



Study of the Role of the Teacher Woman as Researcher and Manager of the Peruvian University using an Indeterminate Likert Scale

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Abstract. This paper analyzes the role of the university women in teaching, from their participation as a researcher and manager in public and private universities in Peru, assuming commitments and tangible actions to achieve the institutionalization, strengthening, increasing and promotion of women in more activities, including the management of academic and research institutions. More than 50% of university students are women. Of the total teaching positions, only a third of them are occupied by women in private universities and a fifth in public universities. Access to university government follows this elusive trend for women. The table of researchers in the Scientific National registration and of Technological Innovation in Peru about the role of women presents a very positive reading, however, it is concluded that social, economic and cultural barriers are still strong that hinder gender equality. Achieving greater intervention and commitment from women requires a reflective and critical attitude. This paper aims to study how women and men perceive gender parity in their campuses within the Peruvian university environment through a survey on this topic. For this, we use an Indeterminate Likert Scale, which we prefer over a classic Likert Scale, because it allows us to capture the opinion and sentiment of the respondent in more detail.

Keywords: Gender equity, gender policies, professional profile, Indeterminate Likert Scale, Neutrosophy.

1 Introduction

The problems of university autonomy, quality, teaching processes, university reform, university government, among others, have been losing force for a long time, [1]. Since the promulgation of university law 30220, in 2014, university problems are foreign to researchers and even to the unions in their environment. Recently, some authors begin to write about social responsibility, research and licensing with great lukewarmness. Despite the problems of the loss of freedoms of the university government, including the role of women in management and research, there is a silence, like there would be some censorship. It is far from the past in which there were analyzed, raised and discussed the problems of our universities, even more so if they were related to governance. In most Latin American countries, these issues are part of university life. In this context, the problem of female teachers in government and research is addressed, considering the need to take up the university issue. The presence of female teachers is a hidden actor, but has a great protagonism in the national university agenda.

This paper aims to study the fact that there are a greater number of women in the university and why this fact does not allow them greater access to the university management ([2,3]), as well as their greater presence in the Scientific National registration and of Technological Innovation (abbreviated Renacyt in Spanish) research cadre. Likewise, it is proposed to know the causes that originate the glass ceilings that prevent the promotion of women teachers in the same conditions as men. To this end, the strategy was to locate the female teacher, describing her dynamics and proportionality in relation to the male teacher, both in public and private universities. Then the Association of Universities of Peru's (abbreviated ASUP in Spanish) files were accessed to quantify the number of rectors and vice-rectors by gender, in the same way, based on the information from of the National Council of Science, Technology and Technological Innovation (abbreviated Concytec in Spanish), tables of the Renacyt

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researchers were prepared, which allow the corresponding quantitative and qualitative analysis. Based on this determination, the respective analysis has been carried out to locate the level of position of female teachers in university management and in the condition of researcher.

The results of the study show that in recent years the female population in the university has multiplied due to the existence of a greater number of women, the significant presence in teaching, reaching a third of the teaching staff, with a relative position in the university management, but with a lot of resistance in the public university, although with a very significant advance in research. The study concludes that the glass ceiling is still a barrier to accessing the highest decision-making level in the university, although the great advance in research opens new doors to access university management.

Women have managed to conquer her rights and gender equality, which represents access to political life, equal work and also in the administration and leadership of the public and private sector in the same conditions as men. The cultural roots, with a racist and sexist ingredient, still prevent the culmination of this process and the materialization of the norms in reality. For C. Olmedo ([4]) it is the cultural elements and prejudices that intervene so that women still have difficulties, even to find work, because cultural prejudices, motherhood and the lack of time of women due to their work in the workplace and home, they attempt their goals to achieve equality.

In the same direction, C. Obregón ([5]) considers that it is women with children who encounter greater discrimination and suffer to climb in society, especially in labor contracts, the author considers that women face a double paralysis due to their feminine condition and because she is a mother. She also thinks that women are 30% less likely to be hired than men. For the International Labor Organization (ILO) ([6]), finding work is much more difficult for women than for men worldwide. They consider that mostly when women work they tend to do so in low-level positions and in vulnerable conditions, seeing little progress in the short term.

