

# Is helping to bridge the gender gap in STEM considered as transfer of knowledge?

## Transfer of Knowledge in STEM

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### ABSTRACT

The recent evaluation of Spanish researchers regarding Transfer of Knowledge has shown how activities that could help in closing the gender gap in STEM areas are penalized in the evaluation. The results have been very disappointing and, from their publication, one could have the impression that, first, Spanish researchers do not achieve more than a mediocre result in transferring the research to the society; second, female researchers are even less capable of transferring knowledge in a profitable, beneficial way; and third, those activities that do not involve a high economic impact, either on the Society or on the research institutions, do not count for promotion or the consideration of prestige of researchers in this research aspect. However, a close examination of the results with the help of a questionnaire elaborated by researchers belonging to a Spanish feminist association show that the very bad results could in fact be due to the intricate call and the low preparation of the evaluation committees in gender aspects, as well as the immature process in general. The conscious analyses of the results with the help of 513 respondents may help in enriching the next calls, avoiding a second disastrous result, and encouraging female researchers to contribute for advancing towards an equal society, even if no economic values are directly derived from their research.

### CCS CONCEPTS

• **Social and professional topics** → User characteristics; Gender; Women.

### KEYWORDS

Transfer of Knowledge, the gender gap in STEM, the Spanish research evaluation system

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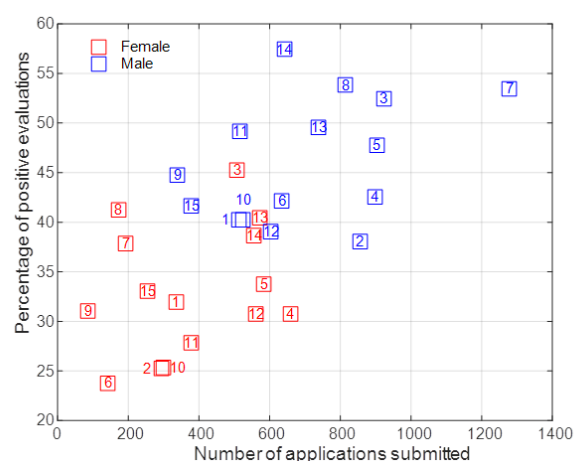
### 1 INTRODUCTION

Bridging the gender gap in STEM subjects should be a shared task among all professors and researchers. However, experience says that the majority leading this task, either at the university or in any public or private research institution, is represented by female researchers. In the last years, were this gap has become so obvious that even those more recalcitrant gender-gap deniers have to admit it, many different initiatives have been launched and implemented. Some of these activities are steps forward to decrease the gap, but some programs can endanger the positive results that are expected from them. One of these jeopardizing instruments is the new implemented Transfer of Knowledge six-year term (sexenio de transferencia in Spanish) that the Spanish Ministry of Science and Innovation (today Ministry of Universities) launched in 2018. The transfer of knowledge six-year terms are productivity complements to the salary that examine the research work and outcomes of academics and researchers working in public institutions.

The results of the evaluation were published by the Spanish Research Quality Agency (ANECA)<sup>1</sup> more than one year later, and they are discouraging [1]. Not only they show that the research transfer in Spain is very poor (less than 43% applications were positive), but that female input in transfer of knowledge is very scarce. Only 34.62% of the proposals were submitted by female researchers. Male researchers doubled the submissions. Probably because only 39.14% of female researchers had the requested research conditions to start with (the obligation to have at least one positive research six-year term, which left young researchers out of the process). Successfulness of women was 33.13%, while for men the number was 42.00%. The successfulness of female researchers taking all the proposals into account was 27%. Figure 1 depicts the percentages of success (positive evaluation) as a function of the number of applications submitted. The numbers on marks in the plot correspond to the different fields of knowledge<sup>2</sup>. Just from these data it is clear that something is not going well in the transfer of knowledge in Spain, and we cannot believe that majority of researchers with a high research profile, demonstrated by the objective data on publications and projects, were left out. From our research, we have determined that either the failure was due to the call itself or to the evaluation process as a whole.

