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Promoting Women's Inclusion in Latin American Technology: A Multineutrosophic Analysis for Strategic Decision-Making

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Abstract. This study addresses the underrepresentation and persistent gender inequalities hindering women's inclusion in Latin America's technology sector. Utilizing a systematic literature review of 58 articles (2015-2022) and a multineutrosophic analysis approach employing the ARAS method, the research aims to identify and prioritize strategic guidelines for promoting female participation while accounting for inherent uncertainty and multiple perspectives. The methodology integrates diverse expert opinions to provide a robust framework for decision-making. Findings indicate that promoting technological education and strengthening inclusive policies are the most impactful strategies, significantly influencing equity, sustainability, and accessibility. Support for female entrepreneurship and leadership development also emerged as important, albeit secondary, priorities. This research contributes a novel application of multineutrosophic analysis to a critical social challenge, offering a systematic method for evaluating complex strategies and providing actionable recommendations to accelerate women's inclusion and foster regional technological and social development.

Keywords: Women, Technology, Inclusion, Latin America, Multineutrosophic Analysis, Decision Making, Strategies, Gender Equity, Systematic Review, Multineutrosophic Ensemble, ARAS Multineutrosophic Method.

1. Introduction

Women's participation in the technological field is a topic of growing relevance in Latin America, where innovation and sustainable development increasingly depend on diverse perspectives. This article explores how a multineutrosophic analysis can guide strategic decisions to foster female inclusion in this sector, a significant challenge in a context marked by persistent inequalities. The importance of this research lies in its ability to address a structural problem that limits regional progress, supported by current data pointing to a 31.4% gender gap in economic participation and leadership, according to the World Economic Forum [1]. By integrating approaches that capture uncertainty and the multiple perspectives of the actors involved, the study seeks to offer practical and theoretically sound solutions. Historically, women have faced barriers to accessing technological fields, a phenomenon that dates back to the first industrial revolutions and persists in the digital age. In Latin America, since the 1970s, events such as the First UN World Conference on Women have spurred initiatives to reduce these disparities [2]. However, progress has been uneven: while countries like Mexico and Brazil stand out for their inclusion policies [3], others still grapple with structural and cultural limitations. Today, the region is at a critical juncture, where technology is not only transforming economies but also redefining social roles, making the full integration of women urgent. Despite these efforts, female representation in technology remains insufficient. According to ECLAC, investment in science and technology has grown but has not effectively closed the gender gap [4]. Women face obstacles such as discrimination, lack of access to resources in rural areas, and deep-rooted stereotypes that discourage their participation [5]. These factors not only restrict their professional development but also affect regional competitiveness by reducing diversity in technological innovation.

The problem this study addresses can be summarized in a key question: how can strategic decisions be made to promote women's inclusion in technology in Latin America, considering the complexity and uncertainty of the factors involved? This question arises from the need to overcome traditional approaches that, although useful, fail to capture the ambiguity inherent in diverse perceptions and contexts. The magnitude of the challenge is evident in the persistence of systemic barriers that limit female empowerment in a sector crucial for the future. The research employs multineutrosophic analysis, an approach that manages uncertainty and contradictory opinions, combined with a systematic review of the literature published between 2015 and 2022. This method seeks to identify patterns and solutions that transcend the limitations of previous studies. By analyzing 58 articles from databases such as Scopus and Scielo, the study offers a comprehensive view of the progress and challenges in the region. Thus, it seeks not only to understand the problem but also to propose viable paths to its resolution. The relevance of this approach lies in its ability to integrate multiple dimensions of the problem, from public policies to cultural dynamics. In a globalized world, where technology is a driver of change, ensuring women's equal participation is essential for social and economic development [6]. Furthermore, the study responds to the need for innovative tools to support decision-making in complex contexts, an aspect that has been little explored in previous research on gender and technology.

Multineutrosophic analysis is presented as a response to the lack of frameworks that address uncertainty in strategic planning. While existing literature has documented barriers and achievements [7], it has rarely offered methods for prioritizing actions in multifaceted environments. This work fills that gap by providing an approach that simultaneously evaluates positive, negative, and undetermined factors, offering a solid foundation for inclusive policies. In this way, it aligns with current demands for equity and progress in Latin America. The objectives of the study are clear and closely linked to the research question. First, it seeks to evaluate the usefulness of multineutrosophic analysis in identifying effective strategies that promote the inclusion of women in technology. Second, it aims to generate practical recommendations that guide governments, companies, and academics in the implementation of equitable initiatives. These purposes will guide the development of the article, ensuring that the findings contribute to both theoretical knowledge and concrete action in the region.