If the entrance of women to the university was part of the gender struggle, the same happened to earn the right to practice university teaching. Until the late twentieth century, the vast majority of teaching positions were filled by men. In Engineering, Medicine, Social Sciences, Law, the male had the hegemony. Today women have gained ground, but not enough to sustain parity. Here the limitations that Peruvian society imposes on women are replicated; whose glass ceilings prevent further advancement. Just as the external labor market does not provide the same opportunities as men. The cultural patterns that deny her the space that she seeks in the public and private sector is also reflected in the university, even more so if the history of our Higher Education Houses were carried out by men, there is no statistic in this regard, but observation. The field study leads us to consider the approximate proportion of one third of women, compared to approximately two-thirds of men, who occupy teaching positions.

In the same field work, the former officials of the National Assembly of Rectors, responsible for interuniversity coordination, coincide with the current specialists of the National Superintendence of University Higher Education (abbreviated SUNEDU in Spanish), in charge of tasks similar to the former university body, which in the public university women do not exceed a third of teachers, while in private universities it reaches or approaches a third of the teaching population. Ku Yanasupo ([7]), considers that the number of university women does not correspond to the percentage of women who teach, since on average they only represent 30% of the total teaching positions. To demonstrate her claim, she presents a statistical table of SUNEDU.

The main purpose of this paper is to carry out a survey on the gender equality of women in Peruvian universities today and their roles as teachers, researchers, and managers. To do this, we conducted a questionnaire of women and men in the university environment on how they perceive gender equality within their higher education centers. We set out to obtain responses that are as close as possible to the thoughts of the respondents, which is why we decided to use an Indeterminate Likert Scale, [8,9]. This type of scale allows respondents to express the degree of agreement or disagreement regarding their opinions and feelings on a given topic, for each of the possible outcomes. That is, unlike the classic Likert scale where a linguistic value is chosen on a scale that usually has five or seven values ([10]), the Indeterminate Likert Scale asks respondents to assign a degree of agreement on each of these five or seven values, [9]. This is undoubtedly more complex, although it is simple enough and allows us processing people's opinions, even when they are contradictory, but always it is attached to capturing their true thoughts. Some neutrosophic approach to model pedagogical scenarios can be read in [1,11-13].

This article is divided according to the following structure; section 2 is dedicated to explaining some basic concepts of Indeterminate Likert Scale. Section 3 contains the details and results of the survey. The last section contains the conclusions.

2 Some notions on Indeterminate Likert scales

In this section we summarize the main concepts of Indeterminate Likert Scales.

Definition 1 ([14]): The *Single-Valued Neutrosophic Set (SVNS)* N over U is $A = \{ \langle x; T_A(x), I_A(x), F_A(x) \rangle : x \in U \}$, where $T_A: U \rightarrow [0, 1]$, $I_A: U \rightarrow [0, 1]$, and $F_A: U \rightarrow [0, 1]$, $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$.

Definition 2: ([14,15]) The *refined neutrosophic logic* is defined such that: a truth T is divided into several types of truths: T_1, T_2, \dots, T_p , I into various indeterminacies: I_1, I_2, \dots, I_r and F into various falsities: F_1, F_2, \dots, F_s , where all $p, r, s \geq 1$ are integers, and $p + r + s = n$.

Definition 3: ([8,16-18]) A *triple refined indeterminate neutrosophic set* (TRINS) A in X is characterized by positive $P_A(x)$, indeterminacy $I_A(x)$, negative $N_A(x)$, positive indeterminacy $I_{P_A}(x)$ and negative indeterminacy $I_{N_A}(x)$ membership functions. Each has a weight $w_m \in [0, 1]$ associated with it. For each $x \in X$, there are $P_A(x), I_{P_A}(x), I_A(x), I_{N_A}(x), N_A(x) \in [0, 1]$, $w_P^m(P_A(x)), w_{I_P}^m(I_{P_A}(x)), w_I^m(I_A(x)), w_{I_N}^m(I_{N_A}(x)), w_N^m(N_A(x)) \in [0, 1]$ and $0 \leq P_A(x) + I_{P_A}(x) + I_A(x) + I_{N_A}(x) + N_A(x) \leq 5$. Therefore, a TRINS A can be represented by $A = \{ \langle x; P_A(x), I_{P_A}(x), I_A(x), I_{N_A}(x), N_A(x) \rangle | x \in X \}$.

