EQUAL SciTech guide

EQUAL SciTech:
promoting gender equality in Science and Technology

PT01-KA220-SCH-000088149

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1. About gender equality

Gender equality, or equality between women and men, represents the equal visibility, empowerment, participation and responsibility of women and men in all spheres of public and private life. In this sense, we must encourage girls and boys to position themselves as actors and subjects of their lives, providing knowledge and experiences that allow them to question themselves, leading them to free themselves from dichotomous models of femininity and masculinity. These are the models that condition the development of every human being, woman or man, as a person.

Today, in almost all countries, equality between women and men is considered a human rights issue and one of the conditions for social justice, which is necessary for societies to become more equitable. As such, it is a requirement for development and peace and, in democratic countries, a condition for the effective and full exercise of citizenship.

The main initiatives in this area are highlighted:

- 1975 - The UN Convention on the Elimination of All Forms of Discrimination - CEDAW is approved by the UN General Assembly which reaffirms and reinforces the principle of equality between women and men;
- 1993 - The UN International Conference on Human Rights in Vienna recognizes that "the human rights of women and girls are an inalienable, integral and indivisible part of universal human rights";
- 1995 - The UN International Conference in Beijing on Women, Development and Peace with the aim of realizing women's rights. It presented a program with 12 action areas, namely "Women and poverty, Women's education and training, Women and health, Violence against women, Women and armed conflict, Women and the economy, Women in power and decision-making, Institutional mechanisms for the advancement of women, Women and the media, Women

and the environment, Girls" and called on states to integrate gender equality into the formulation, implementation and evaluation of all policies and actions. This new approach has been dubbed the gender mainstreaming strategy;

- 2015 - The UN approves the 2030 Agenda and sets out the 17 Sustainable Development Goals (SDGs), encouraging states, institutional and private actors to fulfil their promise to leave no one behind. Gender issues cut across the entire Agenda and the 5th SDG is "achieve gender equality and empower all women and girls".

In society, gender equality is achieved by providing equal access to resources and their equal distribution for both women and men. It also means accepting and valuing their differences and the various roles they play. From this perspective, it is assumed that all human beings, regardless of gender, are free to develop their personal skills, pursue their professional careers and make their own choices without limitations imposed by stereotypes, prejudices and rigid conceptions of the social roles assigned to men and women. The two areas that most help to reinforce and reproduce these conceptions are education and communication. However, they are also the areas that can encourage them to be questioned and transformed. It is for these reasons that it makes sense to involve schools in promoting a project like this, given that, as the Council of Europe recommends in its 2007 report, "Promoting a democratic culture in schools, including the adoption of educational practices aimed at increasing girls' and boys' capacity for participation and action, helping them to cope with change and fostering partnership between men and women, as a prerequisite for the full exercise of citizenship". In this way, it is through the implementation of the "EQUAL SciTech: promoting gender equality in Science and Technology" project that we can contribute to mitigating and reducing gender inequalities, since it aims to promote the social inclusion of girls and young women in the world of STEM. This term refers to the fields of Science, Technology, Engineering and Mathematics. This commitment is supported by the UNESCO 2017 report "Cracking the code", which states that "only 17 women have won a Nobel Prize in physics, chemistry or medicine since Marie Curie in 1903,

compared to 572 men" and that "today, only 28% of all Nobel Prize winners are women". Girls' disadvantage in these areas is not based on their cognitive ability, but on the socialization and learning processes of their environment, which shape their identity, beliefs, behaviours and choices. Also, according to this report, STEM prevails in all aspects of our lives and is a catalyst for achieving the Sustainable Development Goals - Agenda 2030, underpinning solutions to the emerging challenges that arise in our daily lives. Therefore, it is through the development of a project such as this that we aim to contribute to a significant change in the representation of girls in STEM, since its purpose is to improve their interest, commitment and achievement in the areas of science, technology, engineering and mathematics, combating the stereotypes presented by students and teachers and, at the same time, encouraging them to choose careers in this field during their school career. In addition, and in line with the European Council's recommendations on key competences for lifelong learning 2018, the project aims to facilitate the acquisition of key competences and skills for both boys and girls, empowering students so that everyone can reach their full potential, strengthening cooperation and interpersonal communication through group dynamics, games, participatory strategies and diversified activities.

Other aspects to be worked on in the project are to boost excellence in teaching and learning at school using different tools linked to non-formal education, as well as developing skills for teachers, reinforcing and empowering their personal competencies through the use of EQUAL SciTech digital tools. In this way, the project aims to create digital tools such as a digital platform, a cooperative card game and an interactive digital book, with stories and group dynamics activities using Augmented Reality technology. These activities will be available for use by professionals from various sectors. Through their implementation with young people, we aim to achieve the following objectives:

- Promote gender equality;
- Develop new teaching and learning methods and approaches;
- Acquire new digital competencies and skills.

The activities implemented are based on an "open door policy", helping to increase collaboration and cooperation between young people, teachers, researchers, scientists, universities, countries and associations promoting STEM education.

2. STEM

2.1 Education system in each country

Germany has a well-regarded education system, particularly in the field of STEM (Science, Technology, Engineering, and Mathematics). The country places a strong emphasis on technical and scientific education to support its strong industrial and technological sectors. Here are some key features of the main education system in STEM in Germany:

1. Structure: The German education system is divided into different stages, including primary education (Grundschule), secondary education (Hauptschule, Realschule, and Gymnasium), and tertiary education (Universities and Universities of Applied Sciences).

2. Dual Education System: Germany is known for its dual education system, which combines practical training in the workplace with theoretical education in vocational schools. This system is particularly strong in technical and engineering fields, where students alternate between classroom instruction and on-the-job training.

3. Emphasis on Mathematics and Sciences: STEM education in Germany focuses on a strong foundation in mathematics, physics, chemistry, and biology. These subjects are considered essential for pursuing technical and scientific disciplines at higher levels.

4. Rigorous Curriculum: The curriculum in STEM subjects is known for its depth and rigor. The academic programs are designed to provide students with a comprehensive understanding of theoretical concepts and practical applications. This ensures that students develop a strong analytical and problem-solving skill set.

5. University Education: Germany has numerous universities and technical universities renowned for their STEM programs. Many universities offer Bachelor's, Master's, and Ph.D. degrees in various STEM disciplines. Some prominent technical universities in Germany include the Technical University of Munich, RWTH Aachen University, and the Karlsruhe Institute of Technology.

6. Research and Innovation: Germany is known for its strong research and innovation culture. The country invests significantly in research and development, fostering collaboration between academia and industry. There are various research institutions, both public and private, that contribute to scientific advancements and technological breakthroughs.

7. Industry Partnerships: German universities and educational institutions often collaborate closely with industry partners. This collaboration facilitates internships, research projects, and job placements, allowing students to gain practical experience and industry exposure during their studies.

8. Scholarships and Funding: Germany offers various scholarships and funding opportunities for domestic and international students pursuing STEM education. These scholarships aim to attract talented individuals and support them financially throughout their academic journey.

It's important to note that while the German education system is highly regarded, specific experiences and quality can vary between institutions and programs. It's advisable to research and explore individual universities, their curricula, and faculty to gain a more comprehensive understanding of their STEM offerings.

The responsibility for the development of educational policies at a national level in Italy lies with the MIM – Ministry of Education and Merit. The enhancement of STEM education is one of the elements on which the National Digital School Plan launched by the Italian Government (PNSD, Law 107/2015) is based. It is a guidance document of the MIM that aims to innovate the Italian education system through digitalization, highlighting the opportunities it offers in terms of training, skills and employment. Innovation in the school system and digital education opportunities are key drivers of this vision. This Plan is not a simple order for the deployment of technology; no educational process takes place without intensive teacher-student interaction, and technology cannot be separated from this fundamental human relationship, as the OECD recently reminded us. Simply introducing more technology in schools is no longer

sufficient; if we concentrate our efforts solely on technology, we risk ignoring the larger issues, namely knowledge and culture. This Plan answers the call for a long- term vision for Education in the digital age directly linked to the challenges that all of society faces in applying and promoting life-long and life-wide learning, in both formal and non-formal contexts. This has been confirmed by the High-Level Conference of the European Commission in December 2014, by several publications of the OECD's Centre for Educational Research and Innovation, by the World Economic Forum's New Vision for Education Report and by studies such as the Ambrosetti think tank's "Education for the 21st century". Education in the digital age must be viewed above all as a cultural initiative. It begins with a new concept of school: an open space for learning — more than just a physical place, a springboard that enables students to develop skills for life. In this vision, technology is empowering, habitual, ordinary and ready to serve the school, primarily in activities aimed at training and learning, but also in administration, spreading to - and in fact bringing together - all school settings: classrooms, common spaces, laboratories, private and informal spaces. It is an organic plan for innovation in Italian schools, with cohesive programmes and actions organized into five main areas: tools, skills, content, staff training and supporting measures. For each of these, we have defined “critical” but achievable objectives linked to specific actions that will enable us to improve the school system as a whole.

In general, the declination of the MIM strategic lines on educational policies is entrusted to the individual schools, which enjoy wide decision-making autonomy as established by law 59/1997. In Italy there are 8,160 schools, divided into over 40,000 locations. On average, each institution has 900 students and 120 employees. Each institution must define its own educational policies in the form of a PTOF (Three- Year Plan of the Educational Offer). It is in these plans that concrete references can be found to policies based on the STEAM approach. Unfortunately, from this context derives a great fragmentation of policies and a difficulty in identifying strategic lines of national scope. There is a growing interest in the STEAM approaching the local PTOFs in the last years, but at the same time very often the initiatives are attributable more to isolated experimental practices or projects than to actual development lines. The hope is that

within a few years the current fragmentation and periodicity will create the humus for the development of a grassroot movement for the widespread adoption of the STEAM approach.

To date, the MIM is preparing a new enhancing STEM plan related to the PNRR for schools of all levels.

In North Macedonia, the education system is structured into several levels, including primary, secondary, and tertiary education. STEM education is indeed an essential component of the country's education system, as it plays a crucial role in preparing students for careers in science, technology, engineering, and mathematics fields.

Primary education is compulsory for all children and covers grades 1 to 9. During this stage, students are introduced to a range of subjects, including basic STEM (Science, Technology, Engineering, and Mathematics) subjects.

The primary education curriculum typically includes mathematics, where students learn fundamental arithmetic operations, problem-solving skills, and basic mathematical concepts.

Science classes introduce students to the natural world, covering topics like biology, chemistry, and physics, albeit at an elementary level. This helps them develop a basic understanding of scientific principles and phenomena.

While technology education at the primary level may not involve in-depth programming or complex technological concepts, students are often exposed to basic technological tools and applications as part of their learning process. This can include the use of computers, educational software, and other digital resources to enhance their learning experience.

By introducing basic STEM subjects during primary education, North Macedonia aims to lay a strong foundation for students' future academic pursuits and careers. Early exposure to STEM concepts fosters curiosity, critical thinking, and problem-solving

skills, which are essential for students' intellectual development and their potential to pursue further studies or careers in STEM-related fields. Additionally, fostering interest in STEM from an early age can help address the gender gap and encourage more girls to consider STEM education and careers in the future.

After completing primary education, students move on to secondary education during which they continue to study core subjects, including STEM subjects such as mathematics, science, and technology. The curriculum aims to build upon the foundational knowledge acquired in primary education and prepare students for more specialized studies.

There are different types of schools in upper secondary education in North Macedonia, offering various study programs:
Gymnasiums: Gymnasiums offer a more general education, and students can choose to focus on STEM subjects or other areas like social sciences or languages. Those interested in pursuing university studies, including STEM-related disciplines, often attend gymnasiums to prepare for higher education.

Vocational Schools: Vocational schools provide more practical education and training, including specialized STEM programs in fields such as engineering, mechanics, electronics, and information technology. These programs aim to prepare students for specific careers or technical professions after graduation.

Technical Schools: Technical schools also offer specialized programs in STEM-related fields, providing students with technical skills and knowledge for specific professions, such as technicians or technologists.

The division into gymnasiums, vocational schools, and technical schools allows students to choose a path that aligns with their interests and career aspirations, whether it be pursuing higher education or entering the workforce directly after graduation.

Overall, secondary education in North Macedonia aims to provide students with a well-rounded education and the opportunity to explore and specialize in STEM subjects, which are crucial for developing a skilled and knowledgeable workforce in science and technology-related fields.

Higher Education: At the tertiary level, students in North Macedonia have the opportunity to pursue higher education in various universities and colleges across the country. North Macedonia has several universities that offer undergraduate and postgraduate programs in different STEM (Science, Technology, Engineering, and Mathematics) disciplines.

