

Nomination of the Girls4STEM project at the School of Engineering of the University of Valencia for the 2021 Minerva Informatics Equality Award

Head of the nominated School: José Rafael Magdalena Benedicto (etsedireccio@uv.es)

Nominator: Silvia Rueda Pascual (silvia.rueda@uv.es)

The nomination can be considered as a runner up.

A brief summary

The School of Engineering of the University of Valencia (ETSE-UV), Spain, has been actively working since 2011 towards decreasing the gender diversity gap in STEM disciplines. Its program encompasses Bachelor, Master and PhD levels and it works around four main actions: i) Providing institutional encouragement and support; ii) increasing the professional support network; iii) promoting and supporting the leadership; and iv) increasing the visibility of female role models. This program has evolved into the Girls4STEM project, which started in 2019, with the objective of reaching primary students and their families, given visibility to the contributions of women in STEM fields.

Description of the initiative

The School of Engineering from the University of Valencia (ETSE-UV), Spain, through its role as a higher education institution covering undergraduate, master, and PhD levels, can tackle the gender gap problem in STEM mainly from two directions. First, promoting the interaction with secondary schools (fighting stereotypes via establishing female role models) and second, retaining and engaging female students accessing the studies. One seminal component of the ETSE-UV's pilot program is the transmission of the opportunity offered by STEM disciplines for achieving a communal goal. In fact, we believe that highlighting the final link to people is fundamental to engage female students, as pointed out by the literature review on the topic.

The program developed by the ETSE-UV since 2011 is aligned with some of the directions proposed by the UNESCO in 2017, such as the extra-curricular student engagement, the mentorship, and female role models. As this report points out ("Cracking the Code: Girls' and Women's Education in Science, Technology, Engineering and Mathematics (STEM)"), promoting more female role models in STEM fields (increasing the number of female students and faculty members in higher education), is mandatory to attract women and girls to STEM fields. Therefore, four main actions have been implemented at the ETSE-UV: i) Providing institutional encouragement and support for the students; ii) increasing the professional support network after graduation; iii) promoting and supporting the leadership for faculty staff; and iv) increasing the visibility of female role models. These four actions have been developed through the implementation of several activities, both taking place at the ETSE-UV facilities and outside the School. A description of the activities, their link to the literature of the topic, as well as references to parallel initiatives and an exploratory analysis of the results (detailed for each one of the offered degrees) can be found at (<https://www.mdpi.com/1099-4300/21/1/30>). This preliminary assessment confirms that the ETSE-UV's pilot program is contributing in part to reduce the school's gender gap. However, in 2019, the Girls4STEM project has been launched as an umbrella covering and extending the current working program. Basically, the need to reach younger girls (under 15) and to reinforce the interaction with the ecosystem surrounding them (families, school, friends) was put forward. In the following, we introduce and discuss the Girls4STEM initiative.

Literature on the topic indicates that one strategy to increase the student's interest in STEM is to create informal learning environments. However, evidence also indicates that outreach activities have a lower impact on girls unless they open the possibility for the girls to visualize



themselves in the role. Recently, Diekman et al. (2019, <https://doi.org/10.1111/sipr.12052>) have proposed a framework to classify social psychological theories focusing on the incongruities that contribute to the gender gap in STEM: dissociation between STEM contexts and women, and the lower expectancy-value theories. The authors extract a common ground model with three main strategies (to challenge stereotypes, to align with values and to promote growth of attitudes) and identify two intervention tactics, including the arrangement of activities with speakers from a broad range of identities, to highlight the societal impact of their work. This intervention tactic is the Girls4STEM's cornerstone activity. The project has been conceived as an extension of the ETSE-UV's pilot program, covering and extending the activities that started in 2011. Basically, the main difference is the extension of the targeted audience by covering a broader range of pre-university ages (from 6 to 18 years old), as well as their environment (family, teachers/professors). The project is supported by many actors (public institutions, regional entities, companies, and professional entities) and it builds from the interaction between female STEM experts and the participating students. The specific objectives are defined as follows: 1) Promote STEM vocations; 2) Seek the active participation of several actors: students, families, teachers, professional entities, and companies; 3) Increase the visibility of scientific STEM advances and connect them to their societal value; 4) Increase the visibility of female STEM researchers and professionals' contributions.