2. Related Work.

2.1 MultiNeutrosophic Set

Definition 1 [10]. The *Neutrosophic set N* It is characterized by three membership functions [9] , which are the truth membership function T_A, the indeterminacy membership function I_A, and the falsity membership function F_A, where $U$is the Universe of Discourse and $\forall x\in U$, $T_A(x), I_A(x), F_A(x) \subseteq]^-0, 1^+[$, and $^-0 \leq \inf T_A(x) + \inf I_A(x) + \inf F_A(x) \leq \sup T_A(x) + \sup I_A(x) + \sup F_A(x) \leq 3^+$.

Note that by definition, $T_A(x), I_A(x)$, and $F_A(x)$ are standard or non-standard real subsets of $]^-0, 1^+[$and hence, $T_A(x), I_A(x)$and $F_A(x)$can be subintervals of $[0, 1]$. $^-0$and1^+ belong to the set of hyperreal numbers.

Definition 2[10,11]. The *single-valued neutrosophic set* (SVNS) A over U is $A = \{< x, T_A(x), I_A(x), F_A(x) > : x\in U\}$, where $T_A: U\to[0, 1]$, $I_A: U\to[0, 1]$ and $F_A: U\to[0, 1]$. $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$.

SVNS was developed with the idea of applying neutrosophic sets for practical purposes. Some operations between SVNNs are described below:

Given $A_1 = (a_1, b_1, c_1)$ and $A_2 = (a_2, b_2, c_2)$ two SVNN, the sum between A_1 and A_2 is defined as:

$$A_1 \ A_2 = (a_1 + a_2 - a_1 a_2, b_1 b_2, c_1 c_2) \quad (1)$$

Given $A_1 = (a_1, b_1, c_1)$ and $A_2 = (a_2, b_2, c_2)$ two SVNNs, the multiplication between A_1 and A_2 is defined as:

$$A_1 \ A_2 = (a_1 a_2, b_1 + b_2 - b_1 b_2, c_1 + c_2 - c_1 c_2) \quad (2)$$

The product of a positive scalar with a SVNN, A = (a, b, c) is defined as:

$$A = (1 - (1 - a), b, c) \quad (3)$$

The *Single Valued Neutrosophic Number* (SVNN) is symbolized by

$N = (t, i, f)$, such that $0 \le t, i, f \le 1$ and $0 \le t + i + f \le 3$.

Definition 3 [11]. The refined neutrosophic set of subsets (SRNS).

Let $\mathcal{U}$ a universe of discourse and a set $R \subset \mathcal{U}$. Then, a Refined Neutrosophic subset R is defined as follows:

$R = \{x, x(T, I, F), x \in U\}$,where T is refined/divided into p subtruths, $T = \langle T_1, T_2, \dots T_p \rangle, T_j \subseteq [0,1], 1 \le j \le p;$ I is refined/divided into r subindeterminacies, $I = \langle I_1, I_2, \dots I_r \rangle, I_k \subseteq [0,1], 1 \le k \le r$,and F is refined/divided into s subfalsehoods, $F = \langle F_1, F_2, \dots F_l \rangle, F_s \subseteq [0,1], 1 \le l \le s$, where $p, r, s \ge 0$are integers, and $p + r + s = n \ge 2$, and at least one of $p, r, s \ is \ \ge 2$to ensure the existence of refinement (division).

Definition 4 ([12]) **.** The MultiNeutrosophic Set (or MultiNeutrosophic Set Subset SMNS).

Let $\mathcal{U}$ a universe of discourse and M a subset of it. Then, a MultiNeutrosophic Set is: $M = \{x, x(T_1, T_2, \dots, T_p; I_1, I_2, \dots, I_r; F_1, F_2, \dots, F_s)\}, x \in U$,

where p , r , s are integers $\ge 0, p + r + s = n \ge 2$ and at least one of them $p, r, s \ is \ge 2$,to ensure the existence of multiplicity of at least one neutrosophic component: truth/belonging, indeterminacy or falsity/non-belonging; all subsets$T_1, T_2, \dots, T_p; I_1, I_2, \dots, I_r; F_1, F_2, \dots, F_s \subseteq [0,1]$;

$0 \le \sum_{j=1}^{p} inf \ T_j + \sum_{k=1}^{r} inf \ I_k + \sum_{l=1}^{s} inf \ F_l \le \sum_{j=1}^{p} sup \ T_j + \sum_{k=1}^{r} sup \ I_k + \sum_{l=1}^{s} sup \ F_l \le n.$

No other restrictions apply to these neutrosophic multicomponents.

