

# Wisibilízas: Promoting the Role of Women in ICT Among Secondary School Students

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**Abstract:** Although technology comprises an important part of our daily life, no matter your gender, women are underrepresented in the overall sector of Information and Communications Technologies (ICT). Among several reasons, the recurring stereotype that male students are more suitable for technical studies is the one that stands out. In this context, and with the aim of breaking this stereotype, we introduce *Wisibilízas*, a contest addressed to high-school students to show inspirational women to young students, giving global visibility of female ICT professionals and making the students being in touch with technology. Participants have to create a website containing profiles of female ICT professionals. As a requirement, the chosen profiles must correspond to Spanish women who are currently developing their professional career. This way, we promote the active contribution that female engineers have in our current economy and society. 05 students in 15 different teams across Spain took part, creating 50 highly-diverse profiles of women in academia, industry or entrepreneurs, and with different levels of seniority. The contest achieved external impact in media and international recognition. Through some questionnaires, we could evaluate the positive impact of the contest in both students and teachers. The sample is equitable in terms of gender, what makes both girls and boys (and female and male teachers) talk about women working in the ICT domain. The results show the potential interest and relevance that the initiative can have in the educational system and, subsequently, a second edition has been launched.

**Keywords:** women in ICT, gender mainstreaming, education, contest, secondary school

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## 1. Introduction

Despite the increasingly ubiquitous presence of technology in all areas of our lives, the growing employment of women (65,5% in 2016 in Europe, the highest level ever recorded (European Commission, 2017)), the equal and / or higher enrolment of women in tertiary education in most developed countries (54,3% in EU-28, for instance (Eurostat, 2015)) and the good professional perspectives that STEM careers offer around the world, women remain significantly underrepresented in the overall ICT sector. This issue is becoming a growing concern for the main industrial, economic and social stakeholders, from different motivations, ranging from the overall shortage of professionals in the IT sector in most developed countries, the impact that the lack of diversity in the development of technologies may have in our daily lives, or the inequality that this lack of presence may create in a highly technological society.

Among the different reasons for this lack of interest, a large number of studies suggest that stereotypes associated to STEM careers have a strong influence in boys and girls from early ages (Cheryan, Siy, Vichayapai, Drury & Kim, 2011; Cvencek D, Meltzoff AN & Greenwald AG, 2011). Additionally, the fact that there are more men studying and working in STEM fields additionally contributes to the prevalence of gender stereotypes associated to this field as this lower presence may look even lower than it is in reality.

Girls and women are influenced by a number of social, cultural and economic factors, and the effect cannot be reduced to a single one. Studies suggest that stereotypes can have an influence in several different ways:

- Inspirational role models: the professional paths that girls and boys imagine for their future early in life, influence their choices as they progress in the educational system. More specifically, those educational systems where students already choose a specialisation in high school -typically humanities, arts and science-, strongly influenced by gender in the case of science (a comprehensive review is included in Osborne, Simon & Collins, (2003)). The lower visibility of women working in ICT creates less inspirational models for younger girls in the current society, where a large number of activities are associated to gendered roles.
- Abilities associated to disciplines and gender: Some studies suggest that gender distribution may be also linked to both the perception of the abilities required to succeed in that field (Leslie, Cimpian, Meyer,

Freeland, 2015) and the self-perception that children may have about their own abilities (Bian, Leslie & Cimpian, 2017). The studies suggest that the combination of both effects ultimately influences the choice.