Let A and B be two TRINS in a finite universe of discourse $X = \{x_1, x_2, \dots, x_n\}$, which are denoted by:

$$A = \{ \langle x; P_A(x), I_{P_A}(x), I_A(x), I_{N_A}(x), N_A(x) \rangle | x \in X \} \quad \text{and} \quad B = \{ \langle x; P_B(x), I_{P_B}(x), I_B(x), I_{N_B}(x), N_B(x) \rangle | x \in X \}$$

Where $P_A(x_i), I_{P_A}(x_i), I_A(x_i), I_{N_A}(x_i), N_A(x_i), P_B(x_i), I_{P_B}(x_i), I_B(x_i), I_{N_B}(x_i), N_B(x_i) \in [0, 1]$, for every $x_i \in X$. Let w_i ($i = 1, 2, \dots, n$) be the weight of an element x_i ($i = 1, 2, \dots, n$), with $w_i \geq 0$ ($i = 1, 2, \dots, n$) and $\sum_{i=1}^n w_i = 1$.

The *generalized TRINS weighted distance* is ([8,9]):

$$d_\lambda(A, B) = \left\{ \frac{1}{5} \sum_{i=1}^n w_i \left[|P_A(x_i) - P_B(x_i)|^\lambda + |I_{P_A}(x_i) - I_{P_B}(x_i)|^\lambda + |I_A(x_i) - I_B(x_i)|^\lambda + |I_{N_A}(x_i) - I_{N_B}(x_i)|^\lambda + |N_A(x_i) - N_B(x_i)|^\lambda \right] \right\}^{1/\lambda} \quad (1)$$

Where $\lambda > 0$.

Definition 4 ([8,9]): Let A_j ($j = 1, 2, \dots, m$) be a collection of m TRINS, then we define the TRINS distance matrix $D = (d_{ij})_{m \times m}$, where $d_{ij} = d_\lambda(A_i, A_j)$ is the generalized TRINS distance between A_i and A_j and satisfies the following:

1. $d_{ij} \in [0, 1], \forall i, j = 1, 2, \dots, m$;
2. $d_{ij} = 0$ if and only if $A_i = A_j$;
3. $d_{ij} = d_{ji}$ for all $i, j = 1, 2, \dots, m$.

The *Indeterminate Likert Scale* is formed by the following five elements:

- Negative membership,
- Indeterminacy leaning towards negative membership,
- Indeterminate membership,
- Indeterminacy leaning towards positive membership,
- Positive membership.

These values substitute the classical Likert scale with values:

- Strongly disagree,
- Disagree,
- Neither agree or disagree,
- Agree,
- Strongly agree.

The Indeterminate Likert Scale allows us to treat with inconsistencies and contradictions more obviously than by using the classical Likert Scale, [8,9]. The interviewed can have contradictory criteria to certain issues; nevertheless, very often the classical scales impose that they respond one unique value, which can produce prejudiced in the responses. The Indeterminate Likert Scale allows interviewed responding with one degree of opinion for every one of the elements of the scale.

For calculating the results of the survey, in [9] it is proposed an indeterminacy-based minimum spanning tree (MST) clustering algorithm, (see also [19-21]). However, we used another method based on the aggregation of the results.

3 Design and results of the investigation

This section contains the details of the survey design to be applied and the results obtained on gender parity in teaching, research and management in Peruvian universities.

First of all, a preliminary study on this topic was carried out in 95 Peruvian universities, according to the data collected from women and men in the position of rector and the results are those shown in Table 1.

University	Amount		%
	Total	By Gender	
Public	48	Male: 40	83.33
		Female: 8	16.7
Private	47	Male: 40	85.11
		Female: 7	14.89

Total: 95 Rectors of 95 Universities: 80 Men and 15 Women

Table 1: Current rectors according to gender. Source: own elaboration based on archives of the Association of Peruvian Universities.