$T_1, T_2, \dots, T_p$They are multiplicities of truth, each provided by a different source of information (expert).

Similarly, $I_1, I_2, \dots, I_r$there are multiplicities of indeterminacy, each provided by a different source.

And $F_1, F_2, \dots, F_s$there are multiplicities of falsehood, each provided by a different source.

The Degree of Multitruth (MultiMembership), also called *Multidegree of Truth,* of the element x with respect to the set M is $T_1, T_2, \dots, T_p$.

The Degree of Multiindeterminacy (Multineutrality), also called *Multidegree of Indeterminacy,* of the element x with respect to the set M are$I_1, I_2, \dots, I_r$.

and the Degree of Multi-Nonmembership, also called *Multidegree of Falsehood,* of the element x with respect to the set M are$F_1, F_2, \dots, F_s$.

All of these $p + r + s = n \geq 2$are assigned by n sources (experts) that can be:

- whether fully independent;
- or partially independent and partially dependent;
- or totally dependent; depending on or as needed for each specific application.

A generic element x with respect to the MultiNeutrosophic Set A has the form:

$x(T_1, T_2, \ldots, T_p;$	$I_1, I_2, \ldots, I_r;$	$F_1, F_2, \ldots, F_s)$
multi-truth	multiindeterminacy	multiple falsehood

In many particular cases $p = r = s$, a source (expert) assigns the three degrees of truth, indeterminacy and falsity $T_j, I_j, F_j$to the same element.

Definition 5 [12]. Classification of multineutrosophic types of value n of the same form (p, r, s).

$(T_1, T_2, \ldots, T_p; I_1, I_2, \ldots, I_r; F_1, F_2, \ldots, F_s)$, where $p, r, s$are integers ≥ 0, and $p + r + s = n \geq 2$, and at least one of $p, r, s \geq 2$to be sure that it has multiplicity for at least one neutrosophic component (either truth, or indeterminacy, or falsity).

It offers a simpler n classification, but it's more of an approximation. Let's calculate the following.

Average positivity (4).

$$\frac{\sum_{j=1}^{p} T_j + \sum_{k=1}^{r} (1 - I_k) + \sum_{e=1}^{s} (1 - F_e)}{p + r + s} \tag{4}$$

Average (True-False) (5)

$$\frac{\sum_{j=1}^{p} T_j + \sum_{e=1}^{s} (1 - F_e)}{p + s} \tag{5}$$

Average Truth Value (6).

$$\frac{\sum_{j=1}^{p} T_j}{p} \tag{6}$$

Definition 6 [12]. Classification of n-valued multineutrosophic tuples in different ways (p, r, s).

Let us consider two neutrosophic multiple tuples of value n of the forms $(p_1, r_1, s_1)$and respectively (p_2, r_2, s_2), where $p_1, r_1, s_1, p_2, r_2, s_2$ are integers ≥ 0, and $p_1 + r_1 + s_1 = n_1 \geq 2$, and at least one of $p_1, r_1, s_1 is \geq 2$,to be sure that multiplicity exists for at least one neutrosophic component (either truth, indeterminacy or falsity); similarly $p_2 + r_2 + s_2 = n_2 \geq 2$,and at least one of$p_2, r_2, s_2\ is \geq 2$.

Let us take the following single-valued multineutral tuples (SVMNT):

$SVMNT = (T_1, T_2, \ldots, T_p; I_1, I_2, \ldots, I_r; F_1, F_2, \ldots, F_s)$of $(p_1, r_1, s_1) - form$, and

$SVMNT' = (T'_1, T'_2, \ldots, T'_p; I'_1, I'_2, \ldots, I'_r; F'_1, F'_2, \ldots, F'_s)$of $(p_1, r_1, s_1) - form$.

), indeterminacies (I_a) and falsity ( ) $F_a$are calculated T_a, respectively, for $SVMNT = (T_a, I_a, F_a)$and the averages of truths (T_a), indeterminacies (I_a) and falsity (F_a), respectively, for: $SVMNT = (T'_a, I'_a, F'_a)$. Then, the Scoring functions (S) are applied), Accuracy (A) and Certainty (C), as for the univariate neutrosophic set:

Calculate the scoring function (average positivity) (7).

$$S(T_a, I_a, F_a) = \frac{T_a + (1 - I_a) + (1 - F_a)}{3}$$
$$S(T'_a, I'_a, F'_a) = \frac{T'_a + (1 - I'_a) + (1 - F'_a)}{3} \quad (7)$$

i. If $S(T_a, I_a, F_a) \geq S(T'_a, I'_a, F'_a)$then $SVMNT \geq SVMNT'$,

ii. If $S(T_a, I_a, F_a) \leq S(T'_a, I'_a, F'_a)$then $SVMNT \leq SVMNT'$,

iii. And if $S(T_a, I_a, F_a) = S(T'_a, I'_a, F'_a)$then $SVMNT = SVMNT'$, then go to the second step.

