

# Visibilising women in technology: Strategies for working in Telecommunication Engineering

Ana M. Barbancho  
Universidad de Málaga  
ATIC Research Group  
Málaga, Spain  
abp@ic.uma.es

Isabel Barbancho  
Universidad de Málaga  
ATIC Research Group  
Málaga, Spain  
ibp@ic.uma.es

Lorenzo J. Tardón  
Universidad de Málaga  
ATIC Research Group  
Málaga, Spain  
lorenzo@ic.uma.es

Alberto Peinado  
Universidad de Málaga  
BIOSIP Research Group  
Málaga, Spain  
apeinado@ic.uma.es

## Abstract—

Our society displays low representation of women in engineering and, in particular, in telecommunication engineering. This paper presents the different strategies that a group of professors at ETSI Telecommunication, Universidad de Málaga (UMA), have been carrying out since 2018 to make women visible in the technology framework: design of videos and posters about relevant women on the subjects, technological challenges to provide solutions to real problems regarding equality between men and women, women in engineering conferences, study of gender in students' work, etc.

**Keywords—**Telecommunication, engineering, women, equality, visibility.

## I. INTRODUCTION

In our society, there is a low representation of women in engineering and, in particular, in telecommunication engineering. In addition, there is a downward trend in the enrolment of women in STEM (Science, Technology, Engineering, Mathematics) careers. UNESCO has developed a model of measures to promote the education of women in STEM studies, which involve the whole of society [1]. At the same time, it is also important to make women who are engineers and technologists visible to the society, so that girls have female references in all social spheres.

The degrees defined within the framework of the European Higher Education Area (EHEA) include specific references to transversal, basic and general competences that must be developed. Among the general competences common to all the degrees taught at E.T.S.I. Telecomunicación of Universidad de Málaga (UMA) [2], there is the following one:

G-01: Ability to assume and attitude of respecting fundamental rights and equality between men and women.

With the support of UMA, many activities have been promoted and developed to enhance the basic and general transversal competences [3], [4], [5], [6]. However, the competence G-01, has not been developed in depth in them, despite its current great importance at all levels of society. Fig. 1 shows the distribution by course and sex of UMA and ETSIT. This figure shows the great inequality in the percentage of men and women enrolled in ETSIT, as well as the great difference that also exist considering the overall numbers in UMA. At the sight of this figure, which is similar in many universities, it is necessary to take actions to reduce these differences.

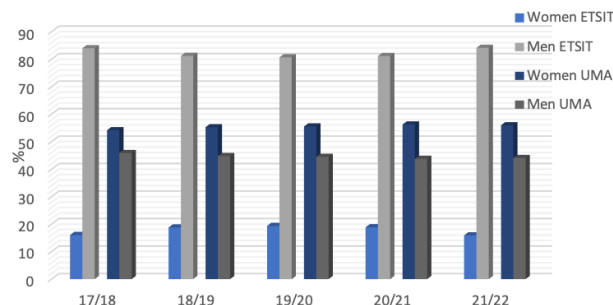


Fig. 1. Distribution of students by year and sex at ETSIT.

Because of this fact, since 2018, a group of professors of E.T.S.I. de Telecomunicación (ETSIT) of Universidad de Málaga, have been developing, with the students of ETSIT, a series of strategies, to work the G-01 competence and help, at the same time, to make visible the work of women in technology in general and in engineering in particular, both within UMA and among

students of secondary, high school and formative cycles, as well as to the society in general. This paper details the different strategies developed.

The structure of this paper is as follows: Section II describes the context in which the different work strategies to make women in engineering visible have been carried out. Then, in section III, each of the strategies is described. Section IV exposes the results obtained in each of the strategies. Finally, section V presents the conclusions drawn from this work.