These universities provide a wide range of courses in fields such as mathematics, computer science, engineering (including civil engineering, mechanical engineering, electrical engineering, etc), natural sciences (biology, chemistry, physics, etc.), and more. The tertiary education system in North Macedonia aims to provide quality education and equip students with the knowledge and skills necessary to succeed in their chosen fields.

The government's investment in the development of the higher education sector is crucial for fostering research, innovation, and academic excellence. By providing students with access to quality education and research opportunities, North Macedonia can nurture a skilled workforce and contribute to the country's economic growth and technological advancement.

Tertiary education in STEM fields is instrumental in preparing students for various career paths, including research, industry, academia, and entrepreneurship. Through these programs, students can gain specialized knowledge and expertise, enabling them to contribute to advancements in science, technology, and engineering and address societal challenges.

Furthermore, higher education institutions in North Macedonia often collaborate with industries and research organizations, creating opportunities for practical experiences,

internships, and partnerships. Such collaborations help bridge the gap between academia and the job market, preparing graduates to meet the demands of the evolving workforce in STEM-related industries.

Overall, the availability of diverse STEM programs at the tertiary level, along with the commitment to providing quality education and investment in the higher education sector, is essential for the country's development and progress in the fields of science, technology, engineering, and mathematics.

The main education system in STEM in Portugal is associated to the main education system overall: In the first part there is a basic education (6 to 14 years old) comprising three main cycles: a first cycle: from ages 6 to 9 (grades 1 to 4); a second cycle: from ages 10 to 11 (grades 5 and 6) and a third cycle: from ages 12 to 14 (grades 7 to 9). During the compulsory education students receive a general education that includes basic subjects in STEM, such as Mathematics, Sciences, and Technology in order to provide a solid foundation for further studies in these areas.

Following there is the secondary education (ages 15 to 18 and consists of three years of study) that prepares branches out into different secondary programmes, i) a higher education-oriented (general secondary programmes), ii) a work-oriented (technological secondary programmes) and an artistic-oriented programme.

The conclusion of secondary education (general, technological or artistic programmes) with passing grades confers a diploma, which will certificate the qualification thus obtained and, in the case of work-oriented programmes the qualification for specific jobs. This stage typically covers ages 15 to 18 and consists of three years of study.

In secondary education, students have the option to choose different pathways, including:

i) The Science and Technology Pathway (scientific-technological) is designed for students interested in pursuing higher education in STEM fields. It includes advanced courses in Mathematics, Physics, Chemistry, Biology, and other relevant subjects.

ii) The Technological Pathway (technological): This pathway focuses on applied sciences and technology-related subjects, preparing students for higher education or immediate entry into the job market.

The STEM education is highly studied during the higher education offered at universities, polytechnic institutions, and other specialized higher education schools. Students can pursue bachelor's, master's, and doctoral degrees in various STEM disciplines.

There are the portuguese universities which provide a broad range of STEM-related courses and are known for their research and academic excellence and the Polytechnic Institutions that focus more on practical and professional-oriented courses in fields such as engineering, technology, and applied sciences.

Bachelor's degrees typically take three years to complete, while master's degrees require an additional two years of study. Doctoral programs can take three to five years to finish, depending on the field and research project. The education system in Portugal starts with 6 years old and is mandatory until 18 years old.

2.2 Main careers

In Germany, women have been making significant strides in pursuing careers in STEM (Science, Technology, Engineering, and Mathematics) fields. While there is still work to be done to achieve gender equality in STEM, women in Germany are increasingly entering and excelling in various STEM careers. Here are some of the main career paths that women pursue in **STEM in Germany**:

1. Engineering: Women in Germany are increasingly choosing engineering disciplines such as mechanical engineering, electrical engineering, civil engineering, and industrial engineering. They contribute to sectors such as automotive, aerospace, energy, and manufacturing.

2. Computer Science and Information Technology: Women are pursuing careers in computer science, software engineering, data analysis, and information technology. They work in areas like software development, cybersecurity, data science, and web development.

3. Life Sciences: Women are well-represented in life science fields such as biology, biochemistry, genetics, and biotechnology. They work in research institutions, pharmaceutical companies, and healthcare sectors, focusing on areas like genetics, microbiology, and biomedical research.

4. Medicine and Healthcare: Women have a strong presence in the medical field, pursuing careers as doctors, surgeons, nurses, and medical researchers. They contribute to healthcare advancements, clinical research, and patient care.

5. Mathematics and Statistics: Women are actively involved in mathematical and statistical careers, including roles in academia, research institutions, finance, and data analysis. They work in areas such as mathematical modelling, actuarial science, and statistical analysis.

6. Environmental Sciences: Women are increasingly engaged in environmental science and sustainability-related careers. They work in areas like environmental research, renewable energy, conservation, climate change, and ecological studies.

7. Physics and Astronomy: Women are pursuing careers in physics and astronomy, working on research projects, space exploration, astrophysics, and quantum physics.

8. Chemistry and Pharmaceutical Sciences: Women are involved in chemical research, pharmaceutical development, drug discovery, and analytical chemistry. They contribute to advancements in pharmaceuticals, materials science, and chemical engineering.
It is worth noting that while women are making progress in these fields, there is still a gender gap to address. Efforts are being made in Germany and globally to encourage more women to pursue STEM education and careers and to promote gender diversity and inclusion in these fields.

Italian women STEM careers are part of a cultural important aspect linked to gender equality in our education system.

They have often been considered as a male “field of action “but today the situation is changing, thanks to the new roles that women are playing. Women are making great efforts to change mentalities built on stereotypes and prejudices. It’s a difficult task but positive results have been achieved.

The Istat report on education levels and participation in training in 2020 shows that 24.9% of Italian graduates aged between 25 and 34 have a degree in scientific and technological areas.

According to data from the Ministry of University and Research, 22% of the total of girls enrolled in the University chose in 2021 a course in Stem, marking an increase compared to previous years. The main careers that women pursue in Stem are related to engineering, astrophysics, information technology and ICT (Information and Communications Technology).

North Macedonia Women have been making strides in pursuing careers in STEM fields, although gender disparities persist. Efforts to encourage and support women's participation in STEM professions are essential for promoting gender equality and harnessing the full potential of talent in these fields. Some of the main careers that women have been pursuing in STEM in North.
Macedonia includes:

1. Computer Science and Information Technology: Women have been increasingly joining the IT industry as software developers, computer programmers, data analysts, web designers, and IT project managers.

2. Medicine and Healthcare: in the medical and healthcare fields, women have been making progress as doctors, nurses, pharmacists, medical researchers, and other healthcare professionals.

3. Natural Sciences: Women have been pursuing careers in biology, chemistry, physics, and environmental science, both in academic and research roles as well as in various industries.

4. Mathematics and Statistics: Women are becoming more involved in mathematics and statistical analysis, working as mathematicians, statisticians, actuaries, and data scientists.

5. Engineering: While engineering fields have historically been male-dominated, there has been an increasing number of women entering engineering disciplines, such as civil engineering, electrical engineering, and mechanical engineering.

6. Education: Women also play a significant role in STEM education as teachers, lecturers, and professors, inspiring the next generation of STEM professionals.

It's worth noting that the representation of women in STEM careers can vary across different fields and industries. Gender diversity in STEM remains an ongoing global challenge, and it requires continued efforts to address barriers, biases, and societal stereotypes that can deter women from pursuing STEM education and careers. Encouraging and supporting women's participation in STEM through mentorship, scholarships, networking, and promoting inclusive work environments can help foster greater gender equality in these critical fields in North Macedonia and beyond.

The main career areas chosen by **women in Portugal** are:

a) Researcher

Among the main careers that women pursue in STEM an important place takes women scientists and engineers. In 2020, Portugal have 52% of women scientists and it was a reference among the Member States of the European Union (EU) according to Eurostat data. At regional level, the data show that the proportion of female scientists and engineers is greater in 11 regions of the EU, with Portugal emerging, once again, in a good position with Madeira (56%) and mainland Portugal (51%). Other data from the Organization for Economic Co-operation and

Development (OECD) corroborate these results. The number of portuguese women studying science, technology, engineering or mathematics is higher than that of men in the same areas. In the area of biology, women are even the overwhelming majority, reports the OECD.

b) Teachers

Other careers where the women are predominant are in education. Women represent overall in 2021 almost 77% of new entrants to the field of education, a sector traditionally dominated by women. In Portugal, men represent 29% of teachers across all levels of education, compared to 30% on average across OECD countries. Other data from the first cycle of the OECD Teaching and Learning International Survey (TALIS 2008) found that, on average in Portugal, almost 70% of lower secondary school teachers were women. Women were also more likely to teach language arts and human sciences rather than teach mathematics and science. Women are also predominant in among primary school teachers and kindergarten teachers representing 95.7% of the professionals in 2018 in Portugal (Source www.cig.gov.pt).

c) Health services

A study in 2018, showed that in Portugal women are predominant in many areas of health professionals as: nursing professionals (82.3%); Nursing assistants and midwives (87.5%). Other health professionals (76.8%); Veterinary (71.3%) and Veterinary technicians and assistants (72.5%) and medicine and pharmacy techniques (71%).

2.2 Disabled areas

In Germany, as in many other countries, there are areas within STEM (Science, Technology, Engineering, and Mathematics) where women are underrepresented. Some of the areas that often witness a deficit of women in STEM in Germany include:

1. Engineering and Technical Fields: Engineering disciplines, such as mechanical engineering, electrical engineering, civil engineering, and computer engineering, tend to have a lower representation of women. These fields have traditionally been male-dominated, and women often face challenges in accessing opportunities and breaking through gender biases.

2. Computer Science and Information Technology: Computer science and information technology fields also experience a significant gender imbalance. Women are underrepresented in areas such as software engineering, data science, cybersecurity, and artificial intelligence. Stereotypes and cultural biases can discourage women from pursuing these fields.

3. Physics and Astronomy: Physics and astronomy are fields where women are historically underrepresented. The lack of female representation can be observed in academic positions, research roles, and leadership positions. Women's participation in theoretical physics and astrophysics is particularly limited.

4. Mathematics and Statistics: Although mathematics and statistics are fundamental

STEM disciplines, there is still a gender gap in these fields. Women are often underrepresented in higher-level positions and academia. Efforts are being made to address this imbalance and promote women's participation and advancement in mathematics and statistics.

5. Leadership and Higher-Level Positions: Women face challenges in attaining leadership and higher-level positions across various STEM fields. This underrepresentation can be observed in academia, research institutions, and industry.

Barriers such as implicit bias, gender stereotypes, and limited mentorship opportunities can hinder women's career progression. It's important to note that while progress has been made to address these gender imbalances, more efforts are needed to create inclusive and supportive environments that encourage women to pursue and thrive in STEM fields.

In Italy the definition of STEM graduate courses is pretty wide, and it is therefore quite interesting to understand how the number of women enrolled is largely dependant on the type of course. As a matter of fact, the presence of women varies from 82% in the Humanities group (here we must bear in mind that the Conservation of Cultural Heritage falls back into the STEM category according to Italian Miur, Minister for Education, University and Research)) to 20% in electronic and computer engineering.

Figure 1 -Italy, The definition of STEM graduate courses

Legend: Maschi= Males, Femmine = Females, Architettura = Architecture, Ingegneria Civile e Ambientale = Civil and Environmental Engineering, Ing Industriale= Industrial Engineering, Chimico farmaceutico = Chemistry and

Pharmacy, Ingegneria Elettronica e dell'Informazione = Electronic and Computer Engineering, Altre Ingegnerie = Other Engineering courses

University Group STEM Students % Women

University Group	STEM Students	% Women
Humanities and Arts	1.545	82%
Health Professions	4.418	71%
Geology, Biology and Biotechnologies	83.084	65%
Chemistry and Pharmacy	25.711	56%
Architecture and Urban Planning	43.886	56%
Statistics	7.138	41%
Engineering (other than the courses below)	19.386	38%
STEM (average data)	**480.377**	**37%**
Civil and Environmental Engineering	42.136	32%
Mathematics and Physics	66.748	26%
Industrial Engineering	115.330	21%
Electronic and Computer Engineering	70.995	20%

Women represent an outstanding majority (71%) in the Health Profession courses. They represent 65% of the student population in the Biology group, 56% in the Chemistry and Pharmaceutical group and 56% in the Architecture group. The STEM courses related to Statistics show a near balance between the number of male and female students. Unfortunately, the gap is still deep when it comes to Engineering, Mathematics and Physics.

However, despite the fact that the data related to the female presence in engineering courses is one of the worst as far as the Gender Gap is concerned, the trend has been definitely improving of late. Apart from civil and environmental engineering – which showed a decrease in the number of both males and females enrolled- the number of women who have decided to enrol to industrial engineering, electronic and computer engineering, biomedical engineering and business engineering have been raising at a higher rate than the male counterpart, which means that the percentage of females enrolled to any engineering course shifted from 20,9% to 24,1% in 2019 and has kept stable since then.