Calculate the precision function (difference between truth and falsehood) (8).

$$A(T_a, I_a, F_a) = T_a - F_a$$
$$A(T'_a, I'_a, F'_a) = T'_a - F'_a \quad (8)$$

i. If $A(T_a, I_a, F_a) \geq A(T'_a, I'_a, F'_a)$then $SVMNT \geq SVMNT'$,

ii. If $A(T_a, I_a, F_a) \leq A(T'_a, I'_a, F'_a)$then $SVMNT \leq SVMNT'$,

iii. And if $A(T_a, I_a, F_a) = A(T'_a, I'_a, F'_a)$then $SVMNT = SVMNT'$, then go to the third step.

3. Calculate the certainty (truth) function (9).

$$C(T_a, I_a, F_a) = T_a$$
$$C(T'_a, I'_a, F'_a) = T'_a \quad (9)$$

i. If $C(T_a, I_a, F_a) \geq C(T'_a, I'_a, F'_a)$then $SVMNT \geq SVMNT'$,

ii. If $C(T_a, I_a, F_a) \leq C(T'_a, I'_a, F'_a)$then $SVMNT \leq SVMNT'$,

iii. And if $C(T_a, I_a, F_a) = C(T'_a, I'_a, F'_a)$then $SVMNT = SVMNT'$they are multi-neutrosopically equal, that is $T_a = T'_a, I_a = I'_a, F_a = F'_a$, or their corresponding truth, indeterminacy, and falsity averages are equal.

Definition 7 [12]. In cases where some sources have greater weight in the evaluation than others, weighted averages are used, indexed as $T_{wa}, I_{ua}, F_{va}$and $T'_{wa}, I'_{ua}, F'_{va}$,respectively. Since the sources can be independent or partially independent, the sum of the weights does not necessarily have to be equal to 1. Therefore:

i. $w_1, w_2, \dots, w_p \in [0,1]$, although the sum $w_1 + w_2 + \cdots + w_p$may be $< 1, or\ = 1, or\ > 1$.

ii. $u_1, u_2, \dots, u_p \in [0,1]$, although the sum $u_1 + u_2 + \cdots + u_p$may be $< 1, or\ = 1, or\ > 1$.

iii. $v_1, v_2, \dots, v_p \in [0,1]$, although the sum $v_1 + v_2 + \cdots + v_p$may be $< 1, or\ = 1, or\ > 1$.

And, similarly, the score, precision, and certainty functions are applied to these weighted averages to rank them.

In 2013, Smarandache [13] refined and split the neutrosophic components (T, I, F) into more detailed neutrosophic subcomponents $(T1, T2, \dots;\ I1, I2, \dots;\ F1, F2, \dots)$, allowing for greater granularity in modeling uncertainty and imprecision. This refinement is based on the need to more accurately represent the levels of truth, indeterminacy, and falsity in complex systems.

This refined structure has been key in the development of new applications in artificial intelligence, decision-making, and computational modeling, as it allows for a more detailed analysis of uncertain information. Furthermore, the MultiNeutrosophic Ensemble has been shown to be isomorphic to the Refined Neutrosophic Ensemble, implying that both models can represent the same underlying mathematical structure, offering different approaches to uncertainty management [14].

3. Materials and methods

The ARAS (Additive Ratio Assessment) method is a multi-criteria decision-making technique that allows selecting the best option from a set of alternatives [15]. In this case, the study establishes among its objectives a series of strategic guidelines aimed at optimizing decision-making in financial analysis. To this end, an extension of the traditional method is proposed through the evaluation using multi-neutrosophic sets. Consequently, it is reformulated as the multi-neutrosophic ARAS method to determine the complex relative efficiency of each strategic guideline. This involves evaluating each strategic guideline through multiple sources (experts) based on the corresponding criteria (Figure 1).