## II. CONTEXT

The number of students enrolled in UMA per academic year, since 2017-2018 academic year to 2021-22 academic year, has always been more than 33,000 students, distributed among 21 centres [7]. With regard to the number of students enrolled in the province of Malaga in secondary, baccalaureate and training cycles, each of these courses is more than 150,000 students [8]. Given the large number of students enrolled in UMA and in secondary, baccalaureate and training cycles in Malaga and province, as control group to extract the results of this study, a group subjects of areas of knowledge have been chosen from all the degrees and masters offered in the ETSIT of UMA. Since the academic year 2017-2018 to the academic year 2021-22, around 1200 students enrolled in these studies [7]. The ETSIT subjects that have been selected cover the five degrees taught at the school (Degree in Telecommunication Technologies Engineering, in Telecommunication Systems Engineering, in Electronic Systems Engineering, in Sound and Image Engineering and in Telematics Engineering) and three of its Masters (Master in Acoustic Engineering (MIA), Master in Telecommunication Engineering (MIT) and Master in Telematics and Telecommunication Networks (MTRT)). Fig. 2 shows the evolution of the number of students in the control group on which the study is focused. This figure shows how the percentage of students is increasingly significant within the total number of students enrolled in ETSIT. The distribution by gender is similar to that presented in Fig. 1.

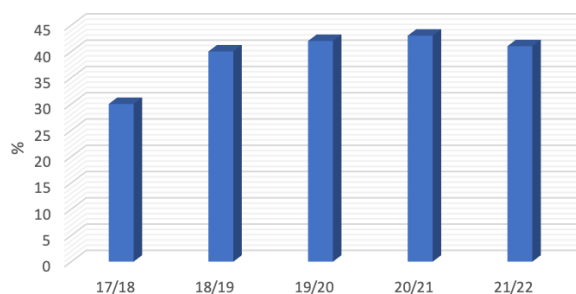


Fig. 2. Evolution of the number of pupils in the control group where the study is focused.

## III. DESCRIPTION OF THE STRATEGIES WORKED ON

In this section, we will describe each of the strategies that have been carried out to make women in technology more visible.

### A. Design of posters on relevant women in Telecommunication Engineering

During the month of September, in the days prior to the start of the course, the themes and the template for the posters (A2 size) to be designed by the students for the first and second semester subjects were defined. The template gives freedom to the design of the posters, but fixes the logos and references to the projects that frame this poster design activity. In addition, for greater dissemination of the content of the posters, they must be written in English. Since the 2017-2018 academic year, the theme has been relevant women in Telecommunication Engineering regarding each of the specific subjects selected for this activity. The evaluation of the posters is carried out in December and April for each semester, respectively. Thus, in May, the best posters were selected for the temporary exhibition of each course. Finally, in June 2021, the 40 best posters were selected, reprinted, framed and distributed among the different classrooms of ETSIT.

### B. Youtube channel: Videos of relevant women in Musical Acoustics

Musical Acoustics is an optional subject in the 4th year of the Graduate Degree in Sound and Image Engineering. In November 2018, the YouTube channel Women in Musical Acoustics [9] was created to gather the videos about relevant women in this subject that have been created since then by the students of this subject. The rules for the creation of the videos are as follows:

- Video duration: 2 to 5 minutes.
- Videos in English or Spanish with English subtitles will be specially appreciated.
- The respect of the copyright of both images and audio of the videos must be observed.

- In order to avoid copyright issues, the students must initially upload the video to their personal YouTube channel. Only if there are no copyright problems, the video is uploaded to the official channel of the subject.
- The way in which the video is made can be chosen freely, as well as the content. Nevertheless, a guide, shown in Fig.3, is given presenting data that can be considered interesting.

| VIDEO: WOMEN IN MUSICAL ACOUSTICS |   |
|-----------------------------------|---|
| •                                 | Name and surname  |
| •                                 | Year and place of birth   |
| •                                 | Year and place of death (if applicable)   |
| •                                 | Origin and personal life:   |
| ○                                 | Family: parent's work, brothers/sisters, relatives with or without relation to music. |
| ○                                 | Personal situation: married or partnered, divorced, children, ...                     |
| •                                 | Professional life:  |
| ○                                 | Professional evolution: Including where her "vocation" comes from.                    |
| ○                                 | Relevance within musical acoustics.   |
| ○                                 | Important milestones in her career.   |
| •                                 | Being a woman...  |
| ○                                 | Is any reference to difficulties/facilities... in the professional career as a woman? |
| •                                 | Other information.  |

Fig. 3. Guide for the making of the videos: women in music acoustics.