To address these challenges and promote gender equality in STEM, it is crucial to implement initiatives that encourage girls and women to pursue STEM education and careers, provide mentorship and support, challenge gender stereotypes, and promote workplace diversity and inclusion. By creating an inclusive and supportive environment, North Macedonia can tap into the full potential of its female talent in STEM and foster innovation and growth in these fields.

Similar to many other countries, North Macedonia also faces a deficit of women in certain STEM (Science, Technology, Engineering, and Mathematics) fields. While there might have been changes since then, some areas where the underrepresentation of women in STEM is observed in North Macedonia include:

1. Engineering: Engineering fields, such as civil engineering, mechanical engineering, electrical engineering, and aerospace engineering, have historically been male-dominated. Women are often underrepresented in these areas, especially in certain specialized engineering disciplines.

2. Computer Science and Information Technology: Computer science and IT-related fields have seen significant growth and opportunities in recent years. However, women's participation in these areas remains relatively low, particularly in roles such as software engineering, cybersecurity, and network administration.

3. Physics and Astronomy: in the physical sciences, including physics and astronomy, women are underrepresented, especially in advanced research and academic positions.

4. Mathematics and Statistics: While women's representation in mathematics and statistics has improved over the years, there is still a gender gap, particularly in higher-level academia and research.

5. Data Science and Artificial Intelligence: as emerging and fast-growing fields, data science and AI have seen increased demand for skilled professionals. However, women's representation in these areas is lower than that of men.

6. Leadership Positions: Women are often underrepresented in leadership roles within STEM industries and academic institutions. This includes positions such as department chairs, research directors, and executive leadership.

It's important to note that the representation of women in STEM fields can vary depending on cultural, social, and regional factors. Efforts to address the deficit of women in these areas include promoting inclusivity, providing mentorship and support programs, challenging stereotypes, and creating policies that promote diversity and equal opportunities in STEM education and careers.

The main areas in Portugal with a very low representation of women are:

a) Leadership position

a. The post of school principal, is largely held by men with less than half of the school

principals were women in Portugal (40%). This suggests that more men than women generally follow this path in their education career. Also, there is a deficit of women in teaching mathematics and science. (source OECD)

b. Head of laboratories. Women are in lower-visibility but effort-intensive tasks in research while the chairs at the top - or, in this case, in front of the laboratories - continue to be men. Overall women occupy 63% of HR positions. But men earn more

b) Engineering, manufacturing, construction, information and communication technologies OECD studies demonstrated that in 2021 girls are on average 11% more likely than boys to expect to work as legislators, senior officials, managers and professionals while only 5% of girls in OECD countries, on average, expect a career in engineering and computing, compared to 18% of boys expect a career in these fields. In Portugal, the proportion of girls planning a career in engineering or computing is less than 10% (https://www.oecd.org/pisa/pisaproducts/pisainfocus/49829595.pdf).

Women tend to be under-represented in certain fields of science, technology, engineering and mathematics (STEM) across most OECD countries. On average, 26% of

new entrants in engineering, manufacturing and construction and 20% in information and communication technologies were women in 2019. In Portugal, women represented 29% of new entrants in engineering, manufacturing and construction programmes and 17% in information and communication technologies.

c) Vocational training

Men are more likely than women to pursue a vocational track at upper secondary level in most OECD countries. This is also the case in Portugal, where 51% of upper secondary vocational graduates in 2019 were men (compared to the OECD average of 55%). Women are generally more likely to graduate from upper secondary general programmes. This is also the case in Portugal, where women represent 55% of graduates from upper secondary general programmes, the same value as on average across OECD countries (see figure below).

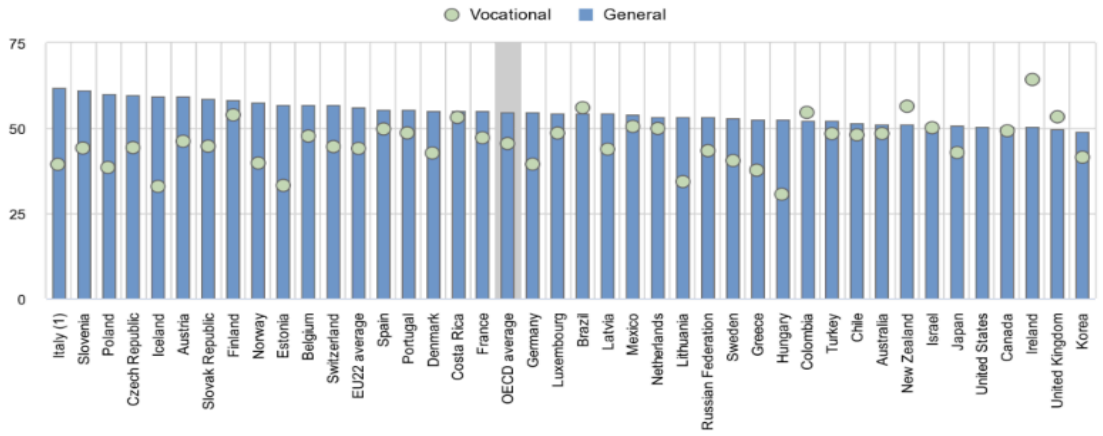


Figure 2- Share of women among upper secondary graduate

2.3 Challenges faced

The challenges faced by women in STEM (Science, Technology, Engineering, and Mathematics) fields in Germany are multifaceted and can vary based on individual experiences and disciplines. Here are some of the main challenges identified in research

and literature:

1. Gender Bias and Stereotypes: Gender bias and stereotypes persist in STEM fields, contributing to a lack of representation and opportunities for women. Research has shown that biases can affect hiring decisions, promotion prospects, and access to resources and funding.

2. Lack of Female Role Models: The underrepresentation of women in leadership positions and prominent roles in STEM fields can limit the availability of female role models. Having visible and inspiring role models is crucial for encouraging young women
to pursue STEM careers. (Sources

3. Work-Life Balance and Family Responsibilities: Balancing family responsibilities and demanding careers in STEM can be particularly challenging for women. Stereotypes and cultural expectations around gender roles can influence decisions regarding career progression, work hours, and pursuing leadership positions.

4. Lack of Support Networks and Mentorship: Building strong support networks and accessing mentorship opportunities can be crucial for career advancement. However, research suggests that women in STEM fields may have limited access to such networks, which can influence career progression and professional development.

It is important to note that the challenges faced by women in STEM are complex and interconnected. Ongoing efforts are being made in Germany and globally to address these challenges and promote gender equality and diversity in STEM fields.
In Italy the main challenge for women in STEM (Science, Technology, Engineering, and Mathematics) fields can be attributed to a variety of factors. Here are a few key challenges that women often face:
1. Gender bias and stereotypes: Women in STEM may experience prejudice, bias, or stereotypes that can impact their career opportunities and progress. Some people still hold the belief that women are not as capable as men in technical fields, which can lead to discrimination and limited opportunities.

2. Underrepresentation: Women are significantly underrepresented in many STEM disciplines, both in educational institutions and the workforce. This lack of representation can often make it harder for women to find mentors and role models who can support and encourage their ambitions.

3. Lack of support systems: Women often face limited support systems within STEM communities, workplaces, and educational institutions. This lack of support can manifest in various forms, such as a lack of networking opportunities, lesser access to resources, or even an absence of policies and initiatives promoting gender diversity and inclusion.

4. Work-life balance: Balancing career aspirations and personal responsibilities, such as raising a family or caregiving, can be particularly challenging for women in STEM. The demanding nature of many STEM careers, including long working hours or frequent relocation, can make it harder for women to maintain a healthy work-life balance.

Addressing these challenges requires efforts from various stakeholders, including educational institutions, employers, policymakers, and society as a whole. Encouraging more equitable representation, promoting inclusive work environments, providing mentorship and support programs, and challenging bias and stereotypes are some ways to help overcome these obstacles for women in STEM.

One of the main challenges for women in STEM in North Macedonia, as in many other countries, is gender disparity and underrepresentation in these fields. Several factors contribute to this challenge:

1. Gender Stereotypes and Societal Norms: Traditional gender stereotypes can influence career choices and discourage women from pursuing STEM fields. Societal norms that associate certain fields with gender can create barriers and limit opportunities for women in STEM.

2. Lack of Role Models and Support: The absence of visible female role models in STEM can make it difficult for young girls to envision themselves in these careers. A lack of

support and encouragement from family, educators, and peers can also deter girls from pursuing STEM education and careers.

3. Gender Bias and Discrimination: Women in STEM may face gender bias and discrimination in academic and professional settings, affecting their career advancement and opportunities for leadership roles.

4. Work-Life Balance: STEM fields often demand long hours and intense workloads, which can be challenging for women balancing career aspirations with family responsibilities.

5. Access to Education and Resources: Limited access to quality STEM education and resources may hinder women's opportunities to excel in these fields.

6. Male-Dominated Work Environments: Male-dominated work environments can create feelings of isolation and discomfort for women in STEM, leading some to reconsider their career choices.

7. Unequal Representation in Leadership: Women are underrepresented in leadership positions within STEM industries and academia, which can limit their ability to influence decision-making and policy changes.

8. Pay Gap: Women in STEM may face a gender pay gap, earning less than their male counterparts for similar work and qualifications.

Among the main challenges for women in STEM, in Portugal, can be found:

The Gender Stereotypes: Traditional gender stereotypes that influence the expectations in society, leading to the perception that certain STEM fields are more suited for men. This can discourage women from pursuing careers in STEM or result in biases in hiring and promotions. There could also be the fear of confirming negative stereotypes about women's abilities in STEM that can create additional pressure and impact self-confidence and performance.

Underrepresentation: Women might be underrepresented in STEM fields, both in academia and the workforce. This underrepresented, on is observed in Portugal mainly in leadership positions and technical roles, perpetuating the gender gap.

Work-Life Balance: Balancing career aspirations in STEM with family and personal life can be challenging, especially when faced with societal expectations regarding traditional gender roles.

Lack of Role Models: A shortage of female role models in STEM fields can limit young women's aspirations and hinder their belief in their own potential to succeed in these areas.

Gender Bias and Discrimination: Women in STEM may face gender bias and discrimination in the workplace, leading to unequal opportunities, lower salaries, and fewer chances for career advancement. **Educational Bias:** There might be biases within the education system that discourage girls from pursuing STEM subjects, leading to fewer female students in STEM-related courses and fields. This happens specially in Networking and Mentorship: Women might face challenges in accessing networking opportunities and mentorship, which are crucial for career development in STEM fields.
Unconscious Bias: Unconscious biases can affect recruitment processes, performance evaluations, and workplace dynamics, creating hurdles for women in STEM.

Lack of Supportive Policies: Insufficient family-friendly policies, such as maternity leave, flexible working hours, and on-site childcare facilities, can make it difficult for women to balance their professional and personal lives. Hostile Work Environments: Instances of harassment or a male-dominated work culture in some STEM workplaces can make it uncomfortable for women and further discourage their participation. Addressing these challenges requires a multi-faceted approach involving educational institutions, employers, policymakers, and society at large. Encouraging diversity and inclusivity, implementing supportive policies, and promoting female role models are essential steps towards creating a more equitable environment for women in STEM in

Portugal. Please note that specific developments or changes might have occurred aper my last update, so it is advisable to refer to more recent sources for the latest information on this topic.

2.4 Educational programs to empower women

There are several empowerment and education programs in Germany aimed at motivating females to pursue STEM careers. These programs focus on providing support, mentorship, and resources to encourage and empower women in STEM fields.

Here are a few examples:

1. Women Professors Program: The Women Professors Program (WPP) in Germany aims to increase the number of women in professorial positions in STEM fields. It provides funding and support for female researchers to advance their careers, develop leadership skills, and establish themselves as role models and mentors for other women.

2. Girls' Day and Boys' Day: Girls' Day (Mädchen-Zukunftstag) and Boys' Day (Jungen-Zukunftstag) are annual events organized in Germany to promote gender diversity in career choices. Girls' Day encourages girls to explore STEM fields and offers opportunities to visit companies, research institutions, and universities to gain hands-on experience in science and technology. Boys' Day aims to broaden boys' career horizons by introducing them to non-traditional fields like nursing, social work, and early childhood education.

3. Women in STEM Networks: Various networks and organizations in Germany focus on supporting women in STEM. For example, the German Association of Women Engineers (VDI nachrichten) and the Association of Women in Science (Verband der Frauen und der Wissenschaft) provide networking opportunities, mentoring, and support to advance the careers of women in STEM.