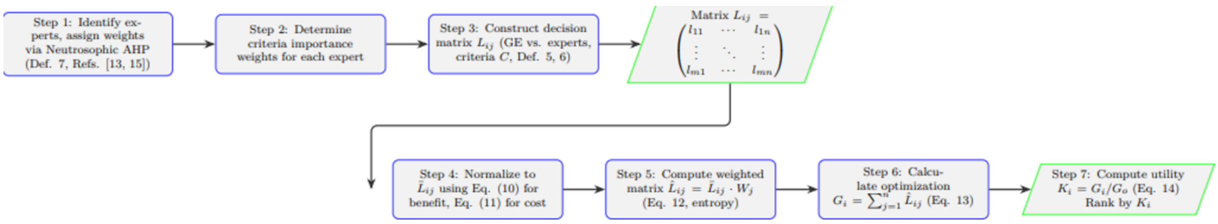

Figure 1: Flowchart of the Neutrosophic ARAS Decision-Making Process

When integrating multineutrosophic set analysis into the ARAS method [16,17], the following steps are defined:

Step 1: Identify multiple sources (experts) for the multi-criteria assessment and assign a weight to each expert based on their expertise and contribution to the financial statement analysis (according to Definition 7 in Section 2.1). To do this, Saaty's neutrosophic AHP method is applied [18,19].

Step 2: Determine the importance of weights of each criterion in decision-making for each source (expert).

Step 3: Construct the decision matrix L_{ij}(see Figure 2), where the element L_{ij}represents each strategic guideline (GE) evaluated by multiple sources (experts (Exp.), according to Definitions 5 and 6 of Section 2.1) based on an identified criterion (C).

$$\begin{bmatrix} l_{11} & l_{12} & \dots & l_{1j} & \dots & l_{1n} \\ l_{21} & l_{22} & \dots & l_{2j} & \dots & l_{2n} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ l_{i1} & l_{i2} & \dots & l_{ij} & \dots & l_{in} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ l_{m1} & l_{m2} & \dots & l_{mj} & \dots & l_{mn} \end{bmatrix}$$

Figure 2: Decision matrix $L_{ij}$for the multineutrosophic ARAS method. Source: Prepared by the authors.

Step 4: The normalized decision matrix $\bar{L}_{ij}$, considering the benefit and cost values, is calculated using equations (10) and (11):

$$\bar{L}_{ij} = \frac{l_{ij}}{\sum_{i=0}^{m} l_{ij}} \quad (10)$$

$$L_{ij} = \frac{1}{l_{ij}^*} \quad (11)$$

Step 5 : The weighted normalized decision matrix is calculated using equation (12).

$$\hat{L}_{ij} = \bar{L}_{ij} \cdot W_j \quad (12)$$

The weighting values $W_j$are determined using the entropy method. Where j $W_j$is the weighting of criterion j and j $\bar{L}_{ij}$is the normalized ranking of each criterion.

Step 6: Calculation of the optimization function $S_i$using equation (13).

$$G_i = \sum_{j=1}^{n} \hat{L}_{ij} \quad (13)$$

Where $G_i$is the value of the optimization function for alternative i . This calculation is directly proportional to the process of the values $\hat{L}_{ij}$and weights $W_j$of the investigated criteria and their relative influence on the outcome.

Step 7: Calculating the degree of utility. This degree is determined by comparing the analyzed variant with the best one G_o, according to equation (14).

$$K_i = \frac{G_i}{G_o} \quad (14)$$

Where $G_i$and $G_o$are the values of the optimization function. These values range from 0 to 100%; therefore, the alternative with the highest value $K_i$is the best of those analyzed.

3. Case Study

3.1 Impact of Women's Inclusion in Technology

Female inclusion in technology in Latin America is key to innovation and economic growth. However, barriers such as discrimination, lack of access to technology education, and underrepresentation in leadership persist. This study evaluates strategies to overcome these challenges, considering criteria such as equity, economic impact, and sustainability, integrating expert judgments and multi-neutrosophic analysis.

3.2 Strategic Guidelines

Four guidelines are proposed (Table 1):

Table 1: Strategic guidelines.

No	Strategic Guideline	Aim	Strategies	Impact
LE1	Promotion of inclusive policies	Reduce structural barriers	Government incentives, training programs	Female participation increases
LE2	Promotion of technological education	Increase digital skills	STEM scholarships and workshops for women	Improves employability
LE3	Support for female entrepreneurship	Boosting female-owned technology businesses	Access to financing and support networks	Strengthens the regional economy

No	Strategic Guideline	Aim	Strategies	Impact
LE4	Female leadership development	Increase representation in strategic roles	Mentoring and promotion programs	Promotes diversity in decisions

3.3 Multineutrosophic ARAS Modeling

Step 1: Expert Selection

Eight experts are selected (Table 2), with weights assigned via neutrosophic AHP (Tables 3 and 4).