<sup>1</sup><http://www.aneca.es/>

<sup>2</sup>1. Chemistry, 2. Physics and Mathematics, 3. Natural Sciences and Biochemistry, 4. Health Sciences, 5. Chemical Engineering and Materials Science, 6. Mechanical Engineering and Naval Engineering, 7. Electronics and Electronic Systems Engineering, 9. Architecture and Civil Engineering, 10. Economy, 11. Business, 12. Social Sciences and Behavioral Sciences, 13. Art and Humanities, 14. Law, 15. Education Sciences.



**Figure 1: Percentages of positive evaluations versus the number of applications submitted. The numbers on marks correspond to the different fields of knowledge. Own elaboration based on ANECA data.**

Due to these astonishing bad results, the authors of this contribution, together with other colleagues from AMIT<sup>3</sup> de Mujeres Investigadoras y Tecnólogas, Women Association for Research and Technology, in the translation to English) decided to investigate where the evaluation procedure had failed. In fact, the results were so dramatic, that even national papers were interested in knowing the position of feminist associations regarding the very bad results for female researchers. As a consequence, the authors of this work were invited to contribute to the Newspaper opinion section of *El País*<sup>4</sup>, the most important Spanish national newspaper, which triggered as well the present study.

This paper consists on the description of AMIT, the methodology used to analyze the results of the transfer of knowledge six-year term, the results and the discussion of these results, as well as some conclusions from the study.

## 2 AMIT

AMIT was created in 2002, with the help of a group of researchers who observed the shortcomings of the Spanish scientific system. AMIT defends the interests and equal rights and opportunities of Spanish researchers and technologists in those contexts where it is claimed that there are not quality female researchers to be part of committees, panels, and government bodies [4]. At present, AMIT has more than 1 000 associates (the same number as when the survey was launched), most of them (969) female researchers. AMIT promotes compliance with the recommendations of the European Commission to achieve gender equity and Spanish regulations contained in the Organic Law for Effective Equality between Women

and Men<sup>5</sup>, as well as the development of what refers to gender included in the Spanish Law of Science<sup>6</sup>. Among the tools used to achieve these objectives is the analysis and monitoring of various activities, such as calls for awards, contests, competitive examinations or promotions, or as publications or scientific events. Even if women are increasing in number when higher education and doctoral studies are compared (58% doctoral graduates are women), the number of female researchers goes down below the one for male researchers in the decision-making highest positions [3]. When imbalances are observed, AMIT proceeds to public denunciation through the media or specific publications. For this reason, the authors of this paper, together with other AMIT associates, developed a survey that was sent to all the associates, but also to all the researchers that were interested in participating in the study, with the intention of investigating whether there was a gender disparity. Not only in the results, but also in the whole process.

## 3 METHODOLOGY

To analyse and discuss the results of the Transfer of Knowledge evaluation we used the data published by the Spanish Research Quality Agency (ANECA)<sup>7</sup> and a survey developed by the authors of this contribution, with the help of other AMIT associates. The survey was developed using the Google Forms tool, and the link was made available to AMIT associates, but also any other researcher that would wish to participate, either if they have applied for the recognition of the transfer of knowledge six-year term or not.

### 3.1 Structure of the survey

The structure of the survey consisted of three blocks: The first block concerns the academic profile of the surveyed, the second block relates to the own results of the call (if the respondent had applied) and, finally, the third one asks for suggestions to improve future calls. In detail, the content of the survey was as follows:

#### Block one: Profile of the participants

In order to define the profile of the participants, data on sex, age, university or organization where they are enrolled were requested, but also their professional category and the number of research terms awarded. It should be taken into account that in the bases of the call it was established that only those investigators, civil servants or with a fixed employment contract, could apply for the six-year term of transfer, and it was also a necessary condition to have recognized at least 1 six-year term of research.

The last question in this block was: *Have you applied for the transfer term?*

#### Block two: Results of the call

In this block, two itineraries were opened depending on the answer, YES or NO, to the last question in Block One:

- In case of NO, information was collected on the reasons why they had not been requested:
- Did not meet the conditions of the call (eg, 1 six-year investigation)

<sup>3</sup>[https://www.amit-es.org/\(Asociación](https://www.amit-es.org/(Asociación)

<sup>4</sup>Transferencia del conocimiento: ¿Estamos haciendo bien las cosas las investigadoras españolas <https://elpais.com/ciencia/2020-07-10/transferencia-del-conocimiento-estamos-haciendo-bien-las-cosas-las-investigadoras-espanolas.html>