### C. Technology Challenge: "Engineering is written with A"

The Technology Challenge activity, promoted by professors of the ETSIT of UMA, has been carried out, with growing success since 2013 [10]. Since its sixth edition in the 2018-2019 academic year, its slogan has been "Engineering is written with A", to promote technological ideas to encourage the interest of girls and young women in engineering. Carrying out a technological challenge each academic year involves a large number of tasks, which are listed in Table 1. It should be noted that since the 2019-2020 academic year, the challenge has been extended to UMA students as well as to ESO, Bachillerato and Ciclos Formativos students.

TABLE I. TASK CARRIED OUT FOR EACH EDITION OF THE TECHNOLOGY CHALLENGE

| Tasks  |   | Timing            |
|--|---|-------------------|
| <b>1. Preparation of the challenge</b>             |   | September-October |
| 1.a  | Challenge definition  |                   |
| 1.b.   | Design of the dissemination plan for the challenge in coordination with ETSIT and the Publications and Scientific Dissemination Service of UMA. |                   |
| <b>2. Launching the challenge</b>                  |   | October-April     |
| 2.a  | Dissemination of the challenge  |                   |
| 2.b  | Follow-up of the proposals submitted to the challenge   |                   |
| <b>3. Awarding and evaluation of the challenge</b> |   | May-June          |
| 3.a  | Review the proposals submitted and select the finalists.  |                   |
| 3.b  | Organization of the final and the award ceremony.   |                   |
| 3.c  | Development of surveys and interviews with students and teachers involved.  |                   |
| 3.d  | Analysis of information and final conclusions   |                   |

Among the tasks presented in Table I, two of them are worth highlighting: the dissemination plan and the challenge definitions.

1) *The dissemination plan:* The dissemination plan is carried out in collaboration with the Publications and Scientific Dissemination Service of UMA. The dissemination plan always includes the following elements: Advertising poster in paper

and electronic format, advertising banner for UMA website and information screens, advertising on ETSIT website, on the website of Department of Communication Engineering, on UMADivulga website, and on UMA social networks, mainly Facebook and Twitter. Emails are also sent to ESO, baccalaureate and vocational training centres in Malaga and province.

2) *Defining the challenges*: Defining the theme of the challenges has been the most time-consuming task, as part of the success of the challenge depends on the choice of theme. The themes of the challenges are described below.

- 6th Edition (2018-2019) and 7th Edition (2019-2020): "Engineering is written with A: Technological ideas to encourage girls' and young women's interest in Engineering". The aim of these challenges was to get students to come up with ideas to get girls and young women interested in STEM studies in general and, more specifically, in engineering studies.
- 8th Edition (2020-20201): "Engineering is written with A: Don't let COVID stop you from being a STEM woman". Technological ideas are sought to avoid the disadvantages that COVID is causing for many girls and young women to study, especially in relation to STEM careers.
- 9th Edition (2021-2022): "Engineering is written with A: Improving the lives of older people and their connectivity to the digital world". People over the age of 65, especially women, have many difficulties regarding the access to the digital world, so ideas are sought to solve these problems.

#### D. *WiSMC: Women and Engineering workshop*

The 1st WiSMC [11] was organised in May 2019, the 2nd WiSMC [12] in November 2020 and the 3rd WiSMC [13] in October 2021. These conferences are especially oriented to pre-university students between 15 and 17 years of age who have to decide what they want to study when they finish their baccalaureate. The aim of the conference is to make both girls and boys aware of the fact that engineering is a great field of study with no genre premises. The first edition was carried out face-to-face and the next two, due to the pandemic, were done online. In all three WiSMCs, the speakers were women, half of them gave the lecture in English and the other half in Spanish. This demonstrates that engineering is as much about women as it is about men. Since the speakers are relevant women in the field of engineering and STEM careers, ETSIT students who have shown interest in these meetings have been allowed to attend. From the 2nd WiSMC onwards, the "Women in SMC" section was added to the website, where podcasts of STEM women have been included, telling their experience as students and professionals in this technology context, as a way of encouraging future university students to choose this type of careers.

#### E. *Gender study in the bibliographies of the students' works*

In order to include gender studies in any subject, tables were prepared which the students had to fill in, for each written assignment, in relation to the percentage of women who appeared in the bibliography of the assignments. Table II shows the tables to be filled in by the students.