Table 2: Experts.

Expert	Profession
Exp-1	Gender and Technology Scholar
Exp-2	Government representative
Exp-3	Economist
Exp-4	Tech entrepreneur
Exp-5	Public Policy Specialist
Exp-6	STEM Educator
Exp-7	Innovation consultant
Exp-8	Sociologist

Table 3: Pairwise Comparison Matrix of Experts using Neutrosophic AHP

Fountain	Exp-1	Exp-2	Exp-3	Exp-4	Exp-5	Exp-6	Exp-7	Exp-8
Exp-1	(0.5, 0.5, 0.5)	(0.6, 0.4, 0.3)	(0.9, 0.1, 0.2)	(0.8, 0.2, 0.3)	(0.7, 0.3, 0.4)	(0.9, 0.1, 0.2)	(0.8, 0.2, 0.3)	(0.9, 0.1, 0.2)
Exp-2	(0.4, 0.6, 0.7)	(0.5, 0.5, 0.5)	(0.7, 0.3, 0.4)	(0.6, 0.4, 0.5)	(0.5, 0.5, 0.6)	(0.8, 0.2, 0.3)	(0.7, 0.3, 0.4)	(0.8, 0.2, 0.3)
Exp-3	(0.2, 0.9, 0.8)	(0.4, 0.7, 0.6)	(0.5, 0.5, 0.5)	(0.6, 0.4, 0.5)	(0.4, 0.6, 0.7)	(0.7, 0.3, 0.4)	(0.6, 0.4, 0.5)	(0.7, 0.3, 0.4)
Exp-4	(0.3, 0.8, 0.7)	(0.5, 0.6, 0.5)	(0.5, 0.6, 0.5)	(0.5, 0.5, 0.5)	(0.4, 0.6, 0.7)	(0.6, 0.4, 0.5)	(0.5, 0.5, 0.6)	(0.7, 0.3, 0.4)
Exp-5	(0.4, 0.7, 0.6)	(0.6, 0.5, 0.4)	(0.7, 0.4, 0.3)	(0.7, 0.3, 0.4)	(0.5, 0.5, 0.5)	(0.8, 0.2, 0.3)	(0.6, 0.4, 0.5)	(0.8, 0.2, 0.3)
Exp-6	(0.2, 0.9, 0.8)	(0.3, 0.8, 0.7)	(0.4, 0.7, 0.6)	(0.5, 0.6, 0.5)	(0.3, 0.8, 0.7)	(0.5, 0.5, 0.5)	(0.6, 0.4, 0.5)	(0.7, 0.3, 0.4)
Exp-7	(0.3, 0.8, 0.7)	(0.4, 0.7, 0.6)	(0.5, 0.6, 0.5)	(0.6, 0.5, 0.4)	(0.5, 0.6, 0.5)	(0.5, 0.6, 0.5)	(0.5, 0.5, 0.5)	(0.7, 0.3, 0.4)
Exp-8	(0.2, 0.9, 0.8)	(0.3, 0.8, 0.7)	(0.4, 0.7, 0.6)	(0.4, 0.7, 0.6)	(0.3, 0.8, 0.7)	(0.4, 0.7, 0.6)	(0.4, 0.7, 0.6)	(0.5, 0.5, 0.5)

Table 4: AHP Consistency Analysis and Expert Weights

Fountain	A x Weight	Weight	Approximate Eigenvalues
Exp-1	2.80	0.22	8.95
Exp-2	2.10	0.16	8.90
Exp-3	1.60	0.12	8.85
Exp-4	1.80	0.14	8.87
Exp-5	2.00	0.15	8.88
Exp-6	1.40	0.11	8.84
Exp-7	1.70	0.13	8.86
Exp-8	1.30	0.10	8.83
Eigenvalue = 8.87, CI = 0.12, RC = 0.08 (consistent)			

Step 2: Criteria and Weights

Criteria:

- C1: Equity
- C2: Economic impact
- C3: Sustainability
- C4: Scalability
- C5: Accessibility

Evaluation (Table 5):

