

Journal-based indicators to assess inter-gender differences in a national research system

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Introduction

Science, Technology and Innovation indicators are essential to study the structure and dynamics of research as well as the position of different actors in the research system. Moreover, indicators are needed to monitor changes and to support strategic decisions of policy makers. In this context, obtaining indicators by gender to analyse and monitorise the already described gender imbalance in science is currently a matter of great concern (Naldi et al, 2004; Mauleón y Bordons, 2006). Women are under-represented in science, they tend to concentrate in specific fields and their share decreases as we go up in the career hierarchy, especially in careers in industry. In Europe, regional and national policies are developed to increase female participation in science, since both men and women are needed to maintain the region as one of the most competitive knowledge-based economies in the world. The measures developed range from the collection of complete statistics on the situation of men and women in science (She Figures, 2009) to the support of different programs aimed at increasing opportunities for women and pushing for gender equality.

This paper presents journal-based indicators to assess differences in the participation of men and women to different levels of the research system. Assuming that publication of research results is an essential stage in the scientific process and that journals select for their editorial boards the most prestigious scientists in the journals' field, we suggest the study of the participation of women as authors and as editorial boards' members to measure their involvement at different levels of the research system.

In Spain, the application of the Law for the Effective Equality between Women and Men (3/2007) seeks to advance towards gender equality and to guarantee the parity in all levels of science and in decision making. The present research establishes mechanisms for collecting gender disaggregated indicators on a selection of Spanish journals with the aim of contributing to the better knowledge of the participation of women in the national research system, as well as to support decisions of the Spanish government oriented towards gender parity in science.

Method

This study focuses on the analysis of a selection of journals edited in Spain and covered by the Web of Science database (WoS) concerning six different disciplines: chemistry, economics, engineering, information science, mathematics and psychology.

Three main aspects are studied for each of the disciplines:

a) Editorial boards: male and female presence in the editorial boards of 41 Spanish journals is analysed. A total of 2 journals in chemistry, 7 journals in economics, 2 in information science,

9 in engineering, 10 in mathematics and 11 in psychology are studied. These journals are selected according to the following criteria: internationality (all of them are covered by WoS database) and high quality (based on impact factor and related measures). For social sciences the scores obtained by these journals in their evaluation in RESH (<http://resh.cindoc.csic.es/RESH>) and IN-RECS products (<http://ec3.ugr.es/in-recs/ii/Documentacion-fecha-2009.htm>) are taken into account.

b) Authorship. Two different indicators are obtained: presence and participation. Presence refers to the percentage of male and female authors of documents per journal. Participation deals with the percentage distribution of male, female and cross-gender documents. This analysis is limited to 2 journals per discipline.

c) Collaboration practices: inter-gender differences in the collaboration practices are analysed. The presence and participation of male and female authors in three classes of documents (no collaboration, national collaboration and international collaboration) are analysed.

d) Comparison of the Spanish journals with top-tier international journals in their corresponding fields (reference journals). Reference journals are selected according to their high impact in the corresponding disciplines.

Time trends from 1998 to 2008 are analysed. Differences by disciplines are explored. Inter-gender differences are analysed with SPSS.

Results

The percentage of women in the editorial boards of Spanish journals showed an upward trend in most of the disciplines. In 2008, it ranged from around 5% in Mathematics to 40% in Information Science (Table 1).

Table 1. Presence of men and women in editorial boards of Spanish journals

	Year	N. Men	N. Women	Total	% Women
Inf.Science	1988	30	14	44	31.82
	2008	42	27	69	39.13
Psychology	1998	368	113	481	23.49
	2008	553	195	748	26.07
Chemistry	1998	32	6	38	15.79
	2008	34	10	44	22.73
Economics	1988	183	23	206	11.17
	2008	169	31	200	15.5
Mathematics	1998	326	20	341	5.87
	2008	341	20	361	5.54

Concerning authorship in Spanish journals, more than 5,300 documents were analysed. Female participation and presence increased from Mathematics to Psychology (table 2 and 3). Documents signed only by men predominated over cross-gender and only female documents in three disciplines, while cross-gender documents were the most frequent type in Psychology and Chemistry. The percentage of only male documents tended to decrease across years while cross-gender documents showed an upward trend. Our preliminary data on collaboration show that women sign as single author of publications less often than men in Mathematics and Chemistry.

Table 2. Participation of authors by gender

	All	Only men		Only women		Men and Women		Female participation
	N. Doc	N. Doc	%	N. Doc	%	N. Doc	%	
Psychology	1528	404	26.4	249	16.3	875	57.3	73.6
Chemistry	1232	439	35.6	98	8	695	56.4	64.4
Inf. Science	630	282	44.8	164	26	184	29.2	55.2
Economics	479	273	57.0	68	14.2	138	28.8	43.0
Mathematics	602	442	73.4	30	5	130	21.6	26.6

Note: disciplines in descending order of female participation. Engineering data are still not available.

Table 3. Presence of authors by gender

	N. Men		N. Women		Total authors	Male presence (%)	Female presence (%)
	N. Men	N. Women	N. Men	N. Women	Total authors	Male presence (%)	Female presence (%)
Psychology	2463	2081	2463	2081	4544	54.2	45.8
Inf. Science	764	512	764	512	1276	59.9	40.1
Chemistry	2599	1516	2599	1516	4115	63.2	36.8
Economics	623	244	623	244	867	71.9	28.1
Mathematics	1044	190	1044	190	1234	84.6	15.4

Note: disciplines in descending order of women presence. Engineering data are still not available.

At present, the following international journals are being analysed: *Acta Materialia* and *Metallurgical and Materials Transactions A* (Engineering), *Biometrika* and *Annals of Statistics* (Mathematics), *European Economic Review* and *Review of Economics and Statistics* (Economics), *Journal of the Science of Food & Agriculture* and *Journal of the American Oil Chemists Society* (Chemistry), *Personality & Individual Differences* (Psychology), *Scientometrics* and *JASIST* (Information Science).

Discussion

Differences between women's representation on editorial boards and authors of documents will be discussed and compared with the presence of female researchers in academy in each of the six fields under analysis. A benchmark exercise is developed to compare the Spanish research system (Spanish journals) to international data (reference journals). Benchmark indicators are provided to measure gender balance and time improvements. Main difficulties in obtaining sex-disaggregated indicators will be described and recommendations for authors and journals will be drawn from the study. Science policy implications of the results will be discussed.

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