From the same source, we collected the following information from the academic vice-chancellors: out of a total of 92, 62 are men who represent 67.39% and 30 are women who represent 32.61%. Regarding the research vice-rectors: of a total of 86, 65 are men, who represent 75.56% and 21 are women that represent 24.42%. This information places Peru in almost the same degree of participation of women in the leadership of the university administration. This is because if we compare that at the level of the vice-rectories the percentages are higher, while at the level of the Rectorate the average is 15%, lower than in the other countries of the region, which could mean a lower index of the presence of the woman. But if we consider that the vice-rectors constitute the rectorial board and make up the senior management, so the highest percentages of participation of women in the composition of the vice-rectors, bring them closer to the leadership of the management of Peruvian universities.

The following table shows us the current situation of gender parity in terms of university research:

Renacyt researchers by gender at the university			
University	Amount		%
	Total	By Gender	
Public	1990	Male: 576	29
		Female: 1414	71
Private	1705	Male: 533	31
		Female: 1142	69

Total researchers: 3,595

Table 2: Data of researchers registered in Renacyt by gender at the university. Source: Adapted of the information obtained from Concytec files.

According to the previous statistical information, female teachers have advanced significantly, placing in a few years at the same level of scientific production as men. The analysis shows that taking as a reference that in the private university the female teacher represents a figure close to a third of the teaching and in the public university an average of a fifth of the teaching, this last table of the registry of researchers by gender offers us a very thoughtful read. In the private university, nearly a third of female research teachers are reached, which represents the same proportion of teaching, and that in the case of men, the same proportion of two-thirds of teachers, this proportion is maintained in male researchers, which means a tie, that is to say that almost 50% of private university researchers investigate, reaching parity in this area. But, with regard to the public university, being female teachers a fifth of university teaching, on the other hand, the percentage of female research teachers is close to one third, above the female percentage of university teachers, which means that proportionally women surpass men in the production of knowledge in the public university, a figure higher than the levels of the other countries in the region.

Apart from these objective results that show us that there is an evident gender disparity, we conducted an online survey to managers, professors and researchers from the 95 universities studied. The intention of this survey is to study the perception that these professionals have regarding gender parity in their institutions. Both, men and women who could be contacted online were asked. For this, a simple questionnaire with three questions was designed. A more complex questionnaire might have required the presence of the respondents or a lengthy explanation, which could be impossible due to the current pandemic situation. In turn, the survey could be carried out by telephone, online, among other means. Specifically, the questionnaire applied was the following:

You have been a part of college life long enough. We want to ask you some questions about gender parity in your institution with the intention of knowing how you perceive this issue. This is an anonymous survey, so your name will never appear in the results.

1. Specify if your university is public or private.
2. Specify your gender.
Select a specified possible answer to each of the following questions:
3. At your university there are equal opportunities for men and women to be hired as a teacher.
 - Strongly disagree,
 - Disagree,
 - Neither agree or disagree,
 - Agree,
 - Strongly agree.
4. At your University there are equal opportunities for men and women to be a researcher.
 - Strongly disagree,
 - Disagree,
 - Neither agree or disagree,
 - Agree,
 - Strongly agree.
5. At your University there are equal opportunities for men and women to be a manager.
 - Strongly disagree,
 - Disagree,
 - Neither agree or disagree,
 - Agree,
 - Strongly agree.

Let us note that we maintained the linguistic terms used in the classical Likert scale, this is because these terms are clearer for the persons and thus they require less explanation about their meanings. However, this is still an Indeterminate Likert Scale due to we asked to the surveyed for a degree of accordance with regard to every one of the five issues, as we explain below.

An important aspect was explained to the respondents that the way to answer is not the traditional one. Instead of selecting a specific answer, a degree of satisfaction should be selected on each of the possible answers. For this we use a graphic design as indicated in Figure 1, where the professors have to select one of them for every one of the five possible responses.



Figure 1: Graphical representation of the accordance degrees to each of the five possible answers.

To each item on the scale in Figure 1 was assigned a numerical value that from left to right is -2, -1, 0, 1, 2.