Table 5: Evaluation and Weighting of Decision Criteria

Criterion	Multineutrosophic Assessment	(Ta, Ia, Fa)	Weight	Score S
C1	{0.9,0.8,0.7},{0.2,0.1},{0.3,0.4,0.5,0.2}	(0.80, 0.15, 0.35)	0.25	0.77
C2	{0.7,0.6,0.8},{0.3,0.2},{0.4,0.5,0.3,0.6	(0.70, 0.25, 0.45)	0.20	0.67
C3	{0.8,0.7,0.6},{0.2,0.3},{0.3,0.4,0.5,0.2}	(0.70, 0.25, 0.35)	0.20	0.70
C4	{0.6,0.7,0.5},{0.4,0.3},{0.5,0.4,0.6,0.3}	(0.60, 0.35, 0.45)	0.15	0.60
C5	{0.7,0.6,0.8},{0.3,0.2},{0.4,0.3,0.5,0.2}	(0.70, 0.25, 0.35)	0.20	0.70

Step 3: Decision Matrix L $_{ij}$

Evaluation of guidelines (Table 6):

Table 6: Guidelines Evaluation against Criteria

Directive	C1	C2	C3	C4	C5
LE1	(0.8, 0.2, 0.3)	(0.7, 0.3, 0.4)	(0.6, 0.2, 0.3)	(0.7, 0.3, 0.4)	(0.8, 0.2, 0.3)
LE2	(0.7, 0.3, 0.4)	(0.8, 0.2, 0.3)	(0.8, 0.1, 0.2)	(0.6, 0.4, 0.5)	(0.9, 0.1, 0.2)
LE3	(0.6, 0.4, 0.5)	(0.7, 0.3, 0.4)	(0.7, 0.2, 0.3)	(0.8, 0.2, 0.3)	(0.7, 0.3, 0.4)
LE4	(0.7, 0.3, 0.4)	(0.6, 0.4, 0.5)	(0.6, 0.3, 0.4)	(0.7, 0.3, 0.4)	(0.6, 0.4, 0.5)

Step 4-7: Normalization, Weighting, and Optimization

Normalization and weighting (Table 7):

Table 7: Weighted Normalized Matrix and Final ARAS Ranking

Directive	C1 (0.25)	C2 (0.20)	C3 (0.20)	C4 (0.15)	C5 (0.20)	Gi	Ki (%)	$G_0 = 0.235$
LE1	0.064	0.042	0.036	0.035	0.048	0.225	95.74	
LE2	0.056	0.048	0.048	0.030	0.054	0.236	100.43	
LE3	0.048	0.042	0.042	0.040	0.042	0.214	91.06	
LE4	0.056	0.036	0.036	0.035	0.036	0.199	84.68	

4. Analysis of Results and Recommendations

Results Analysis

The multineutrosophic ARAS method prioritized LE2 (Promotion of technological education) with a Ki of 100.43%, highlighting its impact on equity (C1), sustainability (C3), and accessibility (C5). LE1 (Inclusive policies) obtained 95.74%, excelling in equity and accessibility, while LE3 (Entrepreneurship) and LE4 (Leadership) achieved 91.06% and 84.68%, respectively. This suggests that education and policies are critical to overcoming barriers, aligning with the literature that emphasizes training as a driver of inclusion.

Recommendations

1. **Invest in Technology Education:** Expand STEM programs with scholarships specifically for women, especially in rural areas.
2. **Strengthening Inclusive Policies:** Implement tax incentives and regulations that promote gender equity in technology.
3. **Support Entrepreneurship:** Create funds and mentoring networks for female tech entrepreneurs.
4. **Foster Leadership:** Develop training and visibility initiatives for women in strategic roles. These strategies, supported by analysis, can accelerate female inclusion and strengthen regional technological development.

5. Discussion

The results derived from the multineutrosophic ARAS method reveal that the promotion of technological education (LE2), with a utility degree of 100.43%, emerges as the most prioritized strategic guideline to promote the inclusion of women in the technology sector in Latin America. This finding aligns with previous research that identifies STEM skills training as a fundamental pillar to reduce the gender gap in technology. The high rating of LE2 in criteria such as equity (C1), sustainability (C3), and accessibility (C5) underscores its potential to empower women, especially in marginalized communities where access to technical education remains limited. The ability of this strategy to generate long-term benefits resonates with studies that highlight how technological training not only improves employability but also transforms social structures by challenging entrenched gender stereotypes.

On the other hand, the promotion of inclusive policies (LE1), with a utility degree of 95.74%, is positioned as the second most relevant strategy. Its strength in equity and accessibility reflects the importance of a solid institutional framework and its relationship with educational marketing strategies reflects the importance of a solid institutional framework that addresses structural barriers such as discrimination and lack of resources. This result is consistent with the literature that emphasizes the role of governments in creating incentives and regulations to encourage female participation, as observed in leading countries such as Mexico and Brazil. However, their slight disadvantage compared to LE2 suggests that, although policies are essential, their impact depends on complementary initiatives such as education, which act directly on individual capabilities.