- Unconscious bias: The general nature of unconscious bias is well understood, and its impact on women in roles traditionally held by men is highly prevalent and subject of increased attention by the research community, employers, educators and policy makers (Corbett & Hill, 2015). This bias, present in relatives, colleagues, teachers or work mates (irrespective of their gender) have as a consequence that girls are offered less opportunities for those roles (studying technical subjects, but also in other contexts such as leadership roles) than boys may receive (Moss-Racusin, Dovidio, Brescoll, Graham & Handelsman, 2012). Unconscious bias develops early in life (Dore, Hoffman, Lillard & Trawalter, 2014). Action is therefore needed not only for girls to fight those biases potentially affecting their lives, but also in preventing that both boys and girls further develop them, perpetuating them in future generations.
- Stereotype threat: Additionally, the performance-inhibiting effects of the psychological phenomenon known as “stereotype threat” affect women in those contexts where a social stigma exists, such as the ICT field (explicitly or implicitly, resulting from unconscious biases) and, more importantly, if the level of identification of the women with their gender is higher. It is also in this context where it is also important to highlight again the increased categorisation of objects (especially toys) by gender (Schmader, 2002; Spencer, 1999), which results in the reinforcement of this stronger association of children with their genders (and its associated effects).

In this context of gender bias, we launched WisibilíZalas (from the Spanish word *visibilíZalas*: “make them visible”). This consists in a contest aimed at breaking stereotypes and increasing the visibility of women among secondary school students. Thus, WisibilíZalas fights against the lack of female presence in textbooks, especially women in ICT.

## **2. Existing initiatives**

Several number of initiatives are carried out worldwide to support female professionals, such as the well-known Association for Women in Computing (founded in 1978) (ACM 2018), the Anita Borg Institute (originally Institute for Women and Technology) (ABI 2018) and the National Center for Women & Information Technology (funded in 2004). More recent initiatives, such as Girls Who Code (GWC 2018) or she++ (SHE 2018), both founded in 2012, are shifting the focus from supporting female professionals to bringing more women to computing. Women Techmakers (WTM 2018) provides also different resources, such as scholarships for women in ICT.

However, less initiatives are addressed to break the stereotypes and promote role models among secondary school student. In Spain, two initiatives targeted secondary school students by means of regional contests in which the students had to create wikis containing information about given and well-known role models in ICT [11, 12].

To the best of our knowledge, WisibilíZalas is the first initiative, at a national level, in which the students should investigate to find current women (not always famous) working in ICT in Spain.

## **3. Objectives**

The objective of WisibilíZalas is breaking the stereotypes associated to women in ICT among young students. For this purpose, we define the following objectives:

- Objective 1: Show the incredible role of women in ICT to high-school students and teachers. As most of the names commonly used for inspiring girls belong to women from the last decades (e.g.: Grace Hopper, Anita Borg, Hedy Lamarr...), we aim to make visible the *current ICT Spanish women*, who can act as more modern and closer models for young students. We measure the impact of the contest in students and teachers by means of some questionnaires.
- Objective 2: Global visibility of the profiles. We aim to show the received profiles to also non-participants, in order to increase the impact of the contest.
- Objective 3: As a side effect, WisibilíZalas also promotes ICT among students and teachers.

## **4. Activity description**

In the 1st edition (launched in 2016), we accepted for participation mixed-gender groups of up to 10 students supervised by one teacher. They had to develop a web site in a format and platform that they chose (although

we recommended Google Sites, for its simplicity) containing profiles of Spanish women currently working in ICT that:

- are well-known and have demonstrated a brilliant path in their careers,
- or even if they are not famous by their work, they are known by or close to the participants.

The teams could use online material to develop their web sites, but new content and personal interviews with the candidates were considered for higher valuation. In line with the second objective of the contest and in order to facilitate the inclusion of the new content in Wikipedia, pages following Wikipedia format were given extra points.

For the evaluation of the received websites, we built a committee composed by 2 members of the organisation, 5 representatives of the sponsors and 2 experts in Wikipedia. The first 7 evaluators had to consider the aspects such as the number of profiles edited, the use of multimedia content, interviews with the candidates and website design. The Wikipedia experts evaluated if the structure of the website fit the Wikipedia format.

