Are Men And Women Different In European Higher Education Area?

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ABSTRACT

One of the principles of universities is to include and promote teaching and research in gender equality and non discrimination in all academic fields of training. But this is not easy to measure. This paper proposes a qualitative methodology to measure the problem and applies it to the University of Castilla-La Mancha (Spain).

Keywords: Education; Gender; Qualitative Data

1. INTRODUCTION

Universities were originally male-only institutions. In the mid-seventeenth century, the German University of Utrecht authorised the entry of Anna Maria von Shuurman, but on one condition: during lectures she had to remain in a separate room next to the classroom behind a wooden wall with holes in it (de Laurentis, 2000). During the same period (1678), Venetian noble Elena Lucrezia Cornaro became the first woman to earn a doctorate degree. In the twentieth century women entered secondary education en masse and by the end of the century represented the majority in Western universities. Over the last three centuries since Elena Lucrezia feat, daring women have reached and exceeded parity in higher education, access to all university courses and on average are the best students in all subjects.

In recent years, in contrast to the historical trend —since the exclusion of women from universities to their gradual inclusion in the nineteenth century—, no gender discrimination can be found in education or in terms of enrolment or academic results. However, both sociological theory (Beck, 1998, Bourdieu, 2000, Lipovetsky, 1999) and empirical studies (Subirats, 1999, Subirats and Brullet, 1988, Morgade, 2001) have stressed the persistence of mechanisms that reproduce the traditional framework of feminine and masculine identities at various educational levels. This could mean that gender inequality is still present in education, albeit more subtle nowadays.

It has also been found that different types of discrimination (gender, class, ethnicity, religion and nationality discrimination, among others) do not occur in isolation in society and they are part of authoritarian social structure (Adorno, 1969). Specifically, several studies (Morgade, 2001, Adaszco and Kornblit, 2007) have pointed out that gender discrimination is linked to other forms of discrimination, where the construction of stereotypes would apply to all social groups (Adorno, 2005), including Jews, black people and women.

In addition, and on a different note, currently it exist the suspicion in the collective of university teachers that some kind of gender discrimination does exist. Consequently, there is no surprise that this issue is one of the hot points of debate between teachers

Several studies coincide that Spain, like other countries (see Olarte and Borrero, 2008, for South American countries) have historically displayed gender inequalities in regard to access and the time spent in the education system as well as the position in the education system. This has often resulted in a lower female participation in science and research and in less access to jobs with decision making responsibilities and power. It has been common practice within households to consider that the primary and sole objective of women is to have children.

Currently, it is a priority to find ways of reducing discrimination and promoting the incorporation of women in various fields, both in the education system and the labour market. Many alternatives have been proposed to try to overcome this situation, but they have failed to have any impact on societies at the highest levels or university education and government.

As a consequence of the above, a range of instruments including statistical techniques are needed to check, or better said test, the existence of gender discrimination in education (both at a student and professional level). This paper proposes some qualitative statistical strategies to test the existence of gender discrimination.

2. METHODOLOGY

In this paper, both the nature of the object of study as it examines the problems and the research approach is projected here is qualitative in nature.

Gender, as a wide range of factors that could be related to it, is a categorical variable, that is it has a measurement scale consisting of a set of categories (men and women). Therefore, categorical data (see Montero, 1995, 2010a,b for details) are in the core of the gender discrimination debate, especially in the Education field. This is the reason why categorical or qualitative statistic strategies are needed to shed some light on issues related to gender discrimination.

This topic arises with the analysis of data taken from a sample of a population classified with respect to two or more qualitative variables. In this case we elaborate a contingency table.

Table 1. Categorical table 2x2

		Columns (Attribute B)		
		b_1	b_2	**Total**
Rows (Attribute A)	a_1	n_{11}	n_{12}	$\boldsymbol{n_{1\cdot}}$
	a_2	n_{21}	n_{22}	$\boldsymbol{n_{2\cdot}}$
		$\boldsymbol{n_{\cdot 1}}$	$\boldsymbol{n_{\cdot 2}}$	$\boldsymbol{N}$

Source: Own elaboration

A table such as the Table 1 above is known as a contingency table. This 2x2 example (the members of the sample having been dichotomised in two different ways) is the simplest form of this type of table. Had the two variables possessed multiple rather than dichotomous categories, the table would have had more cells than the four shown. The entries in the cells for these data are frequencies. They may be transformed into proportions and percentages, but it is important to note that, in whatever form they are presented, the data were originally frequencies or counts rather than continuous measurements.