4. Germany Scholarship: The Germany Scholarship program provides financial support to talented students, including those pursuing STEM fields. The program includes specific initiatives to encourage female students to pursue STEM degrees and supports their academic journey through financial assistance and mentoring.

5. STEM Outreach Programs: Universities and research institutions in Germany often organize outreach programs to engage young girls and spark their interest in STEM. These programs include workshops, summer schools, and mentoring initiatives that provide hands-on experiences and inspire girls to pursue STEM education and careers.

These are just a few examples of the many programs and initiatives in Germany aimed at empowering and motivating females to enter and excel in STEM fields. These efforts play a crucial role in fostering gender diversity and creating equal opportunities in the STEM workforce.

There are different programs that motivate females into Stem careers in Italy. As part of its commitment to a gender-fair Europe, the EU has funded projects that strengthen women's participation in research and innovation and promote structural change in higher education institutions and research organizations.

A brochure published by CORDIS highlights eight EU-funded projects that work to strengthen the participation of women and girls in STEM (science, technology, engineering and mathematics) fields through a great variety of approaches and activities. The eight EU-funded projects are as follows: **SCIENTIX 4** that continues the activities implemented by previous Scientix projects going on to promote collaboration at European level between STEM teachers, education researchers, policy makers and other education stakeholders to inspire students to pursue a career in STEM; **LeTSGEPs** that aims to eliminate gender imbalance in research organizations, using stakeholder workshops and awareness-raising events to support the design and implementation of Plans for Gender Equality (GEP); **CALIPER** that is helping European research organizations to develop GEPs and it is working to encourage dialogue and collaboration between academic institutions, public authorities and practitioners;

T-PEERS that aims to improve and implement seven GEPs in research organizations in order to reduce the gender gap in decision-making and research, and strengthen the impact of gender content in research programmes; **CRITICAL MAKING** that aims for an open and inclusive society and it is working to promote responsible research and innovation helping the global community of young creators, innovators, designers and engineers of all genders to succeed; **EQUALS-EU** that aims to promote gender equality in the digital age and to this end it is incubating women-led start-ups; **SHEMAKES.EU** that focuses on advancing gender equality in the textile and clothing sector in Europe, through training, mentoring and community building events that promote innovation and women-led leadership; **ALLINTERACT** that aims to both increase citizen engagement in scientific research and engage young women in this goal.

In order to strengthen work in support of gender equality in science, technology and innovation (STI) also UNESCO and ENEL have promoted programs that engage females into Stem careers.

UNESCO promoted the **STEM AND GENDER ADVANCEMENT (SAGA)** project in 2015. The main objective of SAGA is to offer governments and policymakers a variety of tools to help reduce the current global gender gap in existing IST fields at all levels of education and research.

Enel's support to Stem education has led to the **ENEL STEM PROJECT "BACK TO SCHOOL"**. The project is based on a practical and concrete approach. The heart of the project is the school, but the project expands outside the classrooms: the goal is to create a comparison between two generations. On the one hand, the Enel professionals who, as role models, enter high schools and speak to young people to promote the importance of STEM education with respect to tomorrow's professions and make their stories and knowledge available to students, on the other hand, students who are encouraged and motivated to approach STEM subjects. The goal of ENEL "BACK TO SCHOOL" is to prepare young people for the world of work through learning and experimentation experiences and to this end students are offered Career

Counseling, Shadowing services and a scholarship for enrolment in STEM degree courses. Another important education program is the **STEM AND MULTILINGUALISM - SCUOLA FUTURA - PNNR** program which aims to grow the scientific culture and international perspectives of school staff on New skills and new languages. The goal is to strengthen the action of schools to promote STEM subjects, computer science and multilingual skills ensuring equal opportunities and gender equality, with a specific focus on female students and with a full interdisciplinary approach.

There have been efforts in North Macedonia to encourage and motivate females to pursue STEM (Science, Technology, Engineering, and Mathematics) careers. These programs aim to empower women and girls, providing them with the support, resources, and mentorship needed to succeed in traditionally male-dominated STEM fields. Some of the initiatives and programs include:

1. Women in Science and Technology Association (WiST): WiST is an organization in North Macedonia that focuses on empowering women in STEM. They organize workshops, seminars, and networking events to support and encourage women's participation in science and technology.

2. Girls in ICT Day: Girls in ICT Day is an international initiative that aims to raise awareness about the importance of encouraging girls and young women to consider careers in ICT (Information and Communication Technology). Various events and activities are organized locally to introduce girls to the world of technology and showcase female role models in the industry.

3. Tech Girls: Tech Girls is an educational program that aims to inspire and empower girls to pursue careers in STEM. It provides workshops, mentoring, and hands-on experiences in technology-related fields.

4. Girls Code Macedonia: This initiative focuses on teaching coding and computer programming skills to girls in North Macedonia. By introducing coding at an early age, the program aims to increase interest and confidence in technology-related fields.

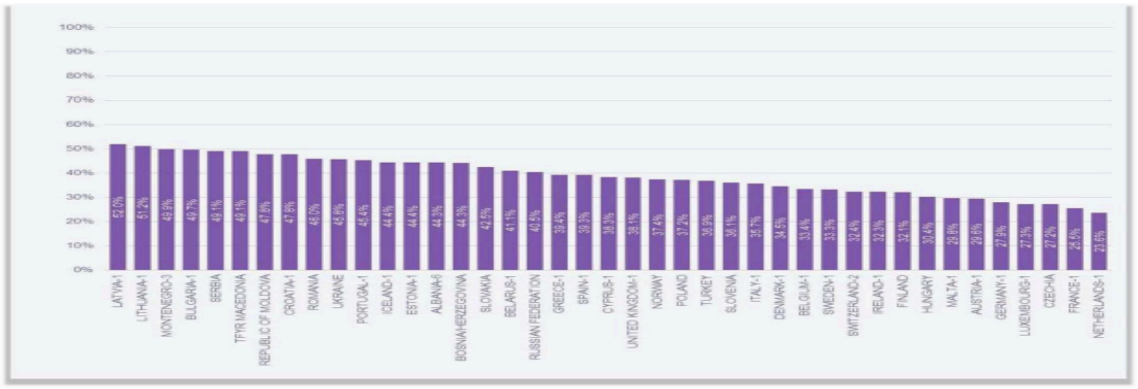
5. University Programs: some universities in North Macedonia have specific initiatives or scholarships aimed at encouraging female students to pursue STEM studies and research.

6. Industry Partnerships: Private companies in the technology and engineering sectors may collaborate with educational institutions to offer internships, training, and mentorship programs targeted at female students.

These are just a few examples of the initiatives and programs that exist in North Macedonia to motivate and empower females to pursue STEM careers. These efforts play a crucial role in breaking down gender barriers and promoting diversity and inclusivity in STEM fields.

Further below you can find the percentage of Women in Science done by the UNESCO Institute for Statistics which depicts the constant grow of women researchers in North Macedonia over the last few years. This, of course, is promising data and hopefully it will lead to changing the perspective of how women in STEM are seen and included.

Female researchers as a percentage of total researchers (HC), 2014 or latest year available.



Notes: -1=2013; -2 = 2012; -3 = 2011; -6 = 2008.
Source: UNESCO Institute for Statistics, August 2016
Fact Sheet No. 43 March 2017 FS/2017/SCI/43

Figure 3- A breakdown of female researchers in Europe - I

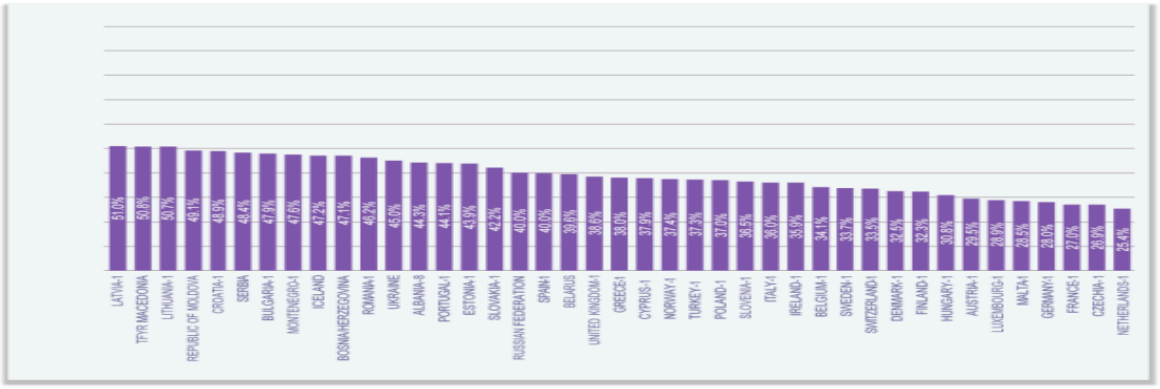


Figure 4 - A breakdown of female researchers in Europe – II

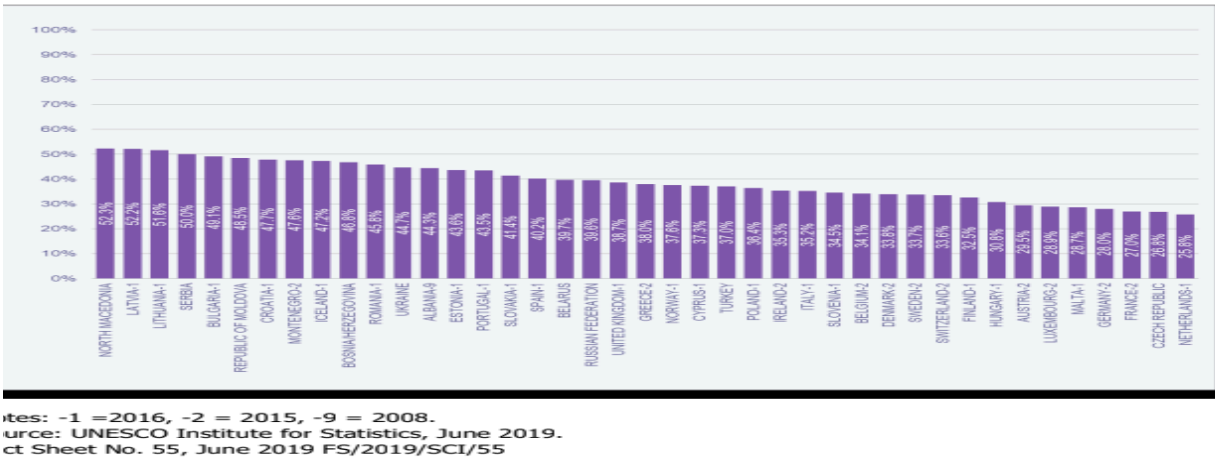


Figure 5- A breakdown of female researchers in Europe – III

In Portugal we highlight the following:

Women in Science (Mulheres em Ciência) books released in 2016, 2019 and 2021, by Ciência Viva, brings together in 2023 over 101 portraits of researchers from different generations and areas of knowledge. From Biology to Mathematics, from Chemistry to Social Sciences, from Physics to Archaeology, from Neurosciences to Geography, from Engineering to History, from Space Sciences to Philosophy, this editorial project focuses on female researchers and their success stories in different latitudes, which have greatly contributed to the rooting of science in Portuguese society and which, Ciência Viva hopes, may inspire young people to follow their vocation.

Science4you: Although not exclusively focused on girls, Science4you is a Portuguese company that designs and manufactures educational STEM toys and games, making science more accessible and engaging for children of all genders.

Educational Institutions Initiatives: Many universities and schools in Portugal have implemented programs to encourage female students to pursue STEM subjects and provide scholarships or financial support to women studying in STEM fields.

Women in Science and Engineering (WISE Portugal) Program: This program focuses on promoting gender equality in science and engineering fields by offering mentoring, networking opportunities, and career development support to female students and professionals.

Engenheiras por Um Dia (Engineers for a Day): This initiative aims to inspire young girls to pursue careers in engineering. It involves hands-on workshops, visits to engineering companies, and interactions with female role models working in the engineering industry.

European Space Education Resource Office (ESERO Portugal): ESERO Portugal is part of the European Space Agency's educational initiative. It offers various programs and activities to promote space-related education, encouraging both girls and boys to engage with STEM subjects.

Portuguese Association of Women in Science (AMCV): AMCV is a non-profit organization that supports women's participation in science and technology fields through mentoring, networking events, and advocacy for gender equality.

Technovation Portugal: This is a global technology entrepreneurship program for girls, which encourages them to develop mobile applications to address real-world problems in their communities. It provides mentorship and support throughout the project.

