STEM GenderIN

EQUALITY PEDAGOGY IN STEM:

An EU Framework

Rosa Monteiro, Lina Coelho, Inês Simões and Sofia Madeira

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STEM GenderIN

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EQUALITY PEDAGOGY IN STEM: AN EU FRAMEWORK

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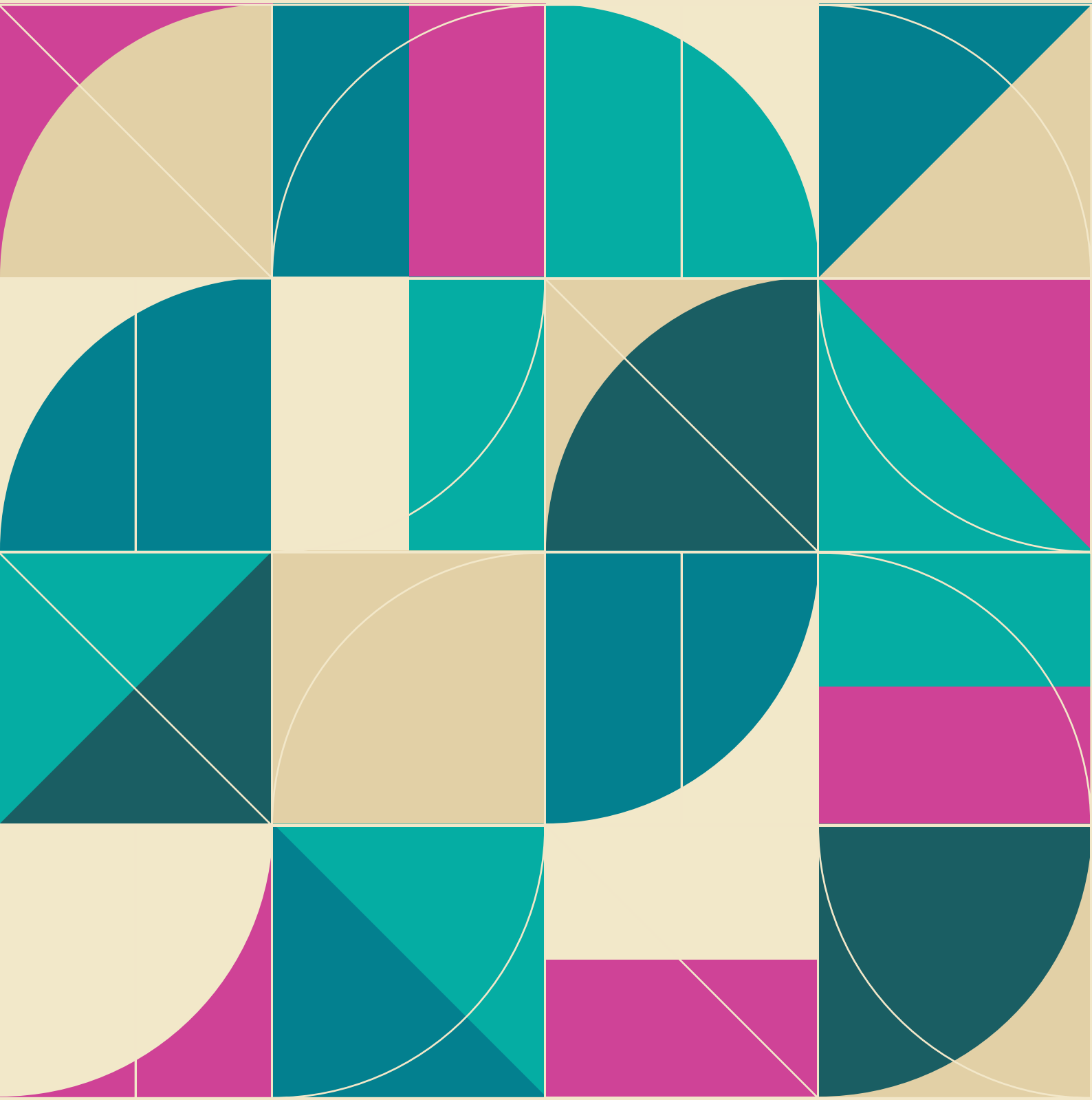

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FOREWORD

The "STEMGenderIN: A bridge to close the STEM gap with gender-inclusive education and teaching" is an Erasmus+ funded project [Project number 2023-1-BE01-KA220-SCH-000157164. Call KA220-SCH - Cooperation partnerships in school education project.], which seeks to reduce the gender gap in STEM fields of study by reinforcing the skills of the teachers of STEM courses in the teaching of STEM with a gender perspective.