Two main kinds of events are planned, differentiated according to the targeted audience. On the one hand, there is a set of sessions for the pre-university students and their families ('Girls4STEM Family'). Before these sessions, students and their teachers should choose one female STEM expert based on a short biography available on the project website (these experts are collaborators of the project). The request is made through a form prepared on the website and once the experts have been assigned to the schools, the students interact with the expert in several possible ways: by visiting her workplace, through a videoconference or meeting the expert in their school or high school. The students should take notes and prepare material for a three-minute video long and when possible, for the realization of a Wikipedia page about the expert to give visibility to her work. The objective is to provide real contact with a female STEM referent and allow students to prepare questions about her professional career, the reasons that led her to choose a degree in the STEM field, the advantages, and possibilities of a career in this area, the obstacles she faced, etc. All this work will be exhibited in a 'family' session where students and teachers from different centers and their families will enjoy a morning session in a leisure environment sharing knowledge about the STEM area. On the other hand, the second set of sessions ('Girls4STEM Professional') targets an adult audience, mainly professionals and teachers. In this case, a group of 4 female STEM experts gives a talk with the aim of including the gender perspective into the research and professional environments, rising awareness of the gender gap. Since the talks are given out of school hours, the teachers attending these sessions (Family or Professional) are given a certificate by the Educational regional entity participating in the project. All the information regarding the STEM experts, the participating schools, the videos, the biographies, and the conferences is published via the project's website and the social media profiles.

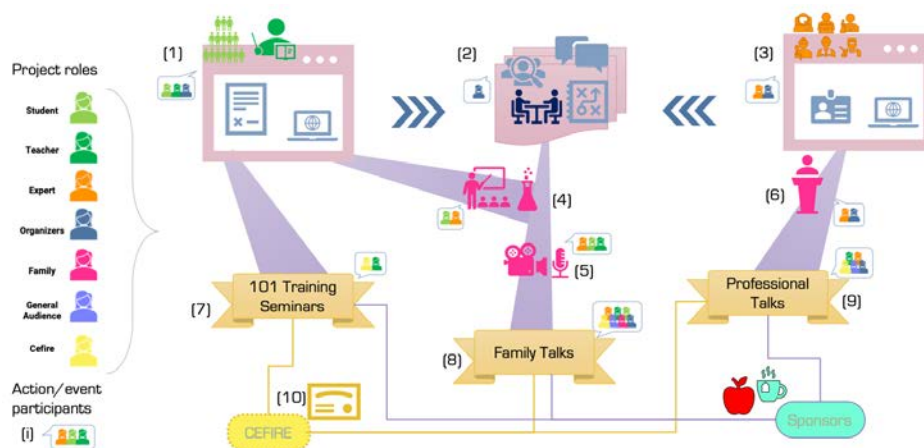


Figure 1: Main activities and roles in Girls4STEM project implementation

Evidence of its impact

A detailed analysis of the ETSE-UV pilot program and the Girls4STEM project can be found in:

- Publication 1: <https://www.mdpi.com/1099-4300/21/1/30>,
- Publication 2: <https://ieeexplore.ieee.org/abstract/document/9137264>,
- Publication 3: <https://www.mdpi.com/2071-1050/12/15/6051>.

Now we give a short overview of the main impact of both the pilot program and the Girls4STEM project. The ETSE-UV offers the Engineering studies of the University of Valencia, that is, Chemical Engineering, Computer Science Engineering, Industrial Electronic Engineering, Multimedia Engineering, Telecommunications Electronic Engineering, Telematics Engineering, and Data Science. The School offer is focused on Engineering studies, but the degrees cover several core STEM subjects (Chemistry, Mathematics, Physics, Informatics, Electronic Engineering and Telecommunication).

We start by assessing the percentage of female students in computer science related undergraduate programs. Following the Spanish Ministry of Education classification, the ETSE-UV's data for Computer Science Engineering and Multimedia Engineering has been aggregated. Note that all the data are publicly available. Fig. 1 shows the evolution in the percentage of female students both at the ETSE-UV and Spain (lines, left axis) and in the total number of students (bars, right axis) for the aggregated fields '06 - Informatics' and '071401 - Computer Engineering'. In the ETSE-UV's case, data is aggregated for Computer Science Engineering (Pre-Bologna, 5 years), Computer Science Engineering, Multimedia Engineering and Data Science (Bologna-compliant, 4 years). Note that Data Science is a degree that started in 2018-2019. Results show that the percentage of female students at the ETSE-UV was below the Spain's average at the beginning of the period. However, it has been steadily increasing until a difference of almost 7% in average (13,80% Spain, 20,36% ETSE-UV) has been reached.