TABLE II. TABLES FOR THE GENDER STUDY OF THE BIBLIOGRAPHIES OF THE STUDENTS' WORKS

| Reference consulted             | # total number of authors | # total number of female authors | % female authors | Female first author? |
|---------------------------------|---------------------------|----------------------------------|------------------|----------------------|
| Authors, title, publication ... |                           |                                  |                  |                      |

| # total references | # total number of authors | # total female authors | % female authors | # female first author | % references woman first author |
|--------------------|---------------------------|------------------------|------------------|-----------------------|---------------------------------|
|                    |                           |                        |                  |                       |                                 |

#### F. *Informative conferences and questionnaires on women and telecommunication*

In relation to the different technological challenges and as a way of presenting them, several informative conferences have been given within the different activities developed by the Publications and Scientific Dissemination Service of UMA linked to the International Day of Women and Girls in Science. The titles of these conferences were: "Engineering is written with A: Music + TIC (2019)", "Challenge yourself in STEM: TIC + Music (2021)" and "Engineering is written with A (2022)".

In these conferences, in addition to presenting the challenge, scientific advances made by UMA research groups in Telecommunication Engineering, with a high percentage of women, have been presented.

In order to assess the knowledge about women and telecommunication in ETSIT of UMA, several questionnaires with questions related to women and telecommunication have been carried out and uploaded to the virtual campus of various subjects.

## IV. RESULTS

This section presents the results obtained in each of the strategies considered. The average age of the university students who participated in these activities is 21 years old, with a male-female distribution of 90%-10%, which is quite similar to the typical distribution of ETSIT students.

### A. Design of posters on relevant women in Telecommunication Engineering

In the five courses in which the poster design activity has been carried out, the total number of posters that have been selected because of their high quality, among all the participating subjects, has been 100, which means about 300 students involved, since it was a group work. Among all these selected posters, a new selection of just 40 had to be made to use them as informative and divulgative panels in the classrooms of ETSI Telecommunication. Therefore, the final result has been a series of high-quality posters which are seen by all the students of ETSIT. Every year, questionnaires and interviews have been carried out with both teachers and students involved in it. The results obtained are as follows:

- All the students and teachers surveyed have seen the posters in the classrooms and have spent time reading and evaluating their content.
- The students have acknowledged that they find it difficult to write posters in English, but they also recognise that they need to work more on this type of activity.
- Working on the subject of women and engineering has been very interesting to both students and teachers, since they are not commonly aware of their existence, nor have female references.

### B. Youtube channel: Videos of relevant women in Musical Acoustics

This channel was opened in November 2021, and currently consists of 21 videos. However, the total number of videos made by the students in these 4 courses has been 32, which means about 90 students were directly involved, since it was a work carried out in groups. Only those videos complying with the rules and with good quality, in terms of both content and image, were uploaded to the channel. The total number of views of the videos on the channel is 4670 at the time of check-up. The most viewed video is the one of the Malaga orchestra conductor María del Mar Muñoz Varo with 2209 views. It can be seen that the videos of current women have more views than those related to women who are already deceased and, to a certain extent, unknown, as is the case of Rosetta Tharpe with only 17 views. It is surprising, however, that the video of Imogen Heap, designer of the MiMu gloves, has only 7 views, given that it is a pioneering and very interesting system for students of sound and image. From the surveys and interviews with the students participating in this activity, the following results should be highlighted:

- All the students have given a favourable assessment of the activity of making videos about relevant women, despite the time they needed to edit them. Both girls and boys affirm that this type of activity is necessary and that the topic is highly relevant at the present time.
- They acknowledge that they had problems in finding relevant female figures in the field of musical acoustics.
- They recommend the continuation of this activity in future courses and recognise that this was the first time that the university asked them to work in this format.

### C. Technology Challenge: "Engineering is written with A"

Fig. 4 shows the evolution of the number of students who have participated in the Technology Challenge in the 18/19, 19/20 and 20/21 academic years. The data for the 21/22 academic year are not shown because they are not yet available. It can be seen that participation, in general, is increasing with respect to previous editions [10]. However, in the 19/20 edition there was a very significant decrease in participation, this is due to the fact that because of the pandemic the dissemination of the challenge was not done as in other editions.