The use of this scale was explained to each respondent. In the case of telephone interviews, it was explained to them orally. The results were aggregated by using the mean of each vector with 5 components, where $v_i = \langle a_{1i}, a_{2i}, a_{3i}, a_{4i}, a_{5i} \rangle$ denotes the degree of opinion of the i -th respondent, where a_{1i} is its degree of opinion about “Strongly disagree”, a_{2i} on “Disagree”, a_{3i} on “Neither agree or disagree”, a_{4i} on “Agree”, and a_{5i} on “Strongly agree”. Each of the $a_{ji} \in \{-2, -1, 0, 1, 2\}$ with $j = 1, 2, 3, 4, 5$.

For example, if a respondent answers $v_i = \langle 2, 1, 0, -1, -2 \rangle$ it means that he/she has a maximum degree (2) of “Strong Disagree”, a degree 1 of “Disagree”, he/she has no doubts (degree 0), has a degree of -1 of “Agree” and the minimum degree (-2) of “Strong Agree”, this means that the respondent is in total disagreement with what is stated in the degrees specified above. Whereas $v_i = \langle -2, -1, 0, 1, 2 \rangle$ means exactly the opposite.

922 teachers from different Peruvian universities were surveyed, 496 men and 496 women; 305 from private universities and 617 from public universities. The results are shown in Tables 3, 4 and 5.

University	Results
	By Gender
Public	Male: <1.1433, 1.8146, 0, -0.13814, -0.25618 > Female: <1.5902, 1.9441, 0, -0.044415, -0.773045>
Private	Male: <1.1095, 1.7327, 0, -0.24751, -0.37599> Female: <1.2944, 1.9004, 0, -0.49382, -0.76519 >

Table 3: Results in the form of TRINS of the means of the respondents' opinions, by gender and by type of university for Question 3 of the questionnaire.

University	Results
	By Gender
Public	Male: < 1.1056, 1.3300, 0, -0.0062788, -0.8273462 > Female: < 1.2658, 1.4344, 0, -0.7409910, -0.7507048>
Private	Male: < 1.1183, 1.3840, 0, -0.4885138, -0.5682985> Female: < 1.4835, 1.4776, 0, -0.0792902, -0.9944931>

Table 4: Results in the form of TRINS of the means of the respondents' opinions, by gender and by type of university for Question 4 of the questionnaire.

University	Results
	By Gender
Public	Male: < 1.9429, 1.8253, 0, -1.0039584, -1.6895929 > Female: < 1.9518, 1.7236, 0, -1.0058385, -1.6848606>
Private	Male: < 1.9323, 1.7022, 0, -1.0004345, -1.3684593> Female: < 1.9258, 1.6406, 0, -1.0028749, -1.5895004>

Table 5: Results in the form of TRINS of the means of the respondents' opinions, by gender and by type of university for Question 5 of the questionnaire.

As can be seen from Tables 3-5, the idea that inequality exists prevails in both men and women, since the positive values of all vectors are higher for the "Disagree" component, followed by "Strongly disagree". In addition, similar responses are noted in both types of universities. Additionally, less inequality is perceived for scientific parity and the greatest inequality is for parity in management positions.

Let us observe that we used a scale in the range of [-2, 2], instead of [0, 1], nevertheless these two scales are equivalent; we only have to use the following formula:

$$S(x) = \frac{x+2}{4} \quad (2)$$

Which maps $x \in [-2, 2]$ in $x' \in [0, 1]$ and this corresponds with Definition of TRINS.

Conclusion

This article was dedicated to studying gender parity in today's Peruvian universities. For this, a survey was applied to 992 professors, researchers and managers of 95 universities in this country, both men and women. The survey was realized online and the results confirmed the previous objective study carried out by the authors, which is that despite the fact that no more men than women graduate from university careers, there is an evident disparity between access to management, teaching and research positions. The most extreme situation is the unequal opportunities for men and women to hold management positions, while the least serious was in the scientific field. There was no obvious difference between the results for private or public universities. The survey carried out is more accurate than the more traditional ones, because an Indeterminate Likert Scale was applied, so that the respondents could express their opinions without concerning about coherence of the responses, therefore the final results reflected more reliably the opinions and feelings of the surveyed teachers.

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