## **5. Analysis of compliance of Objective 1: Show the incredible role of women in ICT to high-school students**

In the first edition of the contest, 20 teams were registered, but we only considered 15 for evaluation, as the other 5 did not submit the URL of the website on time. These 15 teams corresponded to 105 students from 10 different schools from the whole Spanish territory. The average number of components of the groups was 7 and the 65% were female students. Note that some teams include students from different educational levels, being the most frequent one the 1st year of Baccalaureate.

Students developed 50 profiles corresponding to 31 Spanish female professionals working in ICT. Some of them working in Academia, others in top positions of prestigious companies such as Google, IBM or Microsoft and others leading their own start-ups.

In order to evaluate the impact of the contest in the knowledge about female profiles in ICT, two specific instruments were designed, one for teachers and one for students who participated. Both instruments were online supported by Google Form. With the aim to compare the perception of both teachers and students, both surveys had some questions in common and others were specific for each collective. The questions considered in surveys were focussed on motivation, satisfaction, perception of impact regarding the main topic (Women in ICT), etc.

The following sections detail the content of each designed instrument, the samples and descriptive data, as well as the most qualitative assessments provided by the participants. Note that both instruments were anonymous and written in Spanish.

In order to facilitate the reading and understanding of the results, the results obtained by teachers and students are presented separately. At the end of this section a general analysis is presented.

### **5.1 Population and sample**

The population was formed by a total of 10 teachers and 105 students (115 subjects in total). The sample corresponds to the 100% participation by the teachers and 36.2% in the case of the students. The sample size was  $n = 38$ . Over the whole population (115), the overall sample that brings together teachers and students represents 41.7%.

### **5.2 Instruments for the evaluation**

As it has been advanced before, two different instruments were designed targeting teaching staff and students. However, the variables of interest that have motivated the items of both instruments are shared in most cases, so they are presented together.

Both instruments collected personal data (age and gender) and their motivation to participate in the contest. The fourth item consisted of a table with a total of 7 statements (in the case of teachers) and 8 statements (in

the case of the students) on which they should indicate their level of agreement using a scale of 1 to 4 (being 1 the minimum level of agreement and 4 the maximum).

These statements are related to the impact of their participation in the contest considering the following elements:

- Facilitation of a critical reflection and awareness among young people on the topic of women and science / technology.
- The perception of support, follow-up and dissemination by the institution / colleagues regarding the participation in the contest Wisibilíazalas.
- Assessment of the experience both from the point of view of teaching and student and micro-dissemination.
- Perception and self-perception of real impact on the attitude and knowledge of young people regarding the topic of women and science / technology.
- Promotion of the competition among other centres / colleagues.

We also added two open fields in which we asked them about a) a description of what they perceived as strengths of the contest and their participation and b) comments focused on contest improvement for future editions. Finally, we included a section in which they could write other comments or suggestions.

### 5.3 Results

This section presents the results obtained in the evaluation of satisfaction and impact. Since the results come from different groups (teachers and students), they are presented in separate sub-sections and subsequently followed by a global analysis.

#### 5.3.1 Teachers' feedback

At the sample's descriptive level, we got the fully participation on the evaluation process (100%). The average age of the teachers is 43 years old and the gender distribution observed is 50% men and 50% women.

Regarding the motivation to participate in Wisibilíazalas, the participants expressed elements related to:

- Awareness raising and interest in raising awareness among young people about the topic (women and ICT) - 70% of the comments collected.
- They consider the contest as a modern initiative and close to issues handled in the classroom - element highlighted by 20% of participants.
- "I was encouraged by a colleague of the school" - which accounts for the remaining 10% of cases (1 case).

**Error! Reference source not found.** contains the statistics of the 7 statements related to the impact of participation. We remark that the scale to indicate the degree of agreement with the statements was from 1 to 4 (1: minimum agreement; 4: maximum agreement). For each statement we report the average, the standard deviation and the mode.