<sup>5</sup>Ley Orgánica 3/2007, de 22 de marzo, para la igualdad efectiva de mujeres y hombres. <https://www.boe.es/buscar/pdf/2007/BOE-A-2007-6115-consolidado.pdf>

<sup>6</sup>Ley 14/2011, de 1 de junio, de la Ciencia, la Tecnología y la Innovación. <https://www.boe.es/buscar/pdf/2011/BOE-A-2011-9617-consolidado.pdf>

<sup>7</sup><http://www.aneca.es/>

- The criteria were too imprecise; the rules were not entirely clear
- It was an additional effort to the overload that we already have, without guarantees of being able to achieve it
- It seemed to me that he did not have sufficient merits of the type that were requested
- I have participated in transfer actions but I have not been IP or responsible for the projects
- I prefer to focus my effort on the six-year periods of research whose rules are more defined
- Other reasons

Below is a question about their plans for the next call; *Do you plan to request it in the next call? Briefly justify your answer*

- In case of YES:

In case of having requested the six-year term, two scenarios are opened again; the evaluation result has been positive or negative. In both cases, questions are asked about the merits provided and the score received, though the last data is only known to those who have received a negative evaluation.

In case of positive evaluation, it was asked to score from 0 (Not at all) to 5 (Very much) the aspects that have made the difference between a successful and unsuccessful application: The merits contributed and The way to present and argue them. Finally, a recommendation to people negatively evaluated in the face of a new application was asked.

### Block three: Improvement proposals

In this final block we would like to know the opinions of the participants on how to improve future calls, and giving them the opportunity of pointing out some aspects or considerations of the evaluation that have not been sufficiently reflected in the survey and would like to share.

The specific questions were:

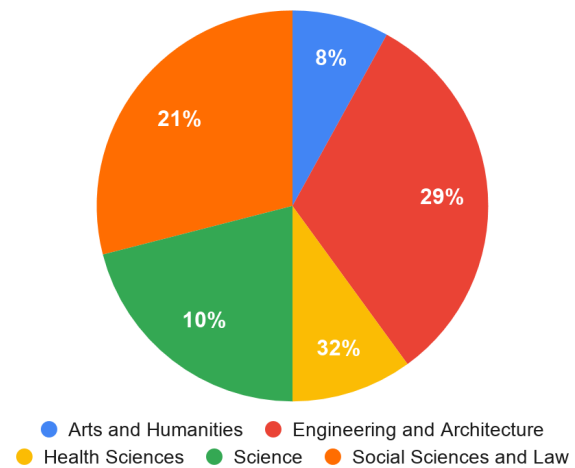
*What aspects do you think should be improved in future calls? (You can indicate more than one option)*

- Publication of the scale with the scoring scale for each item.
- Further develop the information on what type of contributions correspond to each valued item.
- Add a FAQ section that includes examples of successful results in this first call.

*What aspects do you think should be modified in future calls to increase the participation of female researchers? (You can indicate more than one option)*

- Balanced assessment teams based on gender / sex of both its components and coordination.
- Put coordinators in the areas that least women have had a positive evaluation.
- Offer examples of successful contributions from female researchers.
- Use inclusive language.
- Set the guidelines for the scaling as much as possible and make them public.

*The results show that the percentage of women who have requested the transfer six-year term, as well as that of those who have obtained a positive evaluation, is lower than that of men. What, in your opinion,*



**Figure 2: Percentage of participants in the survey according to scientific area.**

*are the causes of the gender gap in these results? (You can indicate more than one option)*

