

Experiences on integrating gender in engineering education at the UC3M School of Engineering

Prof. Dr. Paloma Díaz

Dean of the Engineering School of Universidad Carlos III de Madrid

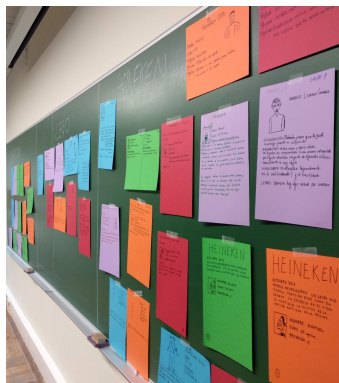
GEDC member

Director of the Telefónica-UC3M Chair on Women and Technology

The School of Engineering of Universidad Carlos III de Madrid is engaged in different activities to make visible the role of women in engineering [1]. The 7th of March four women professors of the School of Engineering were invited to take part in a round table to present and discuss active ways to engage students in identifying gender biases or discovering female role models. This post summarise the four experiences that are implemented in different courses and degrees.

Integrating Gender Inclusion in Web Design Courses through Design Workshops. Dr. Teresa Onorati and Prof. Dr. Paloma Díaz

The design workshop “Integrating gender inclusion in web design” [2] is offered in two different courses: “User Interfaces” in Computer Science & Engineering and “Multimedia Content” in Management of Information and Digital Contents at the Humanities, Communication and Library Science Faculty. The goal of the workshop is to actively engage students in analysing the design of existing websites to identify potential biases.



Students are organized in groups and are provided with 5 websites for 3 different products: a beer, a kitchen robot and a toy store. In the first two cases, an older and newer version are studied.

The course makes use of a collaborative approach based on constructively analyse what the user interface of the web site transmits using a reverse design approach in which students identify one persona per web site. Personas is a well-known design artifact used to generate empathy towards potential users. Students are asked to identify such potential users by looking at the user interface design. All the identified personas are shared in an online or onsite blackboard and the debate about potential biases is initiated.

Teachers act as moderators taking a neutral role since the goal is to learn from confrontation and agreement: the **bias is discovered by the tudents.**



After three years, all the participants identified the same gender bias was identified despite the different backgrounds (engineering students versus library science students). Since the workshop is developed as an active learning process and there is a debate at the end, participants are more engaged and perceive better the negative effects of biases. However, we also learnt that gender

inclusion could be a complex topic to teach because it is affected by personal perceptions. Some students do not like the idea of being confronted with an uncomfortable truth and cognitive biases, like the backfire effect, play their role in not accepting the evidence. Engineering students are more reluctant to recognise that **technology is not neutral**. This experience showed us that gender has to be included in the agenda of ethics teaching and that ethics should permeate throughout all the curriculum, in all those topics related with creation and design.

ICT: towards a sustainable future. Prof. Dr. Ana García Armada

The subject “ICT: towards a sustainable future” is elective for all the students of Engineering degrees in Universidad Carlos III de Madrid. It presents Information and Communication Technologies (ICT) as a facilitating element to build our present and future in a sustainable way. When presenting the basic concepts to understand ICT, a few names of the authors of historical contributions to the evolution of this field are always mentioned. However, none of them belongs to a woman.

This year, we have introduced a new session, with the title “**The contribution of women to the evolution of ICT**”. The need for this topic is first motivated with some data presented to the students showing the evolution of the women enrolled in this kind of engineering studies related to ICT. The students discuss their perspective of why the numbers are so low and **the need for female role models** is brought up. Do they exist? Why are they not so well-known?

The students are presented a collection of names and important achievements, but they are presented in a non-matching order. Then, they need to research and be able to propose which achievement belongs to whom. They do the research in small groups, each of them choosing one female from the list, and they share with the class their findings. After this, they are ready for the test, where they have to connect names and achievements. Besides, they are asked about the experience.

In this first experience 87% of the students matched all the eight women with the right achievements. Only 33% answered that it was difficult to find the information and **100% answered that the experience was interesting and worth doing**.

Now they know that women have developed important protocols, error correcting codes, signal processing and propagation models, that they are leading companies and organizations, and that **Internet has a mother!**

Photonics Subsystems. Prof. Dr. Carmen Vázquez

The subject “Photonics Subsystems” is elective for all the students of the Master degree in Electronics Systems Engineering and Applications (www.uc3m.es/misea) in Universidad Carlos III de Madrid (UC3M). In the first session, as a motivation, there is a discussion about Photonics impact on current world using different Nobel Prizes discoveries of recent years, including the third woman to win a Nobel Prize in Physics in 2018. Showing its societal impact through worldwide connectivity enhancement thanks to the evolution of fiber-optic communication systems, being optical fibers the backbone of the internet and long-distance telecommunication. After the fundamentals of light propagation in fiber optics, we discuss the functional blocks of optical links as well as their interconnections, technologies and new trends in different applications. In course 2022-2023, the subject is part of a project on *Experiences of educational innovation with a gender*

perspective in UC3M. After a personal reflection, the main tools used were **raising awareness about inequalities and gender biases**, integration as part of the continuous **assessment in one of the compulsory planned activities**, **discussion by the students in groups**. As an example on how to raise awareness about historical gender bias, I introduced a debate of a hypothesis present in Rousseau's Social Contract, and we viewed part of a video showing the vision of women in prehistory to awaken an internal debate in students.