The most important aspect of this study is whether the qualitative variables forming the contingency table are independent or not.

In a contingency table independence implies the (percent) distribution of the frequencies corresponding to a category of one of the factors (say factor A) between the categories of the other factor (say factor B) is the same irrespective of the category of factor A. However, we do not work with populations but with samples and although independence holds some divergences from the above equalitarian pattern could happen due to hazard.

To test whether two qualitative variables or factors are or not independent based on a sample, suppose that in the population where the sample has been taken the probability that one individual belongs to the i^{th} category of the row variable and the j^{th} category of the column variable is represented by p_{ij} ; consequently the frequency, E_{ij} , to be expected in the ij^{th} cell of the table resulting from sampling N individuals, is given by:

$$E_{ij} = Np_{ij} . \quad (1)$$

Now, let p_i represent the probability that, in the population, an individual or element belongs to the i^{th} category of the row variable (in this case with no reference to the column variable), and let $p_{.j}$ represent the corresponding probability for the j^{th} category of the column variable. Then, from the multiplication law of probability, independence of the two variables in the population, implies that:

$$p_{ij} = p_{i.} p_{.j} . \quad (2)$$

In terms of the frequencies to be expected in the contingency table, independence is therefore seen to imply that:

$$E_{ij} = Np_{i.} p_{.j} . \quad (3)$$

The independence of the two qualitative variables has been defined in terms of unknown population probability values. In fact, these probabilities may be estimated very simply from the observed frequencies and it is easy to show that the best estimates of the probabilities are based on the relevant marginal totals of the observed values. The use of estimates allows us to forecast the expected frequency in the $\{ij\}$-cell of the table under the assumption that the two variables were independent. This forecast, which shall be represented as E_{ij}, is given by:

$$E_{ij} = N \frac{n_{i.}}{N} \frac{n_{.j}}{N} = \frac{n_{i.} n_{.j}}{N} \quad (4)$$

When the two variables are independent, the expected frequencies and the observed frequencies should differ by amounts attributable to chance factors only. However, if the two variables are not independent, we would expect larger differences to arise. Consequently it would seem sensible to base any test of the independence of the two variables forming a two-dimensional contingency table on the size of the differences between the two sets of frequencies, n_{ij} and E_{ij}.

It has been indicated that we need to investigate the truth of the hypothesis:

$$p_{ij} = p_{i.} p_{.j} . \quad (5)$$

In general this hypothesis will be referred to as the null hypothesis and denoted by the symbol H_0.

According to the rationale above, a good test of independence should be based on the magnitude of the differences between the observed (n_{ij}) and the expected frequencies under the assumption that H_0 holds (E_{ij}). Such a test, first suggested by Pearson (1904), uses the statistic χ^2 given by:

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(n_{ij} - E_{ij})^2}{E_{ij}} \quad (6)$$

to avoid compensation between negative and positive differences and express such differences in relative terms.

If the two variables are independent, these differences will be smaller than if the opposite were true; consequently χ^2 will be smaller when H_0 is true than when it is false. Hence what is needed is a criterion to decide on values of χ^2 which should lead to the acceptance of H_0 and those which should lead to rejecting it. As it can be shown that, under the independence assumption, χ^2 follows a Ji-squared distribution with $(r-1, c-1)$ degrees of freedom (Montero et al, 2010a, b) we can easily compute the p-value associated to the sample value of χ^2. Obviously, values with "low" *p*-value lead to rejection of the hypothesis, others to its acceptance. In practice, a "low" *p*-value is taken to be a value of 0.05 or less and is referred to as the significance level of the test.

In case of rejecting the hypothesis of independence we should identify the sources of the association (which categories of the factors are associated) with and the strength of such an association.

In case of 2x2 contingency tables, the most usual measure is the Yule's Q.

$$Q = \frac{n_{11}n_{22} - n_{12}n_{21}}{n_{11}n_{22} + n_{12}n_{21}} \tag{7}$$

This measure varies between -1 and 1. For negative functional dependence (Q is equal to -1) the association is between the modalities $(a_1; b_1)$ and $(a_2; b_2)$. In case of positive functional dependence (Q is equal to 1) the association is between the modalities $(a_1; b_2)$ and $(a_2; b_1)$. Yule's Q is equal to 0 in the case of independence.