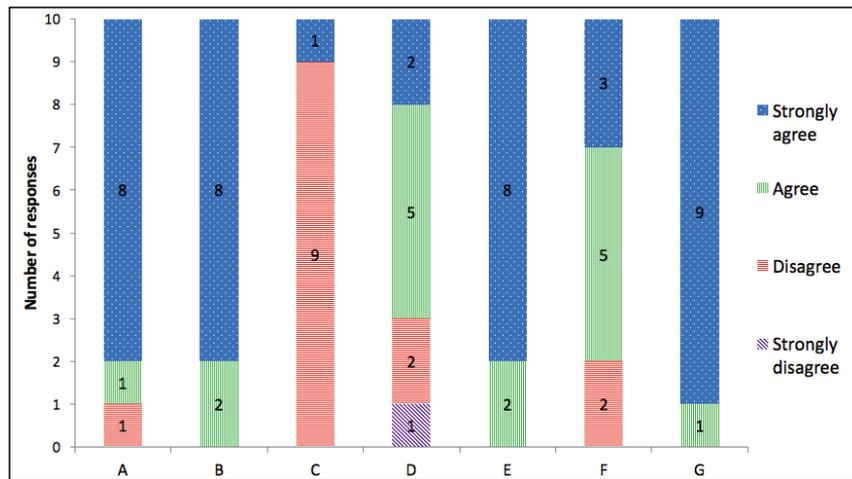
**Table 1:** Teachers' feedback: statistics of the statements related to the impact of participation in the contest

Item	Average	Standard Deviation	Mode
I believe that actions such as the Wisibilíazalas contest help young people to reflect on social issues such as the role of women in science and technology	3,7	0,67	4
I'm glad that my school got involved in the contest	3,8	0,42	4
My colleagues have been concerned about our participation in the contest (showing interest)	2,2	0,63	2
My institution has promoted our participation in Wisibilíazalas	2,8	0,92	3
I really think that this experience has a positive value for both me and my students	3,8	0,42	4

Item	Average	Standard Deviation	Mode
Since we participated in Wisibilízalas I have observed that there is a greater sensitivity and more careful attitude regarding gender issues	3,1	0,74	3
I will recommend to my colleagues and other institutions the participation in the contest	3,9	0,32	4

As it can be seen in Table 1, the average value for the 7 items was above 3/4 in all cases, except for the two items related to the perception of support, follow-up and dissemination of the institution and colleagues about the participation on the contest. Note that the item D has a deviation of more than 0.90 points, being the most heterogeneous item. For the two items related to the impact of participants in issues related to awareness raising, reflection and critical attitude on the topic "women and ICT" (items A and F), we got the average values: 3,7/4 and 3,1/4, getting both items a standard deviation under 0,75 points, and the mode 4 (item A) and 3 (item F). In terms of global satisfaction with their participation in the contest (items B and E) as well as the item related with whether they would recommend participation in the contest to colleagues from other institutions (item G), the highest average values are observed (between 3,8/4 and 3,9/4), with the lowest standard deviations (between 0.32 and 0.42 points). In those three cases the mode is 4/4.

Next, Figure 1 presents the distribution of the level of agreement for each item considered.



**Figure 1:** Teachers’ feedback: distribution of the level of agreement for each item in the evaluation

Regarding teachers’ qualitative comments, the elements highlighted in terms of relevance and impact, are mainly focused on the involvement and interest generated among the young participants (50%), the impact between these and other young people with whom the experience was shared directly or indirectly (40%) and the external appreciation/recognition -not only for the awards itself but at also the one received by colleagues, institution or society- (30%).

Regarding the suggested improvements, the most frequent item (by 30% of teaching staff) was the dissemination of the contest. The organization is encouraged by teachers to increase the dissemination strategy using other channels such as the email.

As a general comment, teachers explain the added value of participation in Wisibilízalas due to the technological impact it has had on students (learning or improving the use of ICT) as well as in other kind of transversal competences such as critical thinking skills, social responsibility and teamwork.