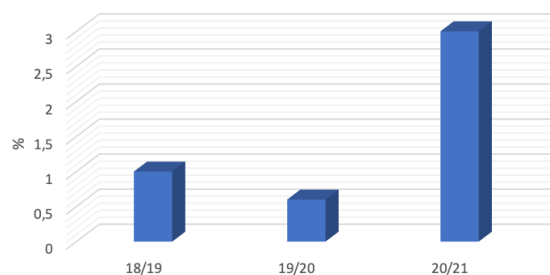


Fig. 4. Evolution of the number of students who participated in the Technology Challenge in the 18/19, 19/20 and 20/21 academic years, with respect to those selected as a control group for this study.

From the surveys and interviews with the students participating in this activity, the following results should be highlighted:

- The technological challenge activity "Engineering is written with A" is favourably rated by the students. In addition, the topic is considered appropriate and highly relevant nowadays.
- Both students and teachers demand more diffusion for this initiative so that it reaches more centres both within UMA and secondary schools in Malaga and its province.
- It should be noted that, although the participation has a lot of room for improvement, the students demand more creative activities of this kind.

- Although the prize is a laptop and two tablets, the students ask for the prize to be more attractive.

#### D. *WiSMC: Women and Engineering workshop*

The number of participants in the 1st WiSMC was 300 students from 4 secondary schools in Malaga city. In the 2nd WiSMC, carried out in on-line format, the number of centres connected was 4: 2 centres from Malaga city, 1 from the province of Malaga and 1 from the province of Seville; the number of pupils connected was over 200. In the 3rd WiSMC, carried out in on-line format, 4 centres were remotely present, 2 from the city of Malaga, 1 from the province of Malaga and 1 from the province of Huelva. Once again, the number of connected students was over 200. In addition, around 20 students from different subjects of ETSIT attended the conferences.

From the surveys and interviews carried out with teachers and students, the following results should be highlighted:

- The face-to-face format allows for better interaction between the students and the speakers. However, it is more time-consuming than otherwise due to the need of traveling to the venue in person, there is a limited capacity due to the size of the room and, also, the attendance of students of schools in the province of Malaga and beyond is reduced.
- The on-line format allows the connection with centres in the province of Malaga and further which, in many cases, do not have the chance of attending this type of event to disseminate the importance of women's equality and technical careers.
- The fact that some of the lectures were in English was appreciated. However, the students confessed that sometimes it was difficult for them to understand English and that they needed to improve their English skills.
- In all editions, some of the presentations have included the topic of reconciliation of work, family and maternity, in order to make students aware that choosing technical studies and a technical job is not incompatible with other aspects of life. However, the responses of both secondary, baccalaureate and 4th year ETSIT female and male students showed that they think those aspects are very distant and, therefore, they were not interested in this part of the presentations.

#### E. *Gender study in the bibliographies of the students' works*

During the academic years 18/19, 19/20 and 20/21 (the results are not yet available for the academic year 21/22), in three different subjects, 2 undergraduate and 2 master's degree subjects, the gender study tables presented in Table II have been included as part of the assignments for students to fill in the bibliographies. In these three courses, 68 gender tables have been compiled from different bibliographies. The average results of these studies are presented in Table III.

TABLE III. TABLES WITH THE RESULT OF THE GENDER STUDY OF THE BIBLIOGRAPHIES OF THE STUDENTS' WORKS

| # total references | # total number of authors | # total female authors | % female authors | # female first author | % references woman first author |
|--------------------|---------------------------|------------------------|------------------|-----------------------|---------------------------------|
| 12                 | 13                        | 4                      | 30%              | 2                     | 16%                             |

It should be noted that in some of the works the students did not find any reference to female authors. Students also highlighted the difficulty, in some cases, of finding out the gender of the authors. Moreover, the students were surprised by the results of the percentages of women they obtained, despite the fact that they were within the expected range. The results in Table III show that the presence of women in technical publications is still low.