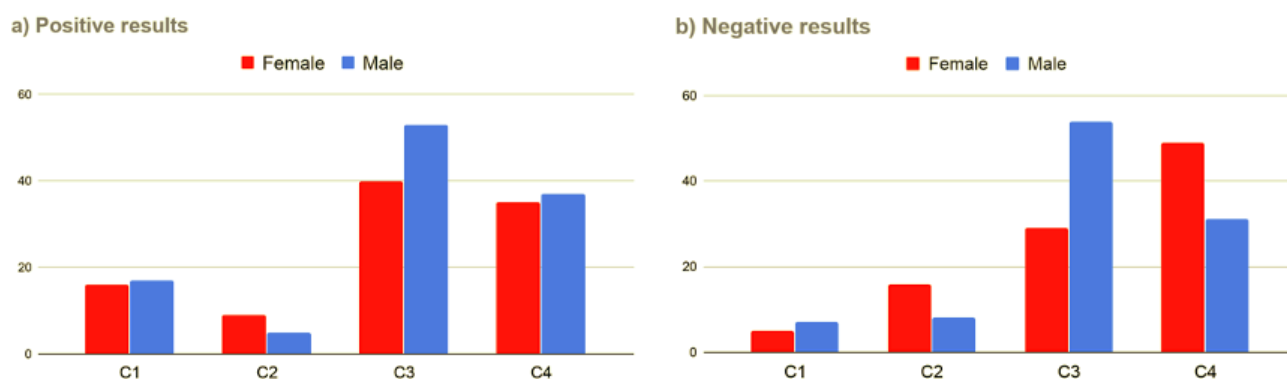
- Lack of training of evaluation teams in gender / sex analysis in research.
- Lack of gender / sex parity in the evaluation teams and in their coordination.
- Lack of clarity in the scaling criteria.
- Insufficient information on these six-year terms and their possibilities.

## 4 RESULTS OF THE SURVEY

A total of 513 (72 men and 441 women) replied to our survey. Despite the high research qualification of the people who participated in the survey, only 296, that is, 58% declared to have applied for the transfer of knowledge six-year term. Regarding the results obtained, less than half of the applications received a positive evaluation; specifically, 47% of those made by women and 55% of those made by men.

Figure 2 plots the different research areas of the researchers responding the survey: 8% corresponded to Arts and Humanities; 32% were from Engineering and Architecture, Health Sciences submitted 10% of the proposals, 29% were from Social Sciences and Law; and Sciences in General (Chemistry, Physics, Biology and Earth Sciences) submitted the 21% of them. As it can be seen, STEM areas were the best represented areas in the research collective replying to our survey; but in any case, the number of negative results was much higher than the positive results in all scientific areas.

The responses are studied in detail and the type of contributions is analysed according to the classification given by ANECA; i.e., C1: Transfer through the training of researchers; C2: Transfer of own knowledge through activities with other institutions; C3: Transfer generating economic value; C4: Transfer generating social value. Histograms in Figure 3 allowed us to clearly see that the most significant difference in the type of contributions between



**Figure 3: Type of contributions according to the classification given by ANECA, disaggregated by sex. a) Applications that have been evaluated positively, b) Applications that have been evaluated negatively.**

a positive result and a negative result was that submissions with a positive evaluation had a larger number of contributions with economic value, while submissions with a negative evaluation had a larger number of contributions with social value. On the other hand, Figure 3 shows that women presented more contributions of type C4 (Transfer generating social value) while men presented more contributions of type C3 (Transfer generating economic value). In this sense, it is important to highlight that type C4 contributions included many actions related to increase awareness of the lack of female students in STEM careers, or publications related to the small number of citations of female researchers in STEM related journals, or the effort made by researchers in participating in activities to highlight this reality (e.g. Girls day, Talent girl). All these activities are organized and carried out by female researchers, but the evaluation committees decided they did not have enough value as transfer of knowledge.

## 5 DISCUSSION AND CONCLUSIONS

The Spanish chart of research areas from the Ministry of Science, Innovation and Universities (as it was called when the evaluation program was launched. Now it is call Ministry of Universities) contemplates Transfer of Knowledge as exclusively related to Engineering and Technology areas [5], which are areas traditionally male-oriented [3, 7]. But this same manual clearly states that there exists a transfer of research and development that should go to the society, independently of the economic benefits. It seems that the Spanish call did not have this transfer of knowledge into account, and evaluators also dismissed this part of transfer of knowledge.

In the last years it has been observed that STEM areas have reduced the number of students [2, 8]. These areas always had a very low number of female students, and the general decrease will undoubtedly affect this number down. Several proposals have tackled this issue and several projects, at the national and international level, have been carried out, also in Spain. The main problem seems related to the lack of role models in the different study areas, but also in the transfer of knowledge to the society [6, 9].

Results from the questionnaire carried out by the authors with the help of other members of AMIT show that this is a reality and

very little concern has been generated in the spheres where these issues should be discussed at a decision-making level, as it looks like this kind of transfer of knowledge is not considered valid for a positive evaluation.