Girls in ICT Day Portugal: Organized by the International Telecommunication Union (ITU), this annual event promotes awareness and encourages young girls to explore

careers in information and communication technology (ICT) through workshops, seminars, and hands-on activities.

Geek Girls Portugal (G2PT): was born in 2010 with the designation Portugal Girl Geek Dinners and is the first portuguese community created to raise awareness and bring together women in the technological area through regular meetings. The mission focuses on engaging, inspiring and empowering women, through meetings and workshops, awareness sessions in schools to inspire young women, and mentoring to support the professional development and progression of women in technology.

2.6 Outstanding women in each country

Here are three current German women who have made significant contributions in thefields of science and technology:

Prof. Dr. Katharina Kohse-Höinghaus: Katharina Kohse-Höinghaus is a prominente German chemist and professor at Bielefeld University. She specializes in the field of combustion chemistry and spectroscopy. Her research focuses on understanding the chemical processes involved in combustion, which has implications for energy efficiency and environmental sustainability. Kohse-Höinghaus has received numerous awards for her work, including the prestigious Gottfried Wilhelm Leibniz Prize.

Prof. Dr. Daniela Jacob: Daniela Jacob is a German climate scientist and professor. She serves as the Director of the Climate Service Center Germany (GERICS) and is as expert in climate modeling and climate impact research. Jacob's work involves analyzing the impacts of climate change on various sectors, including agriculture, water resources, and urban planning. She contributes to the development of strategies for climate adaptation and mitigation.

Prof. Dr. Gesche Joost: Gesche Joost is a prominent German computer scientist and professor. She specializes in human-computer interaction, user experience design, and

inclusive design. Joost has been a driving force in advocating for diversity and gender equality in technology. She has served as the Digital Champion for the European Commission and has received several awards for her research and social engagement in the field of technology.

When they choose these subjects, women standout **in Italy**:
Chiara Montanari is a civil engineer from the University of Pisa with a thesis on a heating project for the Italian base located in the Ross Bay area and carried out in Antarctica.
Two examples of all are Patrizia Caraveo and Simonetta Cheli: both occupy prestigious positions in the field of astrophysics and management.

Patrizia Caraveo, astrophysics training, was included in the list of 100 experts in the STEM area as part of the project "100 women against stereotypes for Science". Cheli, on the other hand, the first woman to win the appointment as head of the Earth Observation Programmes for the European Space Agency, has just been appointed director of Ersrin, the Italian ESA plant located in Frascati, near Rome.

Another example of a woman who standout in the field of Stem is Lucrezia Morabito who deals with the aspects of Mobile Robotics Marketing.

Last but not least, we must mention Samantha Cristoforetti, the first Italian astronaut.
On 28 September 2022, Samantha Cristoforetti became the first European female astronaut as commander of the ISS.
In the north of Macedonia, the following stand out:

1. Hristina Spasevska is Vice-Rector for Education at Ss. Cyril and Methodius University in Skopje and Professor at the Faculty of Electrical Engineering and Information Technologies.

She is currently President of the Association of Engineering Societies-Engineering Institution of Macedonia, President of Metrology Council of the Bureau of Metrology,

National representative at the Forum of the European Council for Innovation and Chairperson of international conferences “WIN-Women In”.

In the last ten years she has been a team leader or participant in more than 20 international research and development projects within the programs: FP7, EUREKA, Horizon 2020, IPA, COST, International Atomic Energy Agency, World Bank and Central European Initiative.

Hristina Spasevska is co-author of more than 80 papers, most of them published in the international scientific journals or presented at conferences in the field new materials and their application in energy systems. She had published more than 10 books and textbooks for students.

In 2019 she won the “13 November” award for outstanding achievements in science, technology and economy in the field of Renewable Sources of Energy and Energy Efficiency.

2. Mimoza Ristova is a university professor, scientist, columnist, novelist, playwright and human rights activist. She was born in Skopje, Republic of Macedonia in 1963. She teaches Electronics and Electromagnetism at the postgraduate studies and Photovoltaics, Medical Imaging and Forensic Sciences at the postgraduate studies at the Faculty of Science and Mathematics, University of St. Cyril and Methodius, Skopje, Macedonia.

The fields of her research are: Thin Semiconductor Films, Photovoltaic Conversion, Electrochemical Cells for Spontaneous Water Splitting, Electrochromic Cells, Amorphous Silicon, Pixel Detectors, Selective Coatings for Thermal Solar Collectors, Forensic Sciences, Radiation Protection and more.

In 2000/01 she was the recipient of the NATO-NSF postdoctoral grant at Texas A&M University, in the USA. In 2014, she stayed as a visiting professor/researcher at the National Lorentz Laboratory in Berkeley, California, USA, where she worked on the project "Electrochemical cells for spontaneous water splitting".

3. Tanja Petrusevska is astrophysicist and docent (assistant professor) at the University of Nova Gorica, Slovenia. She conducts her research work at the Centre for Astrophysics and Cosmology. She teaches courses at the Bachelor level and coordinates the outreach/promotional activity of the School of Science, University of Nova Gorica. She obtained her PhD in 2017 at the Physics Department at Stockholm University and the Oskar Klein Centre, with the thesis Supernovae seen through gravitational telescopes She is a member of the following international collaborations:

- 2021 - present - ePESSTO+: advanced Public ESO Spectroscopic Survey for Transient Objects (active in the Tidal Disruption Events group);
- 2021 - present - LensWatch collaboration aimed at searching for lensed supernovae with targeted surveys of known strong-lensing systems;
- 2019 - present - Junior member of the IAU (International Astronomical Union);
- 2018 - present - Vera Rubin Observatory - active in the Dark Energy Science Collaboration;
- 2013 - 2017 - Intermediate Palomar Transient Factory. Her responsibilities included searching for candidates as probable supernovae in the data, triggering telescopes from an international network, processing;
- spectroscopic data in order to classify the candidates.

The leading women **in Portugal** are:

Elvira Fortunato

Professor and researcher is the current Minister of Science, Technology and Higher Education. As a researcher she secured several grants. One of the most popular outcomes of her teams' research was the creation of a paper transistor. Last year she was elected by the French Presidency, one of the 27 inspiring women of Europe, in a list of more than 30 awards and distinctions.

Isabel Reis

Basic training is in marketing and that was his gateway to the technology sector, where he has worked since the beginning of his career. Isabel Reis began her professional career at Oracle, went through Sopware AG, Informix and arrived at EMC almost 20 years ago. In 2009 she took over the general management of the operation in Portugal, for which reason she has already led the entire process of integrating EMC into Dell, where she remains general manager for Portugal.

Maria Antonia Saldanha

Mastercard's country manager in Portugal has been in the electronic payments sector for over 20 years. Before taking office, Maria Antónia Saldanha made a career at SIBS, where she created the company's Innovation program and one of the first national fintech and payments acceleration programs.

Cristina Fonseca

At the age of 23, he co-founded Talkdesk, one of the unicorns with national DNA, which established itself with a cloud solution to create call centres in a few minutes. Meanwhile, he founded and sold (to Zendesk) another company, Cleverly.ai, and is one of the founding partners of Indico Capital, through which he invests in other entrepreneurs. Cristina Fonseca's potential has been recognized internationally. One of the most recent distinctions came from the World Economic Forum, which placed her on the Young Global Leaders list - the most promising young leaders under 40, as Mark Zuckerberg or Emmanuel Macron have also passed.

3. Surveys

In order to understand the reality of this issue in each of the countries in the consortium, a questionnaire was prepared jointly, with eight questions that we considered to be structural. Its organization was also based on the needs of the project and its objectives. When choosing who would answer the questionnaire, we took the above-mentioned aspects into account. The survey was therefore answered by six women from each of the consortium partners, whose education and current career were in the STEM fields, for a total of 36 respondents.

The questions in the survey are as follows:

1. Do you believe that there has been any recent advancements or improvements in gender equality in STEM?
2. If so, what are they?
3. What are the levels of involvement of women in STEM educational programs?
4. Are there any notable differences in the representation of women across different STEM fields (e.g., engineering, computer science, physics)? In what areas?
5. Are there any notable differences in the experiences of women from different cultural or ethnic backgrounds in STEM fields?
6. What do you believe are the primary factors contributing to the underrepresentation of women in STEM education?
7. Are there any specific challenges or barriers that women commonly face in pursuing STEM education?
8. What strategies do educational institutions have to implement in order to encourage and support women in STEM careers?

We now present the results by partner, noting that all the respondents agreed with the terms set out in the questionnaire.

3.1 Survey analysis

The **German partner - ERASMUS ME** presented the following results for question one, 66.7% of the respondents believe that yes, there has been progress in relation to the situation of gender equality in STEM, while 33.3% do not. As illustrated in the following graph:

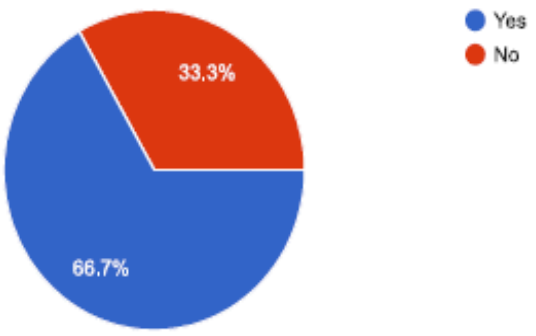


Figure 6 -ERASMUS -ME, Progress of gender equality in STEM

The respondents who selected "yes" listed the aspects that support their answers:

- Yes, there have been several recent advances and improvements in gender equality in STEM. There has been an increase in the representation of women in STEM education and careers. The number of women earning STEM degrees has increased steadily over the past few decades. The increase is due to increase funding for gender equality initiatives by governments, foundations and companies to encourage girls and women to pursue STEM education and careers. While significant progress has been made in recent years, there is still much to be done to achieve gender equality in STEM. Women are still under-represented in many STEM fields and often face discrimination and bias in the workplace:

- Growing representation, increased funding, and heightened awareness propel progress toward gender parity in STEM;

- Increased female representation in STEM leadership, mentorship programs and initiatives addressing bias contribute to advancing gender equality;

One of the respondents who believes there have been no changes also presented her arguments, which we have transcribed:

- I don´t see any changes when it comes to the ratio and representation of various genders within STEM within my years of involvement and experience. You need to define what recent means. In comparison to ten years ago perhaps. But within my ten years of experience, I do not see much change.

On question number three concerning the level of involvement of women in STEM education programs, most respondents, 66.7%, chose level 4, as can be seen in the following graph:

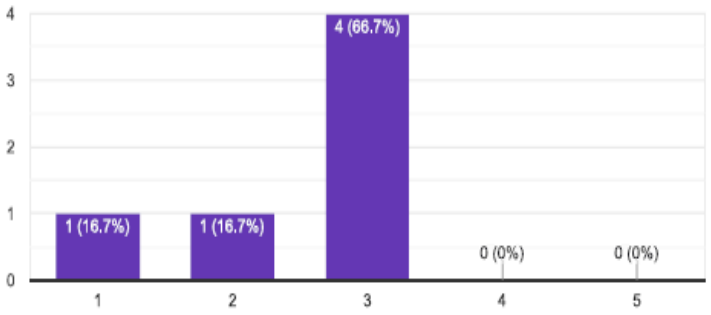


Figure 7 - ERASMUS -ME, Level of involvement of women in STEM

In question number four, 66.7% of the respondents answered that there are differences in the representation of women in the different STEM fields, while 33.3% believe not, as shown in the following graph:

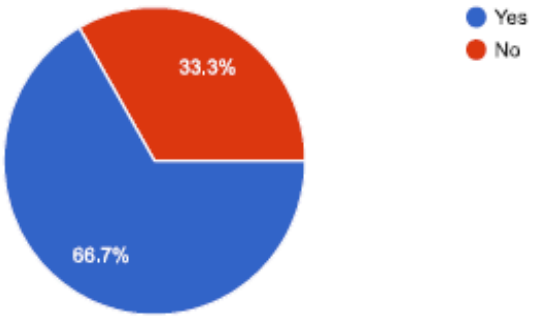


Figure 8 - ERASMUS -ME, Women in the different STEM fields

Regarding the areas that stand out the most, the answers given were evenly split, 50% for technology and 50% for science, as can be seen in the following graph.

