legal-regulatory frameworks and educational public policies so it is established that the experts agree on reforming the regulations in force, including the Organic Law of the Ombudsman so that it is not only an observer of due process but also has the power to sanction according to the case that arises. Thus, not only would greater strength be granted to a figure that watches over respect for human rights.

For the equality and non-discrimination groups and discriminatory or violent behaviors, there is a level of indeterminacy or contradiction among experts on gender identity. Indeterminacy studies must be carried out for each sub-element and analyze the degree of belonging that influences to modify the sociocultural patterns of behavior of society. [14], [19]

The results of the satisfaction of the experts with legal-regulatory frameworks and educational public policies were reaffirmed by the experts' answers to the open questions. Among the most frequent opinions, are the contradictions of the experts on equality and non-discrimination in the observance of human rights, although the results of projects in the field of education help the reflection of current researchers and serve as a guide for the improvement of their research strategies by providing elements that define the contradictions and indeterminacies of the experts to reach the desired consensus.

The indeterminacy and contradiction between the experts reflect that for the human being to adapt to new things is not always simple, much less when it comes to sociocultural behavior patterns of society, which usually change the pre-established schemes about how things are supposed to work. This is why even more effort is needed to gain acceptance and eliminate discriminatory or violent behaviour.

Establish the necessary judicial and administrative mechanisms to ensure that any lesbian, gay, bisexual, transgender, or intersex person who is a victim of violence and discrimination has effective access to compensation, compensation for the damage caused, or another fair, prompt, and effective means of compensation.

Ensure, through suitable means, that the principle of equality is complied with in practice and people are not discriminated against and guarantee through the courts that effective protection is given to people from the LGBTI community who have been discriminated against.

Implement training programs so that those who dispense justice receive sufficient information on the human rights of the LGBTI population.

Promote knowledge and observance of the human rights of the LGBTI population in society. This must be done at the level of colleges and schools, through sex education that emphasizes how diverse and complex human sexuality is.

Modify the sociocultural patterns of behavior of society to eradicate the structural homophobia that it suffers. This will also be achieved with education in rights that counteracts and eliminates entrenched prejudices, customs, and all kinds of practices that base their premise on inferiority.

Conclusion

Building gender equality is not reduced to substituting one letter for another, it is the fact of considering the differences and making visible what has been invisible for so many years. It is suggested to consider the limitations that the female gender has as the male since the states must adopt all the necessary measures to guarantee access to education under equal conditions and the equal treatment of students, staff, and teachers within the education system.

The application of neutrosophic statistics allows experts to represent indeterminacy as part of their knowledge and complementary evaluations. The levels of indeterminacy are displayed in the acceptance of proposing to modify the current regulations so that it is not only an observer of due process but also has the power to sanction according to the case that arises. Thus, not only would greater strength be granted to a figure that watches over respect for human rights. In addition to generating information that helps authorities, directors, teachers, students, and the educational community, in general, to reflect on the importance of approaching education from a human rights perspective, particularly from a gender perspective. Bear in mind that the levels of indeterminacy present high levels that only materialize in sectors with a certain level of information and good use of the applied tools, as demonstrated in the discriminatory or violent behavior factor.

The relevance of education and the educational community in the fight against violence and discrimination can be very high. This must be done at the level of colleges and schools, through sex education that emphasizes how diverse and complex human sexuality is. This will also be achieved with rights education that counteracts and eliminates entrenched prejudices, customs, and all kinds of practices that base their premise on the inferiority, unworthiness, or abnormality of people belonging to the LGBTI community. Therefore, a reform to the current standard must be carried out together with the implementation of training. This would help create greater awareness in the general population and strengthen the fight against these existing discriminatory practices.

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