### 5.3.2 Students’ feedback

At the sample’s descriptive level, we got a students’ participation of 36,2% (38 students out of 105 enrolled in the contest). The average age of participants is 15 years old and the gender distribution of the participants in the questionnaires is 58% female and 42% male.

Regarding the motivation to participate in the contest, the students expressed elements related to different topics that are presented below. We note that 34 answers were collected. Among all answers, the one related with the interest on the topic (Women & ICT/Science) is highlighted. More details are given below:

- The idea of getting to know relevant women in ICT was motivating and interesting; the work methodology and its link with technology were also elements that helped in generating interest from the 62% of the participants.
- In the 14.7% of the cases, the motivation is mostly external, since the competition was part of the curriculum and with the same percentage (14.7%), the participants state that they were encouraged by the teachers. Thus, external motivations of a more academic nature count for 29.4% the answers collected.
- The 3% of the students were motivated by the awards.
- 3% of the students were motivated by sharing experiences with students and by the objective of the contest.
- The last 3% showed no specific reason to participate.

Table 2 contains the concrete statistics measures of the 8 statements related to the impact of participating in the contest regarding different items. We want to note that the scale to indicate the degree of agreement with the statements was from 1 to 4 (1: minimum agreement; 4: maximum agreement). For each statement we report the average, the standard deviations and the mode.

**Table 2:** Students' feedback: statistics of the statements related to the impact of participation in the contest

Item	Average	Standard Deviation	Mode
I believe that actions such as Wisibilízalas help young people to reflect on social issues such as the role of women in ICT	3,50	0,51	4
I'm glad that my school got involved in the contest	3,61	0,55	4
I've talked about my participation in Wisibilízalas with my family and friends	2,89	1,01	4
Before participating in Wisibilízalas I would NOT have been able to cite 3 women professionals in the field of ICT	3,08	1,08	4
Now I would be able to cite, at least, 3 women professionals in the field of science and technology	3,53	0,73	4
Since I participated in Wisibilízalas I feel that I have greater sensitivity and I am more careful regarding gender issues	2,63	1	3
Since I participated in the contest, I have perceived (small) changes on my colleagues and teachers attitude/habits in gender issues	1,89	0,92	1
I will recommend to my colleagues and other institution the participation on Wisibilízalas contest	3,31	0,89	4

As was comment in teachers' feedback section, the items presented in this question respond to several dimensions included in section 4.2.

Item A has obtained an average score according to the agreement level of 3.5/4 with the lowest deviation of the set of statements raised, which indicates a high degree of homogeneity in the responses. Analysing the items regarding perception and self-perception of real impact on the attitude and knowledge of young people regarding the topic of women in ICT/science (items D, E, F, and G), we see that items D and E are directly related with the learning of participants through a clear question of content. The results obtained reflect that the impact is actually perceived and therefore, they confirm the knowledge achieved with respect to female professionals in the field of ICT. The other two items (F and G) were included in the instrument to see how deep and significant was the impact on participants' learning, going beyond the contest itself. In both cases the average is lower and deviation higher, so it can be understood as a sign of dispersion among the total of participants. Then, we can conclude that the level of impact in their learning about the topic (women & ICT/Science) could be quite different depending on the student. Note that the mode for item G is in the lowest value of the scale (1/4), what means that the majority of the participants do not agree with the perception of changes of attitude in both peers and teachers on gender mainstreaming after participating in the contest. On the other hand, the same statement concerning oneself gets an average value of 2.63 / 4 and a fashion of 3/4.