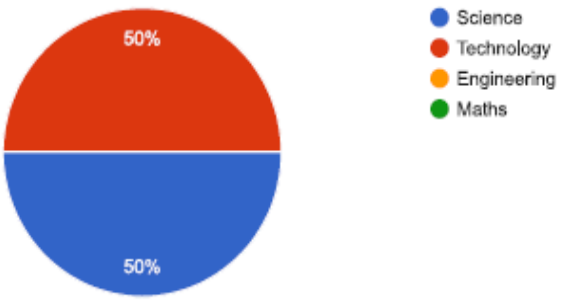


Figure 9 - ERASMUS -ME, Women`s focus areas

With regard to question five, a large majority of respondents, 83.3%, say that there are significant differences in the experiences of women from different cultures and ethnicities, as shown in the following graph:

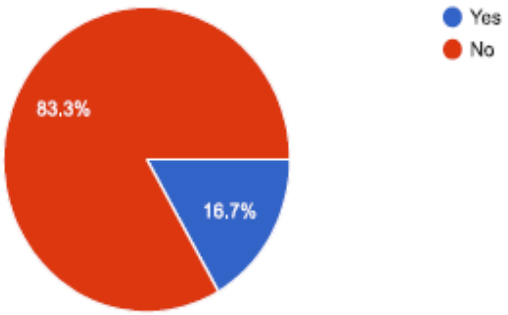


Figure 10 - ERASMUS -ME, women from different cultures and ethnicities

The factors that contribute to the under-representation of women in STEM education indicated by the respondents are:

- Systemic oppression, enforcement of patriarchal norms and stereotypes, gendered pay gap, domestic unpaid labour;

- Multiple factors contribute to the underrepresentation of women in STEM education, including gender stereotypes, lack of female role models, and unwelcoming STEM environments. Women also face work life balance challenges and back access to quality STEM education;

- Discriminatory mindset;

- Stereotypes, lack of female role models, societal expectations and implicit biases;

- Gender stereotypes, bias, and societal expectations hinder women's participation in STEM;

-Bias, stereotypes, social structures;

The respondents cited the following as challenges or barriers faced by women pursuing STEM education were the following:

- Lack of encouragement and motivation during school years, promotion of stereotypical gendered expectations throughout schooling;
- Inequitable access to resources and opportunities, disproportionate responsibilities for childcare and household work, and above all gender stereotyping and implicit biases;
- No
- Yes, women face persistent challenges in STEM education, including gender stereotypes, lack of female role models, and workplace discrimination;
- Bias, stereotypes, lack of representation, and limited opportunities;
- Gender stereotypes salary gaps.

According to the respondents, the strategies to be implemented by institutions to motivate and support women who have STEM careers are, equally, 50% each, merit scholarships and dissemination, as illustrated in the following graph:

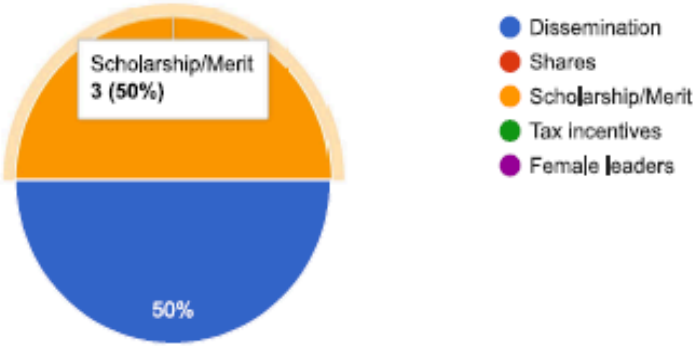


Figure 11 - ERASMUS -ME Strategies to motivate and support women

Regarding Italy, we have the following answers from the **EURO NET** partner to question number one, "Do you believe that there have been any recent advances or improvements in gender equality in STEM", in which 66.7% of respondents answered yes while 33.3% answered no, as illustrated in the following graph.

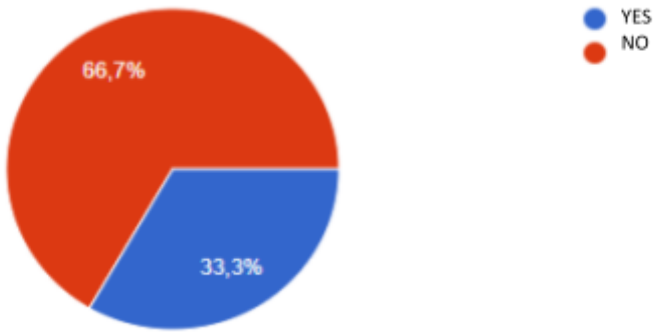


Figure 12 - EURO NET, Advances in gender equality in STEM

Only two of the respondents answered the second question, since they were the only ones who answered yes to question one. Their answers were:

- More women have approached the study of STEM
- Online courses

Regarding question number three, "What are the levels of involvement of women in STEM educational programs", the results obtained were balanced at 33.3% as the choices were distributed between the range 2 to 4 (33.3% in each) as illustrated in the following graph:

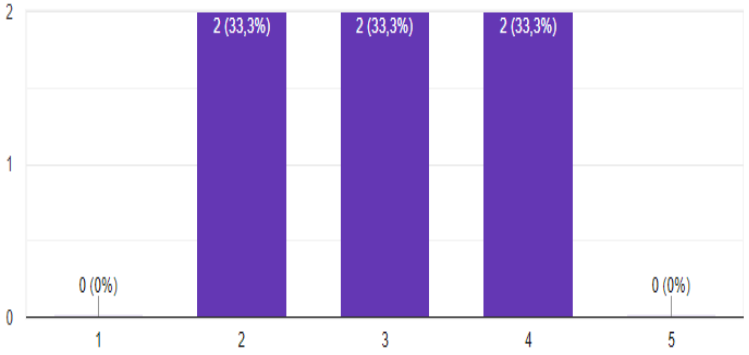


Figure 13 - EURO NET, Levels of involvement of women in STEM

The results obtained in the fourth question, "Are there any notable differences in the representation of women across different STEM fields (e.g., engineering, computer science, physics)" are demonstrative of the significant differences that respondents believe exist in the representation of women in the various STEM areas, given that 83.3% answered yes.

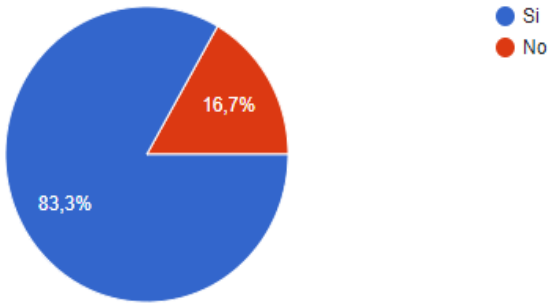


Figure 14- EURO NET, Representation of women across STEM

With regard to the areas chosen by women, engineering stands out with 50% and technology with 33.3%, see the following graph.

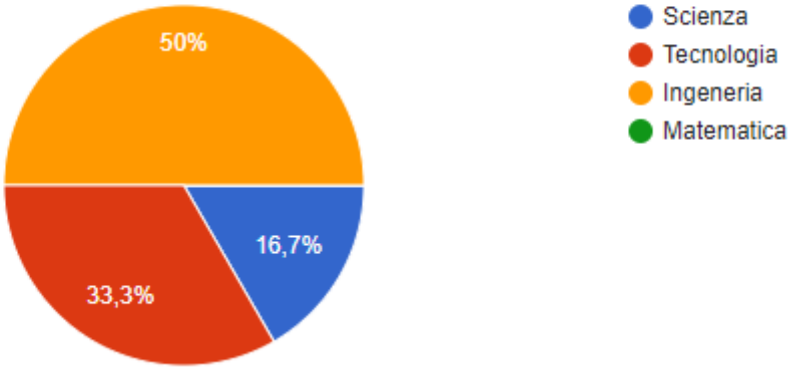


Figure 15 - EURO NET, Women's focus areas

In relation to question number five, "Are there any notable differences in the experiences of women from different cultural or ethnic backgrounds in STEM fields", all the respondents answered yes.

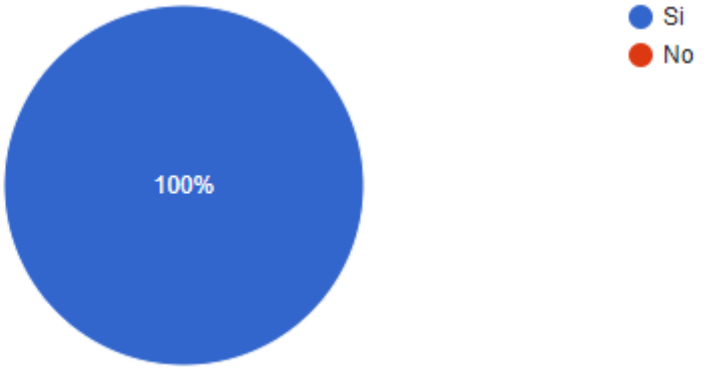


Figure 16- EURO NET, Experiences by cultural or ethnic backgrounds in STEM

In question number six, "What do you believe are the primary factors contributing to the underrepresentation of women in STEM education?" the respondents mentioned the following factors:

- Cultural biases about women's skills
- Self-exclusion
- Prejudice
- Cultural factor
- Less job stability: leaving work due to maternity/family problems
- Education

The barriers mentioned in question seven, "Are there any specific challenges or barriers that women commonly face in pursuing STEM education?" were:

- Mainly cultural and gender biases
- The prejudice
- Search times
- I do not think there are real obstacles
- Cultural stereotypes; little public recognition; lack of financial resources
- Prejudices

The strategies selected by the respondents to answer question nine, "What strategies do educational institutions have to implement in order to encourage and support women in STEM careers" are dissemination and the awarding of scholarships, with 33.3%, while 16.7% chose tax incentives and the implementation of concerted actions.

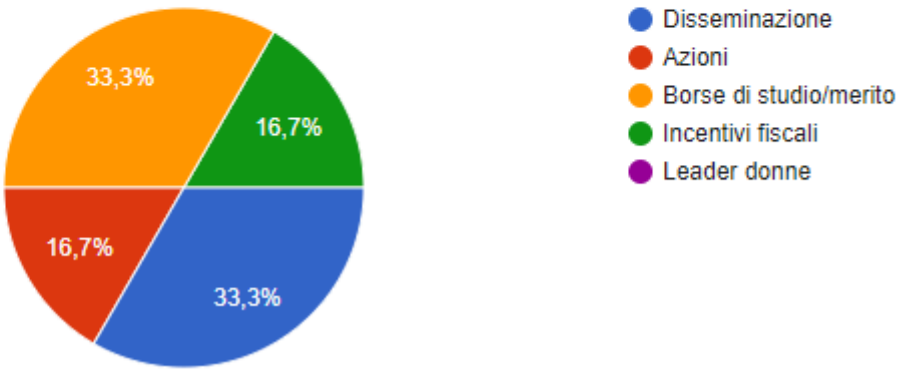


Figure 17 - EURO NET, Strategies for support women in STEM careers

The respondents from the Italian school - **IIS G. FORTUNATO - RIONERO IN VULTURE** to the first question, 66.7% answered yes and 33.3% answered no, as shown in the following graph.

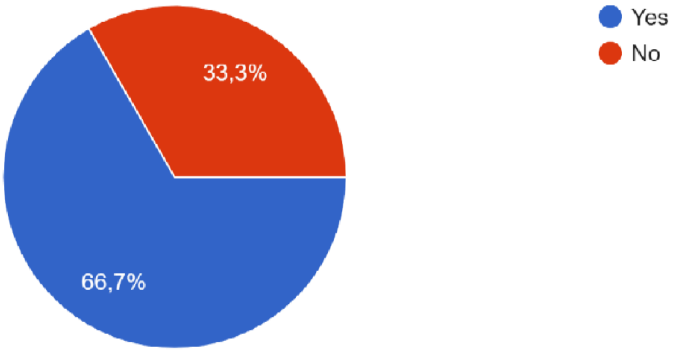


Figure 18 - IIS G. FORTUNATO, Advancements in gender equality in STEM

For question number two, only two of the four respondents who answered yes gave their reasons:

- GIS software applied to Earth Sciences;

- In 2023 women will make up only 28% of the entire STEM workforce. In the EU the percentage is even lower, just 17%. The number has increased significantly over the years thanks to the success of many initiatives and events created by educational organizations and facilities;

With regard to women's levels of involvement in STEM education programs, question number 3, the choices were balanced as 50% selected level 3 and 50% level 4, as can be seen in the following graph.

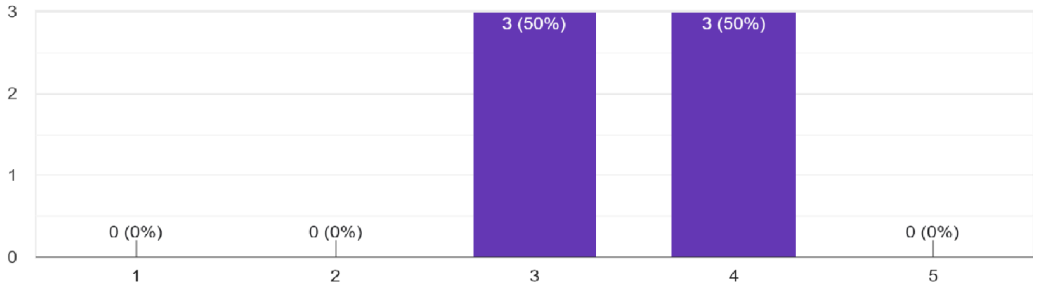


Figure 19 - IIS G. FORTUNATO, Women's levels of involvement in STEM education

The respondents consider that there are considerable differences in the representation of women in the different STEM fields (question number four) as 66.7% answered yes, as shown in the following graph.