There are different methods to quantify the intensity of the association of the factors in a two-dimensional distribution when at least one of them has more than two categories. They include (i) The Contingency Coefficient *C*; (ii) Tschuprow's *T*; and (iii) Cramer's *V*, all of them based on the χ^2 statistic, but Cramer's *V* is the most popular because it corrects some of the deficiencies of *C* and *T*. Cramer's V is defined as:

$$V = \sqrt{\frac{\chi^2}{Nm}}\,, \tag{8}$$

where $m = \min(r-1, c-1)$. This measure varies between 0 (for independence) and 1 (for functional dependence).

Unlike Yule's Q for 2x2 contingency tables, measures of association for (RxC) tables do not indicate the origin of the association. To determine the sources of association we suggest a procedure pioneered by Haberman (1973) that is based on the pattern of residuals $\left(n_{ij} - \hat{E}_{ij}\right)$ and compares the adjusted standardised residuals with a known distribution. The standardised residuals $\left(e_{ij}\right)$ of the cell $\{i, j\}$ are defined as:

$$e_{ij} = \frac{n_{ij} - \hat{E}_{ij}}{\sqrt{\hat{E}_{ij}}} \tag{9}$$

with $\hat{E}_{ij}$ calculated under the hypothesis of independence. These residuals have an asymptotically normal distribution with mean zero, and the variance V_{ij} is $V_{ij} = V\left(e_{ij}\right) = \left(1 - p_{i.}\right)\left(1 - p_{.j}\right)$. The estimate of the variance is

$$\hat{V}_{ij} = \hat{V}\left(e_{ij}\right) = \left(1 - \frac{n_{i.}}{N}\right)\left(1 - \frac{n_{.j}}{N}\right) \tag{10}$$

and dividing the standardized residuals by the estimation of their variance adjusted standardised residuals are obtained:

$$d_{ij} = \frac{n_{ij} - \hat{E}_{ij} \Big/ \sqrt{\hat{E}_{ij}}}{\sqrt{\hat{V}_{ij}}} = \frac{e_{ij}}{\sqrt{\hat{V}_{ij}}} \qquad (11)$$

Under the hypothesis of independence, d_{ij} has Gaussian distribution with zero mean and unitary variance. Therefore, comparing the values of d_{ij} with the critical value of a standard Gaussian distribution, and checking which of them are significant we can discover the sources of the association between the two factors involved in the contingency table.

3. RESULTS

Taking into account the issues raised in this paper, we conduct a descriptive and conclusive documentary study. We obtain data from the University of Castilla-La Mancha Working Paper, 2009, in order to support the historical information and theoretical aspects of the topic being studied. We can claim to be conclusive, because this research is designed to provide information for the assessment of female participation in Higher Education in 2009 (the latest year available).

Table 2. Relationship between gender and level of degree. 2009

	3-year Degree	5-year Degree	
Women	8,219	6,590	**14,809**
Men	6,240	5,725	**11,965**
	14,459	**12,315**	**26,774**

Source: Own elaboration

First, we analyse two core characteristics of the students: the level of degree and the type of degree. From Table 2 we can guess that in 2009, in case of association between the attributes gender and the level of the degree obtained, it is not strong. Note that, 56.84% of 3-year Degree graduates are women and 43.16% are men. In the case of 5-year degrees, 53.51% are women and 46.48% are men. Thus, the proportion of women and men are similar in both cases.

But, as is well known, whether these percent differences are significant or not depend on the sample size and how asymmetric are the margins. To test the statistical significance of the above differences, we carry out a Ji-squared test of independence between the levels of the two attributes under study. The χ^2 statistics is equal to 29.86, under the null hypothesis of independence, so we reject (at a significance level of 5%) that the attributes level of degree and gender are independents. From the sample value of the Yule's Q (0.07) we can conclude that the existing association is positive, that is, the percentage of women with a 3-years Degree significantly exceeds the corresponding percentage in men; on the contrary, the percentage of men with a 5-year Degree significantly exceeds the corresponding percentage in women. However, and according to our preliminary suspicion, the above association of women with a 3-year Degree and men with a 5-year Degree is very weak. In this sense (3-year or 5-year degree graduates), we could state that the gender differences in education are very slight, at least at the University of Castilla-La Mancha.