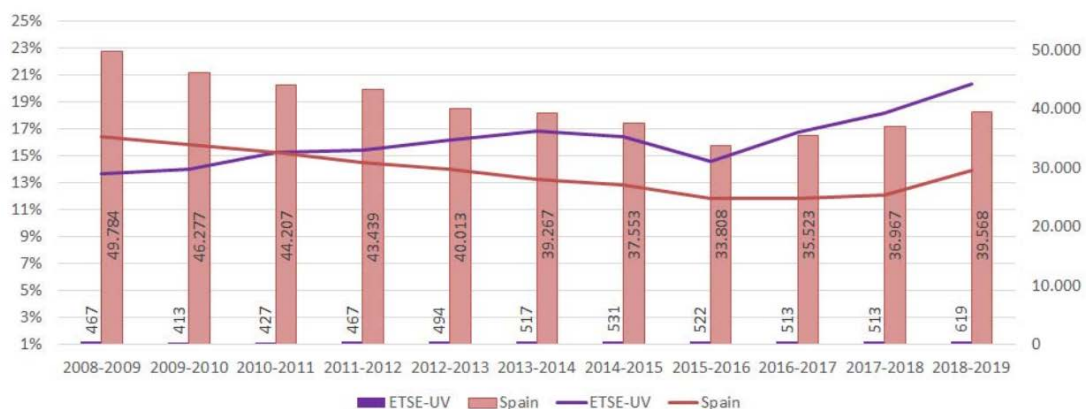


Figure 2: Percentage of female students at the ETSE-UV vs. total number of students (undergraduate). Spain's situation is used as a benchmark. Aggregated

A logistic regression model has been considered in order to test whether the program had an effect (at 0,05 significance level) in the proportion of registered female students at the ETSE-UV. The available data has been divided in a pre-period between 2008-2009/2012-2013 and a post-period between 2013-2014/2018-2019. Fig. 2 shows that there has been a significant effect of all the elements (gender, program, fields) of the model. In particular, the proportion of female students at the ETSE-UV has increased in the post period for the aggregation '06 - Informatics' and '071401 - Computer Engineering', as well as for the field '071405-Electronic Engineering', but it has decreased in the field '071101 - Industrial Chemical Engineering'. To understand the magnitude of the effect, we can analyze the change in the ratio women-to-men, what is also known as the Odds Ratio (OR). For the aggregation '06 - Informatics' and '071401 - Computer Engineering' the increase is a 17%, going from 1 in 6 to 1 in 5.

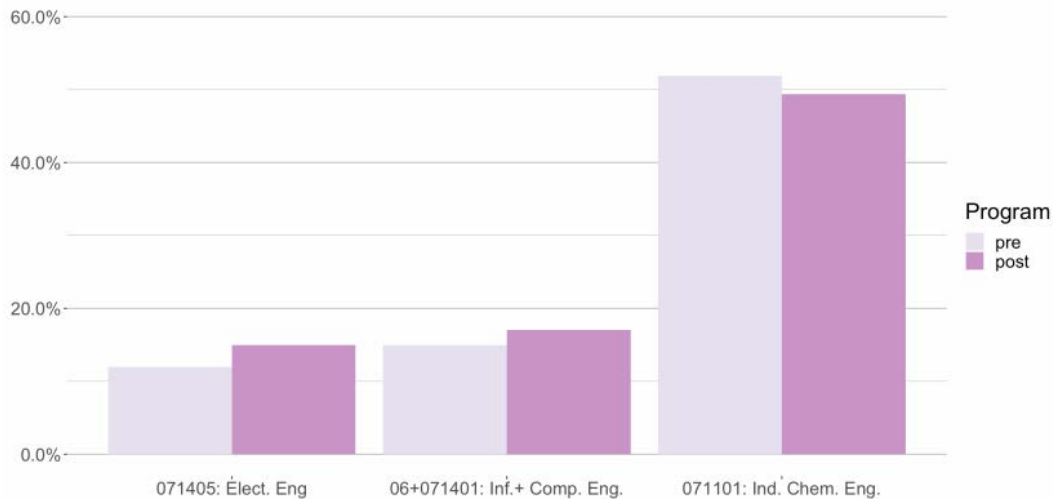


Figure 3: Pre-post proportion of women in the three fields of study at the ETSE-UV.

Regarding Girls4STEM project, currently, the second edition is just ending with the final Family session. In the first edition (2019-2020), 10 schools participated in total with around 400 students involved. In particular, 75 students from primary (17%), 311 from secondary (first and second cycle) (71%), and 9 from professional studies (2%), with 56.7% of them being women. The Professional Talks were attended by a total of 414 people, 56% of them being women. Interestingly, around 33% of the attendees were professionally related with education. The data gathered in this first edition allowed us to assess aspects related to the perception of STEM disciplines or student's self-efficacy in STEM (see Publication 3). As an example of these results

In the second edition, the project has slightly changed the format to adapt to COVID-19 special measures, so most of the activities are now on-line. Despite the difficulties that schools are facing, 8 schools managed to finish this edition and more than 300 students have participated, mostly from secondary education. To date, 9 Professional and 4 Family Talks have been developed, to which must be added the Family talk scheduled for June 19, 2021.