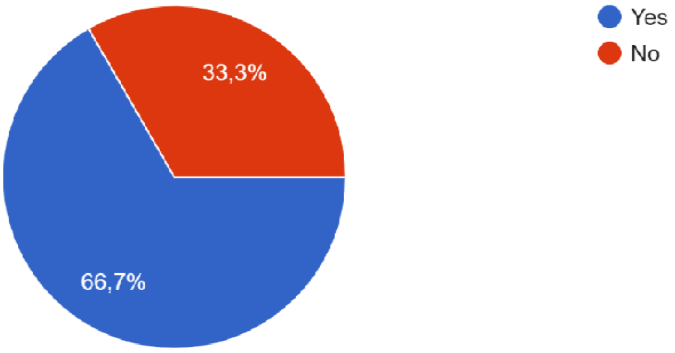


Figure 20 - IIS G. FORTUNATO, Representation of women in the different STEM

The areas they selected were evenly distributed between the sciences and engineering, with 50% each (see graph).

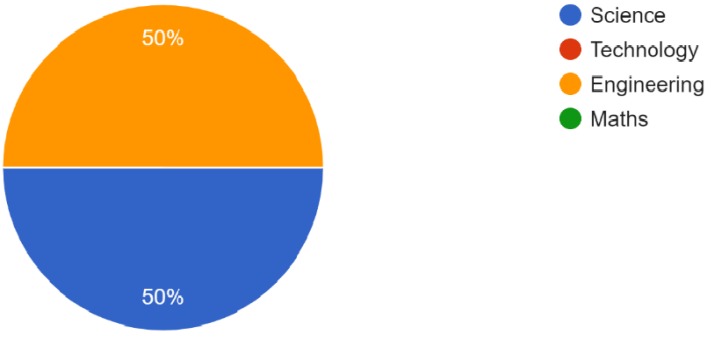


Figure 21 - IIS G. FORTUNATO, Women's focus areas

Regarding whether there are significant differences in the experiences of women from different cultural or ethnic backgrounds in the STEM fields, 66.7% think so as opposed to 33.3% who think not (question number five). As illustrated in the following graph:

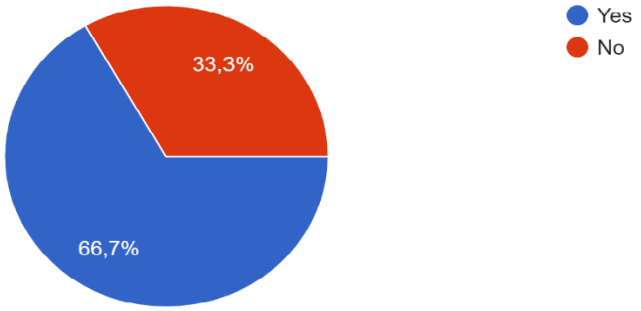


Figure 22 - IIS G. FORTUNATO, Women from different cultural or ethnic backgrounds

The main factors contributing to the under-representation of women in STEM education mentioned by the respondents were (question number six):

- Women are twice as likely to leave science and engineering jobs as men;
- I have always met female teachers who are competent in STEM;
- Scolarships are mainly granted to male students;
- The reasons why women who choose STEM paths are a minority are many and range from individual - factors to social and family background elements;
- I believe that nowdays there are no differences between men and women. In STEM education, there are a lot of women leaders for exemple;
- The fact that people believe that women are not so capable.

Of the four affirmative answers to question number seven, the barriers mentioned were:

- Women are not fully involved in maths-oriented labs and practices during High School activities
- A sort of psychological barrier for women, who from childhood are led to feel inferior to males in these ambitions. Furthermore, motherhood leads to work interruptions which hinder a career progression comparable to that of men.

The strategies chosen by respondents to be implemented by educational institutions in order to encourage and support women in STEM careers are 50% scholarships/merit awards and 16.7% for all other categories, as illustrated in the following graph.

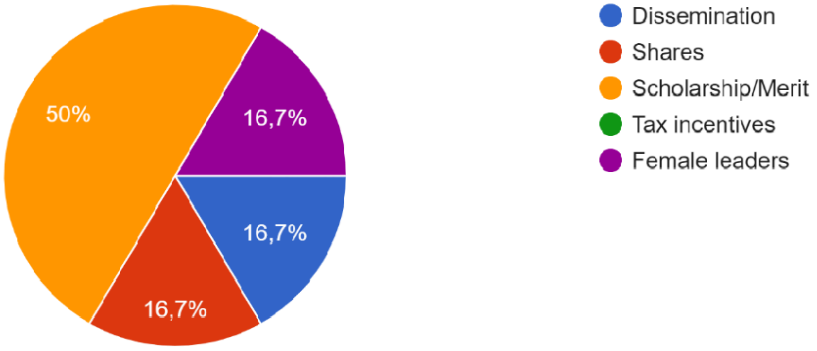


Figure 23 - IIS G. FORTUNATO, Strategies to encourage and support women

Regarding the first question, 83.3% of the respondents from the **Sou Pero Nakov school** in the Republic of North Macedonia answered that there had been an improvement in gender equality in STEM, as can be seen in the following graph.

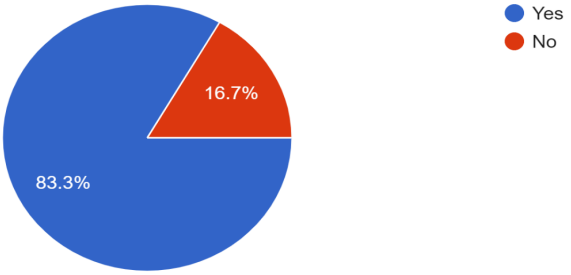


Figure 24 - Pero Nakov, Improvements in gender equality in STEM

As regards effective changes, question number two, the arguments put forward are:

- In Macedonia more and more women graduate on technical faculties: Mechanical engineering, Civil engineering, Architecture, IT, Electrical engineering. I graduated 2014 as Mechanical engineer, and whenever I would apply for a job, and then be there for an interview, I would witness that the engineering team was 100% male. Now I work in a company in which the ratio of male vs female engineers in my office is 9/8;
- More women can be seen studying and later taking up work positions in STEM fields;
- More women are becoming scientists, engineers, researchers;

The levels of women's involvement in STEM education programs (question number three) selected by the respondents were 50% level 7 and 33.3% level 8, as illustrated in the following graph.

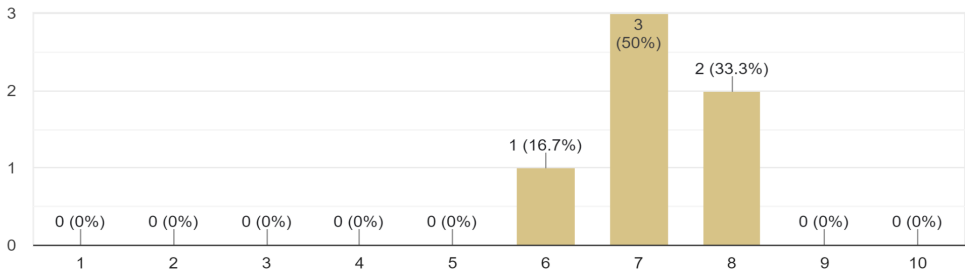


Figure 25 - Pero Nakov, Women's involvement in STEM education programs

The responses to the differences in the representation of women in STEM fields were very favourable, with 83.3% choosing yes, see the following graph.

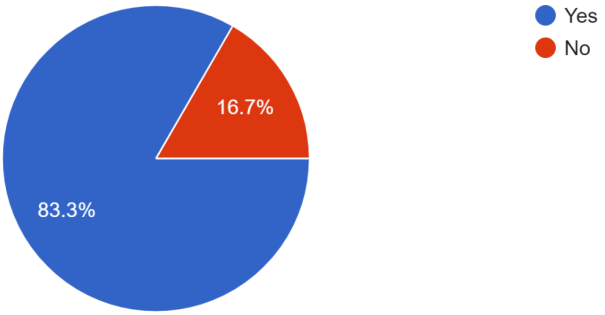


Figure 26- Pero Nakov, Representation of women in STEM fields

The areas that stand out most according to the respondents are engineering with 50% and the sciences with 33.3%, as shown in the graph.

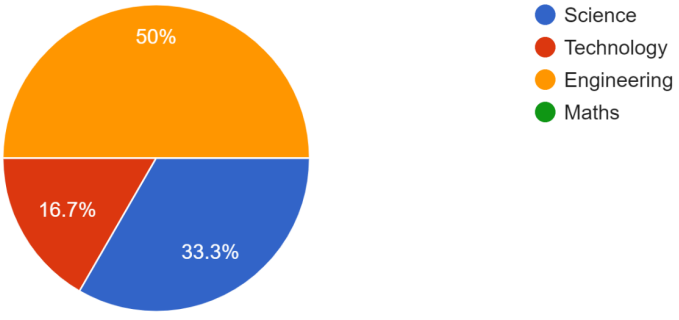


Figure 27 - Pero Nakov, Women's focus areas

The respondents' answers to question number five are clear in that 83.3% believe that there are significant differences in the experiences of women from different cultural or ethnic backgrounds in the STEM fields, compared to 16.7% who don't think so, as can be seen in the following graph:

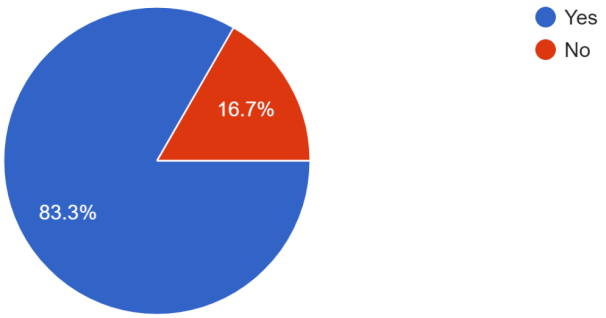


Figure 28 - Pero Nakov, Women from different cultural or ethnic backgrounds

According to the respondents' beliefs, the main factors contributing to the under-representation of women in STEM education are:

- Wrong perception for women's capabilities, general discrimination;
- Remnants of socialism where it was known that some things could only be done by men;
- Lack of good influence regarding women in STEM, stereotypes, discriminations.

The challenges or obstacles that women usually face in pursuing STEM studies identified by the respondents are:

- The view of society about what kind of occupation is for girls and for boys is still (to a certain extend) an obstacle. Some parents tend to influence the choice of their children about fields of study;
- Lack of support in educational systems, not being completely aware of the possibilities and opportunities of pursuing STEM education;
- Discrimination and being underestimated, etc.

Of those surveyed, 50% believe that the best way to motivate and support women to pursue STEM careers is by awarding scholarships/merit and 33% believe it is by having women in leadership, as illustrated in the following graph.

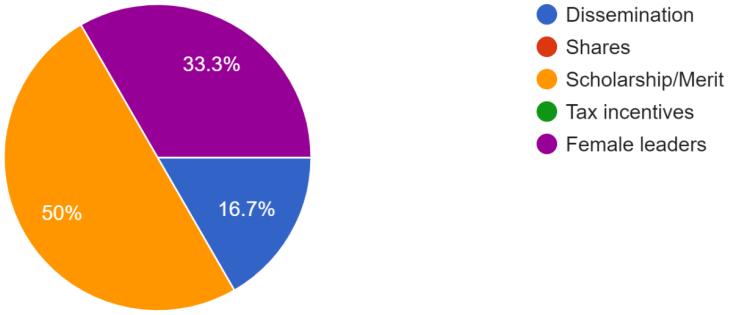


Figure 29- Pero Nakov, Way to motivate and support women to pursue STEM careers

The Portuguese partner - Geoclube - presented the following results for question number one: 83.3% of respondents believe that there has been progress in relation to gender equality in STEM (see graph below)

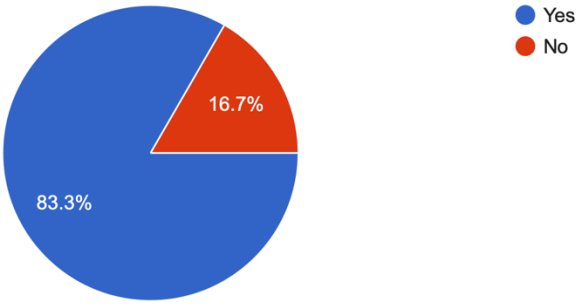


Figure 30 - In Portugal, Progress in relation to gender equality in STEM

Of the five respondents who answered yes, only two answered the second question:

- There are many women's working on investigations and with publications, in politics too;

- More women in science universities;

With regard to question number three, women's involvement in STEM education programs, 66.7% of respondents chose level 4, while two respondents chose level 3 and 5 respectively, as can be seen in the following graph.