Table 3. Degrees at the University of Castilla-La Mancha. 2009

	Humanities	Science	Health Science	Low and Social sciences	Engineering	
Women	1,690	558	1,984	8,850	1,727	**14,809**
Men	925	291	566	5,337	4,846	**11,965**
	2,615	**849**	**2,550**	**14,187**	**6,573**	**26,774**

Source: Own elaboration

If we study gender differences taking into account the type of degree (see Table 3), we can appreciate some peculiarities. For example, the percentage of female graduates in Humanities, Science, Health science, Law and Social sciences and Engineering stands at 64.62%, 65.70%, 77.81%, 62.40% and 26.27%, respectively. These wide differences between of women and men in the different degrees traduce in a χ^2 -statistic equal to 3179.97, which is clearly significant at the 5% significance level.

Table 4. Adjusted standardised residuals

	Humanities	Science	Health Science	Law and Social sciences	Engineering
Women	10.09	6.20	24.02	24.70	-54.51
Men	-10.09	-6.20	-24.02	-24.70	54.51

Source: Own elaboration

From Table 4 we observe the following sources of association (again at a 5% level of significance): Women with Humanities, Science, Health science, Low and Social sciences degrees and Men with Engineering degrees. The Cramer's V is equal to 0.35, so we can conclude that there is little association between attributes, gender and degrees. Of course, Goodman and Kruskall's lambda would be a preferable measure of association, but in this case the predicted level of degree knowing and not knowing the level of the attribute gender is the same and a consequence it is null and not interpretable. The reason for choosing the Cramer's V is that it take into account the sample size and the numer of categories of attributes.

Second, we analyse the gender differences focusing on the the lecturers at the University. In order to do so, first of all we study whether or not there is a relationship between Ph.D holders and gender.

Table 5. Standard deviation of standardized residuals

	Ph.D.	No Ph.D.	
Women	491	670	**1,161**
Men	864	900	**1,764**
	1,355	**1,570**	**2,925**

Source: Own elaboration

Table 5 shows the distribution of lecturers according to both gender and qualification (Ph.D or no Ph.D). Women account for 36.23% of Ph.D holders, while 63.77% are men. Out of those lecturers who do not have a Ph.D, 42.67% are women and 57.33% are men. Thus, it suggests an association between women and not having a Ph.D and men and having a Ph.D. This suspicion is confirmed by Ji-square test of independence, as $\chi^2 = 12.58$ is significant at a level of significance of 5%. However, the Yules's Q is equal to -0.12, which reveals that the association between gender and qualification of lecturers is extremely weak.

Table 6. Professional categories at the University of Castilla-La Mancha

	Full professor	Associate Professor	Senior Lecturer	Lecturer (level 1)	Contracted Senior Lecturer	Lecturer (level 2)	Lecturer (level 2)	Teaching assistant	Assistant Lecturer (level 1)	Assistant Lecture (level 2)	R&D Personnel	Other	
Women	14	188	12	113	95	11	84	30	209	116	286	3	**1161**
Men	128	294	37	172	101	3	55	46	471	131	318	8	**1764**
	142	**482**	**49**	**285**	**196**	**14**	**139**	**76**	**680**	**247**	**604**	**11**	**2925**

Source: Own elaboration

If we study gender differences taking into account professional categories (see Table 6), we can appreciate that only 9.86% of full professors are women, while 90.14% are men. Meanwhile, 24.49% of senior lecturers are women versus 75.51% in the case of men. However, women enjoy a greater presence in junior positions than men. This is the case for contracted senior lecturers and Lecturers (levels 1 and 2), with percentages of 48.47% (women) versus 51.53% (men), 78.57% (women) versus 21.43% (men) and 60.43% (women) and 39.57% (men), respectively.

The Ji-squared test of independence $(\chi^2 = 140.50)$ leads us to conclude that attributes gender and professional categories of lectures at the University of Castilla-La Mancha are not independent. Nevertheless, the strength of the association between the above factors is extremely weak: the Goodman & Kruskall's lambda hardly reaches 0.03, that is, when it comes to predict the professional category of a lecturer or the University of Castilla-La Mancha, the gender factor only reduces by 3% the error committed when the prediction is made without explanatory factors. This fact des-encourages the searching for the sources of association, but as seen in Table 7 it can be appreciated a more significant presence of women in the categories of Contracted Senior Lecturer and Lecturers, and of men in the categories of Full Professor, Senior Lecturer, Assistant Lecturers and R&D Personnel. As stated above the extreme of the association is very weak, with the exception of the relation of Full professors and Assistant lecturers level 1with men and Lecturer level 2 with women.