The Professional Talks have been attended, in person and or virtually, by more than 800 people, of which 56% were women. It is noteworthy that 33% of the total attendees were professionals related to education. This data indicates that the Professional Talks are interesting not only for the teachers of the centers who want to participate in the project, but also for a wider audience.

Regarding the number of current registered experts (May 29, 2021), the database of STEM experts registered in the project includes more than 150 women, with very varied profiles and jobs, as can be seen in the project website (www.girls4stem.es).

To this direct impact, it must be added the impact through social networks and the media. The videos on the project's YouTube channel add up to a total of 3,500 views and the project currently (May 29, 2021) has 1900 followers on Twitter, 685 on Instagram and 241 on Facebook, which add up to more than 6000 direct audiovisual audience impacts.

The program also includes gender perspective training for professors. In this sense, in January 2020 the first course was organized, and the second edition is scheduled to be organized between July and September of this year.

Reference list and URLs of supporting material

Letters of Support

- [1] [Letter from female students](#) participating in Girls4STEM first edition.
- [2] [Letter from Autonomic Secretariat of Education of Generalitat Valenciana](#) supporting the creation of Girls4STEM project.

Scientific publications collecting the evidence (Publication 1-3)

- [3] <https://www.mdpi.com/1099-4300/21/1/30>
- [4] <https://ieeexplore.ieee.org/abstract/document/9137264>
- [5] <https://www.mdpi.com/2071-1050/12/15/6051>

Girls4STEM webpage

- [6] <http://www.girls4stem.es>

Girls4STEM Social networks

- [7] Twitter: <https://twitter.com/Girls4STEMVLC>
- [8] Facebook: <https://www.facebook.com/Girls4STEM/>
- [9] Instagram: <https://www.instagram.com/girls4stemvlc/>
- [10] YouTube channel: <https://www.youtube.com/channel/UCz-leOykkPlhxzKhNkOwfwg>

News and media articles

- [11] October 2, 2019 - Article in Diario Feminista: <https://eldiariofeminista.info/2019/10/02/entrevista-a-silvia-rueda-ingeniera-informatica-impulsora-de-la-iniciativa-girls4stem/>
- [12] October 22, 2019 - A Punt TV #LesNotíciesDelMatí <https://twitter.com/apuntnoticies/status/1186535452712538112?s=20>
- [13] February 11, 2020 - A Radio TV #AIRas <https://apuntmedia.es/va/a-la-carta/programes/escoltat-en-la-radio/al-ras/11-02-2020-al-ras-primera-hora>
- [14] May 20, 2020 - TEDxValènciaSalon <https://www.youtube.com/watch?v=Sy6pTNI091k>

Examples of dissemination carried out by public and private entities and non-profit initiatives supporting the project:

- [15] <https://www.coitcv.org/blog/2019/10/23/proyecto-girls4stem/?lang=es>
- [16] <https://www.coicv.org/actualidad/noticias/2869-presentacion-del-proyecto-girls4stem>
- [17] <https://acpv.cat/2020/01/30/databeersvlc-programa-un-especial-dona-i-ciencia-dedicat-a-mary-jackson/>
- [18] <https://www.uv.es/uvweb/unidad-igualdad/es/novedades/universitat-valencia-presenta-proyecto-girls4stem-1285923358637/Novetat.html?id=1286100250815>
- [19] http://jardibotanic.org/?apid=actes_i_activitats-42&id=1681#.YCT0tGgzY2w
- [20] <https://portal.edu.gva.es/cefireambientcm/es/2019/12/16/proyecto-girls4stem/>
- [21] http://mecenatge.gva.es/es/proyectos-i-activitats-cientifiques-d-interes-social-a-la-nostra-comunitat/-/asset_publisher/172tMyBqeWmq/content/universitat-de-valencia-girls4stem
- [22] <https://appi-a.com/blog-appi/page/3/>
- [23] DatabeersVLC: <https://www.facebook.com/databeersvlc/?tn-str=k%2AF>
- [24] 11 de febrero (<https://11defebrero.org/2019/12/08/girls4stem/>)
- [25] Son Pioneras (<https://www.sonpioneras.es/girls4stem/>)
- [26] ACM-W UPV: (<https://www.inf.upv.es/www/etsinf/es/myt-2019-i-foro-upv-sobre-mujeres-y-tecnologia/>)
- [27] STEM Women: <https://stemwomen.eu/girls-4-stem/>
- [28] FINDING ADA: <https://findingada.com/> <https://findingada.com/event/online-girls4stem-talks-with-4-women-in-stem-2/>
- [29] SEDOPTICA-MOF: <https://areamujersedoptica.wordpress.com/2021/01/21/feminismo-y-stem-tejiendo-redes-en-la-red/>