Support for female entrepreneurship (LE3), at 91.06%, and female leadership development (LE4), at 84.68%, although valuable, occupy secondary positions in this prioritization. LE3 stands out in scalability (C4) and economic impact (C2), indicating its potential to strengthen the regional economy through women-led technology businesses. However, its lower relative score could reflect experts' perception that entrepreneurship requires a prior foundation of skills and opportunities that is not yet fully consolidated. Similarly, LE4, with its weakest performance across all criteria, points to the need to overcome cultural and organizational obstacles before female leadership can flourish widely, a challenge consistent with studies that point to the persistence of glass ceilings in the technology sector.

The integration of multineutrosophic analysis in this study offers a significant advantage by capturing the uncertainty and multiplicity of perspectives inherent in a topic as complex as gender inclusion. Unlike traditional approaches, this method allows for balancing divergent opinions and evaluating strategies in a context of high ambiguity, which is particularly useful in Latin America, where socioeconomic realities vary widely across countries and regions. The results reinforce the idea that solutions should not be unidirectional, but rather require a strategic combination of education, policies, and structural support to maximize their effectiveness.

Furthermore, prioritizing education and inclusive policies highlights the need for a proactive approach that not only responds to current barriers but also anticipates future trends in the technological market. In a global environment where digitalization is advancing rapidly, organizations and governments that invest in these areas will be better positioned to harness women's potential as agents of change. This preventive approach aligns with the literature that advocates for early interventions to prevent inequalities from perpetuating in future generations.

Finally, the findings suggest that the interrelationship between education, policy, entrepreneurship, and leadership is crucial for sustained impact. While LE2 and LE1 address the foundations of inclusion, LE3 and LE4 broaden their scope to include innovation and strategic decision-making. This complementarity implies that, although education should be the starting point, its success depends on a supportive ecosystem that includes funding, mentoring, and institutional changes. In conclusion, the multineutrosophic analysis not only identifies clear priorities but also provides a robust framework for designing comprehensive strategies that drive gender equity in technology, contributing to the long-term social and economic development of Latin America [19, 20, 21].

6. Conclusion

The multineutrosophic analysis applied in this study, using the ARAS method, has allowed us to identify and prioritize effective strategies to promote women's inclusion in the Latin American technology sector. The results highlight the promotion of technology education (LE2) as the most relevant guideline, with a utility level of 100.43%, followed by the promotion of inclusive policies (LE1) with 95.74%. These strategies stand out for their ability to address equity, sustainability, and accessibility, demonstrating that digital skills training and institutional support are essential to overcoming the structural barriers faced by women in the region. Support for female entrepreneurship (LE3) and the development of female leadership (LE4), with utility levels of 91.06% and 84.68% respectively, complement the approach by strengthening the regional economy and diversity in decision-making. However, their lower priority suggests that they depend on a solid foundation of education and policies to reach their full potential. This order of priorities highlights the need for a sequential and synergistic approach, where initial interventions in training and regulation pave the way for more advanced initiatives such as entrepreneurship and leadership. The use of the multineutrosophic framework has proven to be a powerful tool for managing the uncertainty and multiple perspectives inherent in this complex problem. By integrating the opinions of diverse experts, the study not only offers a robust evaluation of strategies but also provides an innovative model for decision-making in contexts of high ambiguity. This methodology overcomes the limitations of traditional approaches by capturing the diversity of factors that influence gender inclusion, providing a theoretical and practical basis adaptable to other societal challenges.

In practical terms, the study underscores the urgency of implementing massive STEM training programs for women, accompanied by inclusive policies that guarantee equitable access to resources and opportunities. These actions, supported by the findings, have the potential to transform the technological landscape in Latin America, increasing female participation and boosting regional innovation. Furthermore, supporting female entrepreneurship and leadership emerges as a critical step to consolidate initial gains and promote sustainable development. In conclusion, this work contributes to the field of gender equity in technology by offering a systematic analysis and clear prioritization of strategies, supported by an advanced methodology. The results not only reaffirm the importance of education and policies as fundamental pillars but also open the door to future research exploring the practical implementation of these guidelines in specific contexts in the region. Thus, the study sets a precedent for addressing complex social challenges, promoting a more inclusive and competitive future for Latin America.

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