#### F. *Informative conferences and questionnaires on women and telecommunication*

The main results obtained from the informative conferences have been the start of collaborations with secondary schools in Malaga and its province. This is due to the fact that most of those attending the conferences have been secondary school teachers from Malaga, who are looking for activities and information to motivate their students.

With regard to the questionnaires on women and telecommunication, Fig. 5 shows, by way of example, the marks obtained by students in the subject Audio Equipment (compulsory in the 3rd year, 2nd semester of the Degree in Sound and Image Engineering). Given that this was a voluntary questionnaire and that it did not count towards the final grade, the degree of participation was high and so was the interest in answering correctly. In addition, it shows that students already have, thanks to the various initiatives carried out both from ETSIT and from various institutions, some knowledge about women and technology.

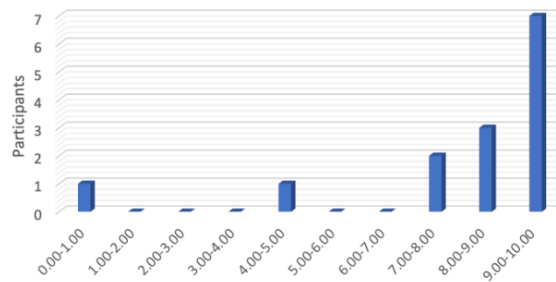


Fig. 5. Grades obtained by students in the subject Audio Equipment in the 2019/20 academic year (compulsory in the 3rd year, 2nd semester, of the Degree in Sound and Image Engineering), in the questionnaires on women and telecommunications.

## V. CONCLUSIONS

The main conclusions obtained from the different strategies considered to improve the visibility of women in technology were:

- Posters, as a tool for disseminating knowledge, in this case about women in telecommunication engineering, are a successful choice if they are located in places where students spend a lot of time, such as classrooms. All the students and teachers at the venue have read at least one of the posters attentively. So, it is an effective task that needs to be continued.
- In the VI, VII and VIII editions of the technological challenge whose theme was "Engineering is written with an A!". The students state that this is an activity in which they have worked directly on the transversal competence G01: Ability to assume and attitude of respecting fundamental rights and equality between men and women. It should also be noted that the proposals showed respect and interest in participating in this highly topical subject.
- The Technological Challenge is an activity that is very favourably valued by both university and pre-university teachers and students. Participation is increasing year by year, so the activity is becoming increasingly popular and successful.
- The students demand more activities like the Technological Challenge, but they think that they need to be better publicised. On this idea, we are working in coordination with the department of scientific dissemination of UMA.
- The average age of the university students who have participated in these activities is 21 years old, with a male-female distribution of 90%-10%, which is quite similar to the typical distribution of ETSIT students. The distribution of the grades of the participating student is typical of ETSIT student, so they do not present any notable differential trait.
- The organisation of any event that involves the attendance of students from any educational stage is a challenge. First of all, it is necessary to draw the attention of the schools so that they can include the activity in their calendars. After this first step is achieved, it is necessary to get the students interested and foster their involvement.
- The on-line format has allowed centres from other provinces to connect, but interaction with the students is more difficult. All in all, the feedback received from the teachers in charge of the schools was positive. Also, it was a good idea to have some of the conferences in English, since this allowed the attendants to practise their skills, although it was difficult for the students to follow the content exposed.
- The study on gender in the bibliographical references of the work carried out in the different subjects involved in this project has allowed the students to see that there is still a long way to go on the road to equality between men and women in technical careers. It is worth noting that the students carried out this task willingly.
- The number of visits to the youtube channel "Mujeres en acústica musical" (Women in musical acoustics) is increasing year by year. One of the videos dedicated to the orchestra conductor María del Mar Muñoz Varo has already attained more than 2000 views. We can see the interest of the students and society in making the work of women visible.
- The dissemination conferences make it possible to initiate collaborations with people and educational centres, which would otherwise be very difficult, as well as to share the innovations that are developed within the university.
- The results of the questionnaires on female engineers have shown that students already have some prior knowledge about women and engineering and, moreover, that this knowledge is easily accessible on the internet. Therefore, there is already a lot of prior work done by the society.
- In order to increase the number of students participating in this type of activities, it is necessary to involve as many teachers as possible, both from ETSIT and from other technical schools, so that they are carried out within a larger number of subjects. This would also enable new joint activities to be carried out between students from different schools.