The Transfer of Knowledge six-year term evaluation that has been implemented for the first time by the Spanish Ministry of Universities has resulted in the most dramatic results. More than half of proposals were rejected (around 58%), but only 34% of the successful evaluations were submitted from female researchers. We have noticed that the number of positive evaluations is even lower when commissions applied a more rigorous criterion, which nobody knew, and finally resulted in very controversial outcomes. For example, we have found evidences that in some cases the same contribution submitted by two different researchers (e.g. co-participation in a project, co-editing of a publication) was evaluated with different criteria and, therefore, obtaining different score. This was not necessarily related to a gender issue.

There are several very worrying consequences of the results of this new Transfer of Knowledge evaluation. One very obvious is to know that Spanish researchers do not contribute in a positive way to the Science transfer of knowledge to the Society. Another one is the extremely low positive results of female researchers (27%). And another disquieting consequence, related to the issue tackled in this contribution, will be related to the loss of interest of (female) researchers in trying to bridge the gender gap in STEM areas. Data show that in the last years university students, male and female, are decreasing in number of scientific and technology degrees (STEM areas), but the number of the latter is even lower. From the comments included in the survey that we used to analyse the results of the Transfer of Knowledge evaluation, we had the occasion to confirm how several proposals, projects, publications, etc. . . dealing with this issue had been presented to the evaluation committee, but they were not accepted as quality transfer of knowledge.

The main problem of lacking female students in STEM subjects seems to be related to the lack of role models in the different study areas, but also in the lack of recognition of this kind of transfer of knowledge to society, that will lead to the loss of interest of the collective in charge of it; that is, the female researchers. This is a

reality, now once more put into evidence, but very little concern has been generated in the spheres where these issues should be discussed at a decision-making level. There are some good European examples that should be followed in preparing evaluation calls like the one discussed in the paper. European programs such as the Marie Skłodowska-Curie<sup>8</sup> have included very clear criteria when evaluating submitted proposals. The gender aspects should be considered in the proposals, when needed, and a transfer of knowledge should be evaluated as an impact of the research. The evaluation of the measures to exploit and disseminate the research results is focussed on: how the new knowledge generated by the proposed research will be realistically disseminated and exploited; what are the targeting audiences: scientific, industry and economic sectors, professional organizations, policy makers, and wider community. Only if applicable, the evaluation takes into account the potential commercialization of results. This evaluation protocol seems correct and straightforward.

The evaluation of the transfer of knowledge in the Spanish six-year term program, however, seems to have been based in random criteria, although it also seems that the high economic impact of the transfer to the economic sector could have been a priority. It seems that the evaluation committees did not take into account that it is very different to transfer results to the Pharmacy industry, for example, than to the construction and building sector, where companies try to get the transfer of knowledge with as little economic contribution as possible. However, to try to involve female researchers in general, and female students in particular in projects related to the construction and building sector is a very valuable transfer of knowledge, because such sector has been traditionally male oriented. The general suspicion is that those contributions that did not generate a high economic outcome were not considered as valid transfer of knowledge. Besides, the work done by female researchers to approach girls to Science and STEM matters in general, does not generate a direct economic value to compete with high-price projects presented mainly by the male scientific community.

To conclude with our study, it seems that the whole evaluation process was not mature enough to be implemented. The call was very intricate, criteria were not clearly specified, and evaluation committees were not trained about how to evaluate the criteria from the value of all the dimensions, including the gender dimension. This can be demonstrated with data, where evaluation with

exactly the same contributions received different results: sometimes one was positive and the other negative, or both negative but with very different results for exactly the same contribution. It has to be noticed that this random evaluation was not related to gender, as the erratic results were obtained by both male and female researchers but gives the impression of the same lack of objectivity and transparency of the subject.

If the evaluation process is not reviewed and shortcomings are tackled, researchers in general and female researchers in particular will tend to dedicate their efforts in more direct rewarding activities, like publishing in highly recognized journals. This activity will always be considered in the parallel evaluation process, the research six-year term, which has a more definite, transparent evaluation process. And all the efforts to bridge the gender gap in STEM subjects will be left behind.

## ACKNOWLEDGMENTS

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