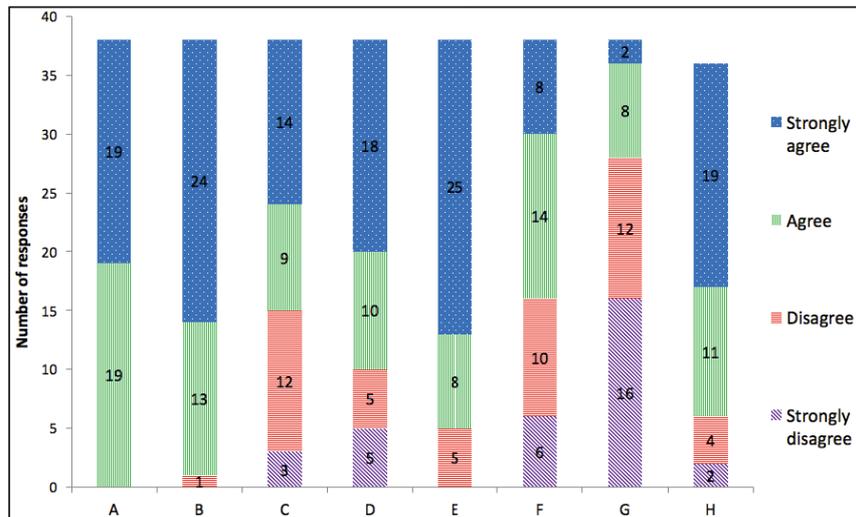


Figure 2 presents the distribution of the level of agreement for each item considered.

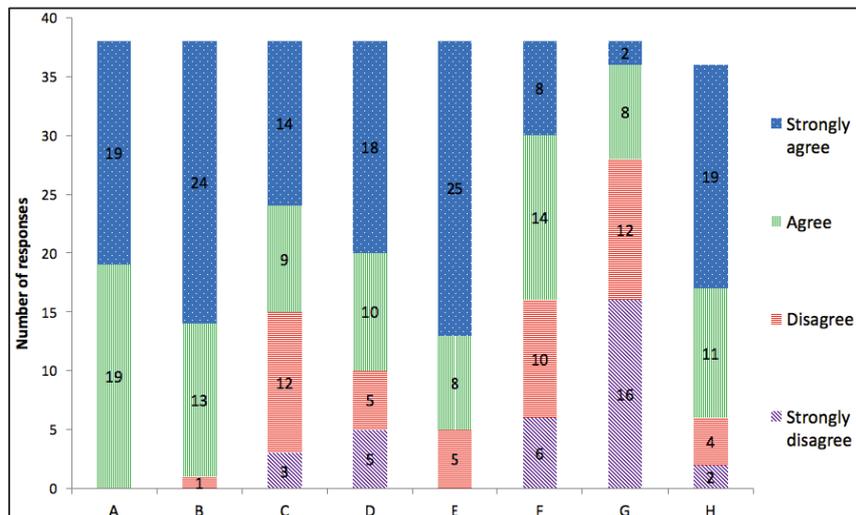


Figure 2: Students' feedback: distribution of the level of agreement for each item in the evaluation

Concerning the items related to participants' general satisfaction and the one regarding if they will recommend the participation in the contest to their friends (items B and H), the average values are higher than 3.3/4. In both cases the mode is 4/4 and the deviation has a low value.

Finally, in terms of the dissemination they could have made during their participation in Wisibilízalas contest (item C), an average value of almost 2.9/4 and a considerable deviation (1.01) were observed. The mode value is located on the highest level of agreement (4/4). Considering the three elements, we can conclude saying that there have been participants who have shared their experience with regularity / intensity with their family and friend environment and others who have done just a little or nothing.

The survey included a qualitative open question focussed on the most valued items by participants and the least liked as well. In both sections, we ask for three elements but during the data analysis we detected some participants that they didn't answer to these items and other which they don't said three elements, concretely the item related with the aspects they like the most was answered by 32/38 participants and the one related with the aspects they like the least was answered by 10/38 participants. Regarding the most valued elements by the students, 25 participants highlighted the topic of the initiative and its objective: to give visibility to relevant women in the scientific and ICT field, as well as the tasks implicit in the participation in the contest (researching,

meetings and talks with relevant women). Secondly, with 14 records (18%), they highlight the fact that this was a group activity that allowed them to interact, collaborate and strengthen links with their colleagues. The third most valued element by the students was the impact on their own learning as well as on their social interactions. The fourth element to highlight is the fact of participating in a contest (emotion, experience). Regarding what they least liked or suggested improvements, a single comment appeared with frequently higher than 1, referring to the management/logistics/help to attend the awards ceremony.