#### ACKNOWLEDGEMENTS

This publication is part of the project PDC2021-120997-C33, funded by MCIN/AEI/10.13039/501100011033 and by the European Union “NextGenerationEU”/PRTR. This work has been done within Campus de Excelencia Internacional Andalucía Tech. This work has been partially funded by Junta de Andalucía: Proyectos de I+D+i en el ámbito del Plan Andaluz de Investigación, Desarrollo e Innovación (PAIDI 2020), under Project No. PY20\_00237, and Programa Operativo FEDER Andalucía 2014-2020, under Project No. UMA18-FEDERJA-023. This work has been done within Campus de Excelencia Internacional Andalucía Tech.

#### REFERENCES

- [1] UNESCO, “Cracking the code: girls' and women's education in science, technology, engineering and mathematics (STEM)”, Paris, France, 2017. [Online]. Available: <https://unesdoc.unesco.org/ark:/48223/pf0000253479.locale=es>
- [2] E.T.S.I. de Telecomunicación, Programación docente. Curso académico 2021-2022, E.T.S de Ingeniería de Telecomunicación, 2021.
- [3] A.M. Barbancho, I. Barbancho, A. Peinado, “Improvement of the autonomous and cooperative learning in the telecommunication engineering students at the University of Málaga”, in *Proceedings Proceedings of the 5<sup>th</sup> International Technology, Education and Development Conference, INTED2011*, Valencia (Spain).
- [4] A.M. Barbancho, I. Barbancho, L.J. Tardón, “Musical acoustics: improved motivation in the teaching and learning process of the telecommunications engineering students at the University of Málaga,” in *Proceedings of the 4<sup>th</sup> International Conference on Education and New Learning Technologies, EDULEARN2012*, Barcelona (Spain).
- [5] A.M. Barbancho, I. Barbancho, L.J. Tardón, A. Peinado, J. Munilla, A. Peinado, I. Barbancho, S. Sammartino, “Improvement of critical thinking and active participation in the teaching and learning process of the telecommunications engineering students at the University of Málaga,” in *Proceedings of the 2<sup>nd</sup> International Conference of Education, Research and Innovation, ICERI2009*, Madrid (Spain).
- [6] A.M. Barbancho, I. Barbancho, L.J. Tardón, A. Peinado, J. Munilla, A. Ortíz, F.J. Mata, “History and posters: Dynamizing elements in the learning process at telecommunication engineering,” in *Proceedings of the 9<sup>th</sup> International Conference on Education and New Learning Technologies, EDULEARN2017*, Barcelona (Spain).
- [7] UMA, portal de transparencia, <https://www.uma.es/portal-de-transparencia-universidad-de-malaga/info/120015/datos-de-matriculacion/> (last access 07/03/2022)
- [8] Junta de Andalucía, Consejería de Educación y Deporte, <https://www.juntadeandalucia.es/educacion/> (last access 07/03/2022).
- [9] Canal de YouTube: Mujeres en Acústica Musical, <https://www.youtube.com/channel/UCFdpuUhmWtXORZWtyHCmo-w/about> (last access 07/03/2022).
- [10] A.M. Barbancho, I. Barbancho, L.J. Tardón, A. Peinado, J. Munilla, A. Ortíz, F.J. Mata, “Desafío Tecnológico: Herramientas para trabajar y evaluar las competencias básicas y generales en los estudios de grado de la ETSI de Telecomunicación”, in *Proceedings of XXXIII Simposium Nacional de la Unión Científica Internacional de Radio, URSI2018*, Granada (Spain)..
- [11] WiSMC2019, [http://www.wismc2019.uma.es/index\\_esp.html](http://www.wismc2019.uma.es/index_esp.html) (last access 07/03/2022)
- [12] WiSMC2020, [http://www.wismc2020.uma.es/index\\_esp.html](http://www.wismc2020.uma.es/index_esp.html) (last access 07/03/2022)
- [13] WiSMC2021, [http://www.wismc2021.uma.es/index\\_esp.html](http://www.wismc2021.uma.es/index_esp.html) (last access 07/03/2022)