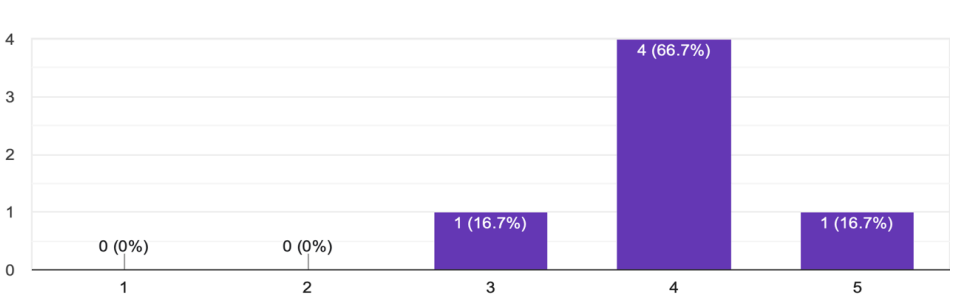


Figure 31 -In Portugal, Women's involvement in STEM education

With regard to question number four, 66.7% of respondents think that there are differences in the representation of women in STEM fields, with the areas of technology and engineering standing out with 33.3% each, as illustrated in the following two graphs.

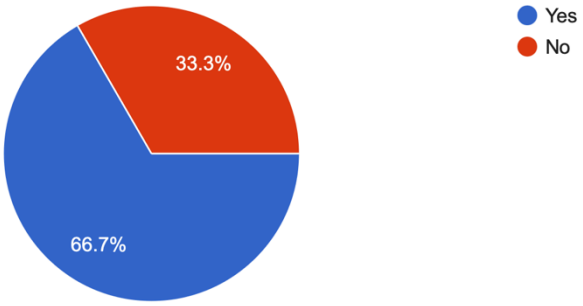


Figure 32 -In Portugal, Representation of women in STEM

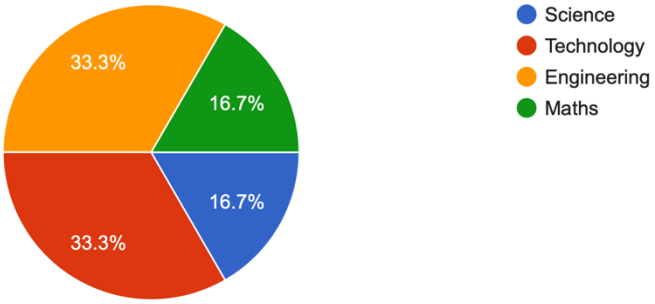


Figure 33 -In Portugal, Women's focus areas

Regarding whether there are significant differences between women of different cultures and ethnicities, the answers were the same: 50% think so and 50% think not, as can be seen in the following graph:

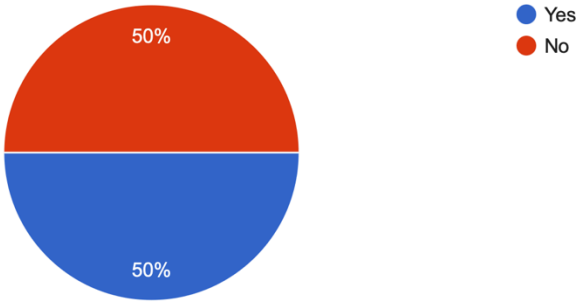


Figure 34-In Portugal, Women of different cultures and ethnicities

In Portugal, regarding the factors that contribute to a lower representation of women in the STEM education system, the answers were:

- I don't feel any difference
- Lack of interest, maybe?
- Ethnic background
- Effect of stereotype threat can negatively impact a student are held back by biases, social norms and expectations influencing the quality of the education they receive and the subjects they study.
- Old behaviour patterns. Lack of equal/real opportunities.
- Culture

Regarding the specific challenges and barriers that women face when pursuing STEM education, the following responses were obtained:

- this doesn't happen
- I think not
- No
- Gender stereotypes; Lack of representation
- Gender bias; Unwelcoming environment
- Work-life balance
- Need to demonstrate higher abilities than man in the field.
- Woman better then man but not recognized

What the respondents mentioned as the main strategies to encourage and support women who have chosen STEM careers are dissemination and the dissemination of female leaders, with 33.3% of the choices for each (see graph).

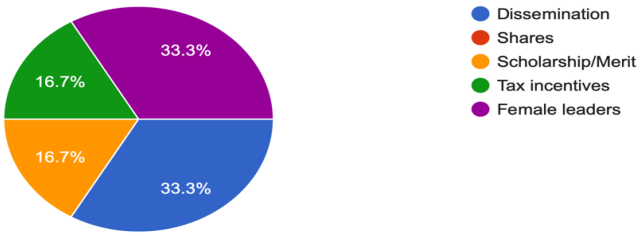


Figure 35 - In Portugal, Support women who have chosen STEM careers

The answers given by the respondents from Agrupamento de Escolas de Águas Santas de Portugal to the first question show that a significant majority, 83.3%, believe that there have been significant advances in gender equality in STEM, as illustrated in the graph.

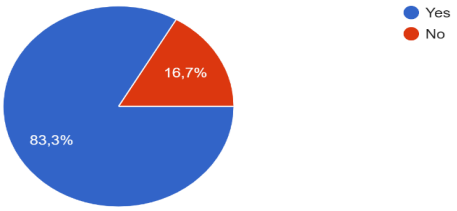


Figure 36 - In Portugal, Improvements in gender equality in STEM

When asked what these advances are, they mentioned the following:

- More females become accepted in PhD programs than years ago, within specific graduate programs women achieve now higher positions, programs and institutions give emphasis in the percentage of women in the particular field
- During the last decade, different actors, from government institutions and universities and research centres to civil society and international agencies, as well as private companies, have launched different types of initiatives aimed at reducing the gender gap in STEM
- A lot of improvements
- Better in general.

With regard to the level of involvement of women in STEM education programs, the majority of responses were 66.7% at level 3 and 33.3% at level 4, as can be seen in the following graph:

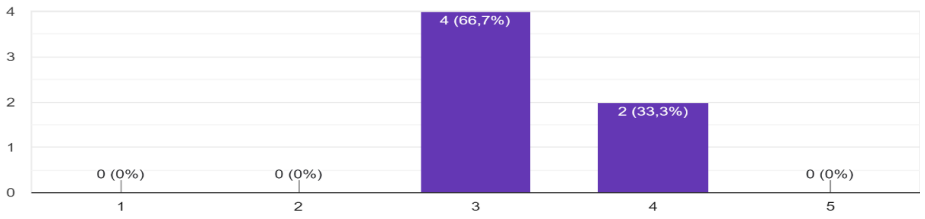


Figure 37 - In Portugal, Levels of involvement of women in STEM

Regarding question number four, the respondents were unanimous in their answers, as 100% replied that there are differences in the representation of women in the different STEM areas, see the following graph.

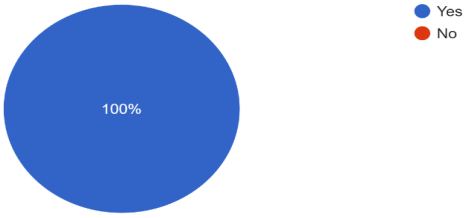


Figure 38 - - In Portugal, Women across different STEM fields

With regard to the areas in which women excel, 50% of the respondents opted for the sciences and 33.3% for technology, which is illustrated in the following graph.

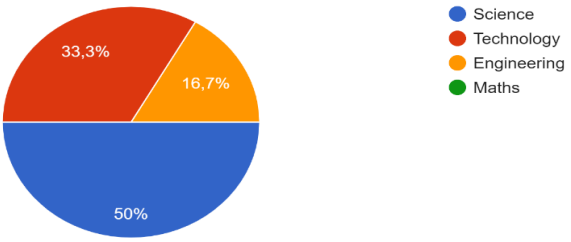


Figure 39- In Portugal, Women`s focus areas

As far as question number five is concerned, 66.7% of the respondents believe that there are significant differences between women from different cultures and ethnicities, while 33.3% do not (see graph).

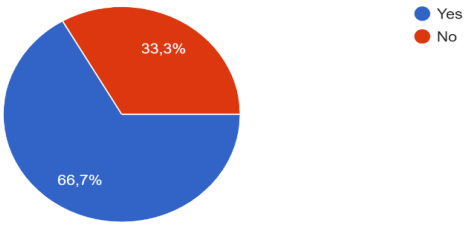


Figure 40- In Portugal, Women cultural or ethnic backgrounds in STEM fields

The main factors mentioned by the respondents that contribute to the under-representation of women in STEM education are:

- Old mindset that men are better than women in specific tasks (e.g. calculating, driving a car etc.) combined with the power which men feel towards a woman and make them believe they are better leaders, inconvenient working environment for women who also want to create a family combined and men who do not take any responsibility in the household.
- Lack of role models, there are fewer visible female role models in STEM can make it challenging for young women to envision themselves in these careers;
- Social norms and pressures, including from families, systematically keep girls away from science and mathematics;
- There are some tasks that are mainly performed by men;
- Systemic organisation;
- People's perception.

The challenges and barriers faced by women pursuing STEM education, according to the respondents, are:

- Women have to work much harder in order to convince themselves that they deserve the position they got or to get a new higher position, struggle with personal life;
- Work life balance;
- The lack of flexible work arrangements and family care responsibilities that women continue to shoulder in unequal proportions also limit the retention of women in science and engineering workplaces;
- Some cultural and/or religious expected behaviour;
- Not aware;
- Gender.

The most chosen strategies for supporting and encouraging women in STEM careers mentioned by the respondents are dissemination and publicising women leaders with 33.3%, followed by awarding scholarships and sharing, as shown in the following graph.

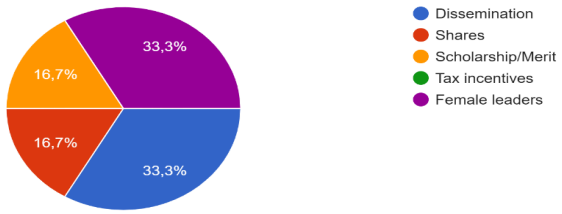


Figure 41 - In Portugal, Strategies to encourage women in STEM

4. Conclusions

After a careful analysis of the answers collected by the consortium partners, it is important to mention the main points on which the 36 women surveyed agree.

Regard to the progress made in terms of gender equality in STEM, the consortium respondents chose yes, with the respondents from Portugal and the Republic of North Macedonia standing out as having the highest choice, 83.3%.

The progress made by all the women interviewed by the consortium is as follows:

- the significant increase in the representation of women in STEM;

- Increased number of programs/initiatives/strategies by governments, universities and other organizations to motivate, support and encourage women to pursue STEM studies and careers.

As far as levels of involvement of women in STEM education programs, the respondents selected level 3 and 4.

Regarding the representation of women in the different areas, all the respondents broadly agree that there are differences, especially the case of the Portuguese respondents from the Águas Santas school group, who showed 100% agreement. In terms of areas of representation, Sciences and Engineering stood out.

In terms of significant differences in the experiences of women from different cultural or ethnic backgrounds in STEM fields, the majority of respondents said yes, especially the Italian women from the YES partner, with 100%.

The factors mentioned by all the respondents that contribute to the under-representation of women in STEM are:

- Gender stereotypes;

- Gender roles;

- Social expectations for women;

- General discrimination;

- Prejudices about women's skills and abilities;

- Cultural reasons;

According to the respondents, the barriers that women face the most are:

- Gender stereotypes;
- General discrimination;
- Cultural reasons;
- Gender roles;
- Prejudices;
- society's view of what professions/occupations should be for girls and boys.

The strategies to be adopted by educational institutions to support and motivate women in STEM careers highlighted by the majority of respondents were awarding scholarships/merit in first place and dissemination in second place.

The results obtained by the consortium reinforce and support the need to invest in implementing projects like this on the ground. The aim of developing and strengthening teachers' skills so that they can help improve girls' interest, commitment and achievement in STEM, leading them to increasingly opt for these areas in their school career, is undoubtedly the way forward.

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