Finally, and as global feedback, a total of 12 records have been collected that refer to different aspects. The most frequent element highlighted as a positive point - also present in the section designed for it - was the fact of creating a web with content of interest both in a personal and social level (58% of participants). They also noted how beneficial and satisfactory was to work as a team (50% of the participants). The general satisfaction of having participated in the competition (experience) appears in 25% of the registrations. Finally, two participants referred to the prizes in their global comments, one of the cases regarding their satisfaction with them and in the other case proposing an improvement.

#### **5.4 General results regarding objective 1**

Here we point out some coincident elements in the results of the evaluation carried out with both teachers and students.

- Regarding the motivation to participate in the contest Wisibilízalas, both teachers and students highlight elements of personal / intrinsic motivation, specifically 70% in the case of teachers and 62% of cases in the student body.
- In terms of the impact and perception of the impact on their learning after their participation in Wisibilízalas, average and standard deviations of both teachers and students indicate a positive perception.
- We would like to note that, for both teachers and students, the participation in the contest has been a positive experience. In general, they would recommend the participation in Wisibilízalas to their peers and colleagues.
- As a transversal and common element in both teachers and students, they cite the value and importance of teamwork as well as the fostering of technological skills during the participation in the contest Wisibilízalas.

#### **6. Analysis of compliance of objective 2: Global visibility of the profiles**

In order to accomplish the second objective of Wisibilízalas, if some of the received profiles are not still included in Wikipedia, we are in the process of creating new pages for them with the collaboration of Wikimujeres (<http://wikimujeres.wiki/>). This non-profit organisation launches wiki marathons to add new content to this encyclopaedia in order to reduce the gender bias in Wikipedia (Graells-Garrido, Lalmas & Menczer, 2015).

Also, we created a Wisibilízalas profile in two different social media platforms: Twitter and Facebook. Through these channels, we broadcast info about the contest, news or posts about women in ICT and any other content to promote women in ICT.

Analysing the followers of both Twitter and Facebook profiles, it is clear the success getting global visibility of women in ICT. Regarding gender, most of our followers are female (71% Twitter; 79% Facebook), which is precisely the audience we want to target. The contest was launched for secondary-school students (less than 18 years old), but we could see that we are also reaching readers from all the age ranges, especially those from 25 to 54 (87% Twitter, 85% Facebook). This age range is key as most of these people might be teachers or parents that can act as a clear influence for children.

Regarding geographical visibility, the impact in the whole territory of Spain has been attested by the groups participating in the contest. However, Wisibilízalas profiles in social media also registered interest from other 13 countries, specially United Kingdom, by representing the 6% of the Facebook audience of our profile.

#### **7. Analysis of compliance of objective 3: Promote ICT among students and teachers**

As students had to develop a web page, both the students and teachers had to learn and show their skills in web development. Also, the prizes we gave to the finalists consisted on 3D printers and technological games

(<http://www.makeymakey.com/>) that allow students to stay in touch with technology and discover that ICT can also be used for entertainment.

## 8. Conclusions

The Wisibilízalas contest was launched as a tool to break the stereotypes associated to gender in technology. On one hand, this contest increased the visibility of female inspirational models among secondary-school students. By the active work of (male and female) students in the identification and description of female experts in ICT, Wisibilízalas directly fights unconscious biases present (or under development) in them (objective 1). We could also reach the teachers, relatives and, via the general dissemination of the objectives and results, the general society (objective 2).

On the other hand, the evaluation of this first edition showed a positive impact in both students and teachers, not only in empowering women in ICT, but also in the use of technology (objective 3).

Finally, the results showed the potential interest and relevance that the initiative can have in the educational system and, subsequently, a second edition has been launched.

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