Margarita Sánchez.- Women in prehistory: deconstructing some myths and proposing others

For integration in the context of continuous assessment, the students have to **develop an essay in groups in which they have to add a section about gender perspective**. Some guidelines were provided as a list of possible contributions in that section: identify any gender bias in the analysed experiments, women with relevant jobs in the subject, adding articles or books written by women as part of the bibliography, showing work experiences of women in the field... I make a presentation including examples to stimulate and guide those students who need more support. The presentation includes examples of outstanding contributions of women, bias gender in experiments with an optical fiber sensors, leaders in transoceanic links, authors of books on photonics for radar networks, messages from scientific societies and associations. To stimulate the search, I include a set of videos of women working in Electronic Engineering and Photonics showing their own experiences and challenges. Examples of the students works are:

- group 7 with topic “Photonic Subsystems in Space” selected a women leader in African Space industry and include one of her personal challenge at work from an interview: “[...]I went to visit a manufacturer and took a male student [...] with me. The manufacturer only addressed the student. He just assumed that being a man; the student was the leader. {...}”
- group 4 with topic “Transoceanic Links”, apart from describing the technical specifications of the Grace Hooper link, they commented in the conclusions which was not mandatory, one of her thoughts “I’ve always been more interested in the future than in the past”.

In summary, **student search, interpret and defense in public the gender perspective with a very positive attitude**. All of the 8 groups chosen to include references, 3 looked for in different sources to those provided to them, 1 included personal experiences. I was gratefully surprised with the outcomes considering that out of the 16 students only one was a woman.

Telematic Applications. Dr. Celeste Campo.

“Telematic Applications” in the Bachelor in Telematics Engineering is a compulsory subject, taught in the third course, first semester. The main objective is to provide students a detailed understanding of the main Internet application-level protocols (such as DNS, HTTP, and email),

which are standardized by the Internet Engineering Task Force (IETF) [3] and openly published through public documents called RFCs (Request For Comments).

During the last two academic years, in this subject, a gender perspective has been introduced through three actions that are integrated throughout the contents:

- Firstly, all teachers have made an effort to use inclusive and equitable language in both written materials (teaching materials and messaging with students) and oral communication. We have used the specific guides provided by our university.
- Secondly, diversity measures carried out in recent years within the IETF have been collected and presented to the students, as the organization has been aware that "*participation was almost entirely composed of a small group of well-funded, American, white, male technicians*" [4] historically.
- Thirdly, biographies of relevant women in the development of the Internet and communication networks, such as Radia Perlman or Allison Makin, have been collected.

The second and third actions are being integrated into a collaborative Wiki within the university's educational platform (based on Moodle), in which both students and teachers are expected to contribute actively, with the aim of expanding it throughout the next academic years.

In this subject the number of female students is very low, they represent only 20%.

Biomedicine for Beginners. Prof. Dr. Marcela del Río Nechaevsky

"Biomedicine for Beginners" is elective for students of different bachelors in engineering in the Universidad Carlos III de Madrid. Our main goal is that students acquire enough basic biomedical knowledge to develop a critical attitude to the advances that appear on the media daily. Students are expected to understand the basics of the experiments that have been the foundation of modern biology. The results of clinical trials using innovative drugs, tissue engineering tools, stem cells as well as new concepts of genetic and epigenetic are reviewed and discussed with intent to provide students a current scientific-technological vision.

During the last two academic years, a gender perspective has been introduced in "Biomedicine for Beginners" and integrated throughout its contents. Some examples of the actions taken in this regard are summarized below:

- 1) We discuss in class that medicine was a sector characterized by a strong male presence which conditioned the forms of work. Thus, for centuries it was assumed that, studying the "male human being", in his physiology and pathology, was equivalent to having studied "female human being" too. We stress that this strategy had consequences and introduce recent scientific articles showing, for instance, that heart attack symptoms in male and female can be very different. We emphasize the need to properly understand the symptoms in female to give the right diagnosis and treatment.
- 2) We share the decision taken, in 1977, by the agency that regulates drugs and food in the United States (FDA) by which women of child bearing age were explicitly excluded from clinical trials (gender bias). We open a debate around this issue and deal with the consequences of that decision today.

- 3) We highlight in class the work done by women, using clear examples, such as Rosalind Franklin (DNA structure, Nobel Prize granted to Francis Crick and James Watson) and Anna Veiga in Spain (test-tube baby), among others.

We believe that these actions can raise awareness of gender inequalities and biases. It will also help to visualize the work performed by women and generate new references in Biomedicine.

During the courses 2021-2022 and 2022-2023, Biomedicine for Beginners was part of the project “Experiences of educational innovation with a gender perspective” in UC3M.

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[3] <https://www.ietf.org/>

[4] RFC 7704. D. Crocker, N. Clark. “An IETF with Much Diversity and Professional Conduct.” <https://datatracker.ietf.org/doc/html/rfc7704>