Table 7. Adjusted standardised residuals

	Full professor	**Associate Professor**	**Senior Lecturer**	**Lecturer (level 1)**	**Contracted Senior Lecturer**	**Lecturer (level 2)**	**Lecturer (level 2)**	**Teaching assistant**	**Assistant Lecturer (level 1)**	**Assistant Lecture (level 2)**	**R&D Personnel**	**Other**
Women	-7.45	-0.34	-2.19	-0.02	2.60	2.98	5.12	-0.04	-5.45	2.44	4.32	-0.84
Men	7.45	0.34	2.19	0.02	-2.60	-2.98	-5.12	0.04	5.45	-2.44	-4.32	0.84

Source: Own elaboration

4. CONCLUSIONS

Since the late twentieth century, the European Union has incorporated gender equality in European education policy. In relation to the Bologna Process, the Preamble to the Communiqué of the Conference of Ministers of Higher Education, held in Berlin on September 19, 2003, entitled "Building the European Higher Education Area", set the goal of reducing gender inequalities in higher education both at national and European level. Four years later, at the Conference held in Berlin in 2007, the European Network on Gender Equality in Higher Education examined how much had been achieved towards gender equality in the development of the EHEA and its introduction in Degrees and the influence that national legislation.

One of the principles of universities is to include and promote teaching and research in gender equality and non discrimination in all academic fields of training.

This paper describes the problem of gender discrimination in education and proposes qualitative techniques to measure it. The suitability of these techniques has been tested on the University of Castile-La Mancha (Spain).

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REFERENCES

1. Adorno, T. (1969). Educación después de Auschwitz, en *Educación para la emancipación*, ediciones Morata, Madrid.
2. Adorno, T.W. and Horkheimer, M. (1987). *Dialéctica del Iluminismo*, editorial Sudamericana, Buenos Aires.
3. Beck, U. (1998). La sociedad del riesgo, Barcelona, Piados.
4. Bourdieu, P. and Passeron, J.C. (1974) *La reproducción. Elementos para una teoría del sistema de enseñanza*, Ed. Laia, Barcelona.
5. Bourdieu, P. (2000). *La dominación masculina*, Barcelona, Anagrama.
6. De Laurentis, T. (2000). *Diferencias. Etapas de un camino a través del feminismo.* Madrid, Instituto de la Mujer/Ministerio de Trabajo y Asuntos Sociales.
7. European association for quality assurance in higher education (2005): Standards and Guidelines for Quality assurance in the European Higher Education Area. Helsinki, Finland.
8. Haberman, S.J. (1973). The analysis of residuals in cross-classified tables. *Biometrics*, 29, 205-220.
9. Lipovetsky, G. (1999). *La tercera mujer*, Barcelona, Anagrama.
10. Montero, J.M., Fernández-Avilés, G. and García, M.C. (2010a). Revisiting the expectancy/disconfirmation paradigm for small questionnaires: The cultural/heritage tourism case. *Rect@*. 11, 155-177.
11. Montero, J.M., Fernández-Avilés, G. and García, M.C. (2010b). Contraste de independencia con corrección de continuidad asimétrica: Una aplicación al turismo cultural. *Anales de Asepuma*, 18, 801
12. Morgade, G. (2001). *Aprender a ser mujer, aprender a ser varón*, Ediciones Novedades Educativas, Buenos Aires.
13. Olarte, M. and Armando Borrero, A. (2008) Analfabetismo y discriminación por género en América Latina FERMENTUM Mérida - Venezuela - ISSN 0798.
14. Pearson. K. (1904). Report on certain enteric fever inoculation statistics. *British Medical Journal*, 3, 1243-1246.
15. Plan de igualdad entre mujeres y hombres (2010). University of Castilla-La Mancha. Working paper.
16. Ruiz-Maya, L. Martín, J., López, J., Montero, J. M. and Uríz, P. Alfa (1995). *Análisis estadístico de encuestas: datos cualitativos*. Editorial AC.
17. Saldaña, N. (2010). Gender studies in the Degrees in Law: Proposals for a curriculum design of the teaching of Constitutional Law with a gender perspective in the EHEA. *Education and Law review*.
18. Subirats, M. (1999). Género y Escuela. en C. LOMAS (comp.) *¿Iguales o diferentes? Género, diferencia sexual, lenguaje y educación*, Paidós, Madrid, 19-31.
19. Subirats, M. y Brullet, C. (1988). Rosa y Azul: la transmisión de los géneros en la escuela mixta, en Belaustegui y Mingo (eds.) *Géneros prófugos*, UNAM, México.