The project is coordinated by Interface3.Namur (Belgium) and involves the following partner entities: Centre for Social Studies of the University of Coimbra (Portugal), the Euphoria Net Srl (Italy), M.Y.CULTURE (Italy), and Scoala Gimnaziala Nr. 16 Take Ionescu (Romania). This is a 24-month project whose start took place in September 2023. The main specific objectives of the project were:

- To sensitise the teachers of STEM courses (those who teach pupils between the ages 11-15, lower-secondary schools): challenge them on their inclusion skills and gender practices.
- To inform the teachers through the identification and creation of resource documents.
- To equip teachers with tailor-made tools to better integrate gender aspect in their practices with the students.
- To reinforce our capacity as actors in the school sector to address this issue and support any future school stakeholders on the matter.
- To develop a network of relevant parties and draw attention to the orientation role of the schools at a young age.

The STEMGenderIN project is organised around three main activities, to develop a digital mini-training programme including information, awareness raising tools and ready-to-use activities for STEM teachers to promote a STEM education with an effective gender perspective. Those activities are:

- To produce an EU framework on equality in STEM at school and education, presented in this publication which provides a robust scientific foundation for the construction of the tools, consolidating existing research and practices to address gender disparities in STEM education effectively.

[1] Project number 2023-1-BE01-KA220-SCH-000157164. Call KA220-SCH - Cooperation partnerships in school education project.

- To develop a tailor-made suite of tools for equality in STEM pedagogy, where awareness and ready-to-use tools will be developed, mainly available in digital format to ease their dissemination and spreading. The tools encompass resources for raising awareness regarding gender bias in STEM education, alongside practical, ready-to-use activities specifically designed for classroom implementation.
- To create a multilingual platform as a reference sharepoint to support gender equity in STEM in the classroom.

The project is divided into 4 Work Packages (WP), the second one (WP2) corresponding to the core activities of scientific and technical research about STEM gender gap, STEM education and equality pedagogies.

WP2 was coordinated and developed by the Centre for Social Studies of the University of Coimbra (Portugal), by the researchers Rosa Monteiro and Lina Coelho. Between September 2023 and June 2024, the team carried out intensive work of data collection and scientific analysis, presented in the two documents produced.

The first publication **Equality Pedagogy in STEM: An EU Framework** offers a deep exploration of:

- Data, analytical tools and fundamental elements for the explanation of the persisting gender inequalities and gaps in STEM fields and in STEM education.
- Challenges within STEM education that contribute to this persistent gap.
- The European regulatory framework on this issue.
- Research findings from a survey to teachers in the partners' countries.
- A systematic analysis of reference practices for gender-sensitive STEM education.
- An annotated scientific literature list.
- A list of the essential inclusive language manuals (in Portuguese, French, Italian, Romanian and English).

The second document produced is the **Guide for including gender in STEM schools and education - main recommendations on a three-dimensional model**, published under a separated volume. This publication presents comprehensive recommendations, resources and information that resulted of the analysis developed to establish a framework of knowledge about the role of education, schools, teachers and other professionals and actors (e.g., parents and families) in the educational and professional decisions of girls regarding STEM. Authors believe it contributes not only for the STEMGenderIN activities, and for schools' and teachers' guidance and training, but also as a reference document for other European initiatives and stakeholders (academia, trainers, NGO and public authorities) in this area.

Equality Pedagogy in STEM: An EU Framework is structured into two parts.

Part I delves into compared data and facts, and also into conceptual frameworks surrounding the gender gap in STEM and in STEM education. It examines the specific characteristics of STEM education and its potential contribution to the gender gap, thus emphasising the importance of equality pedagogies in these fields of study. It also presents relevant European normative regulations on gender mainstreaming in education, with a specific focus on STEM education.

Part II offers the results of the empirical research undergone, namely the findings from questionnaires administered to teachers (about their needs and perspectives) in Belgian, Italy, Portugal and Romania. Then, a selection and analysis of twenty pedagogical practices. A commented list of thirty key scientific literature references follows. Finally, a set of guides for inclusive language is presented.

INTRODUCTION

Gender sensitive pedagogies in STEM: A foundational framework for gender equality education

The acronym STEM, while widely recognised, lacks a universally accepted definition. The very definition of STEM remains a contentious issue, encompassing not only the scientific fields it represents but also the pedagogical approaches employed in its education (Li *et al.* 2020).

The acronym STEM does not have a one-size-fits-all definition. In fact, there is some ambiguity and complexity due to multiple perspectives in the definition and specification of what constitutes STEM and STEM education (Li *et al.*, 2020; Aguilera & Ortiz-Revilla, 2021). It was originally proposed in the context of the United States of America, by the National Science Foundation (NSF).

The acronym includes sciences, technologies, engineering, and mathematics, but as an umbrella term used to group together disciplines that can be very different, even when we look for gender gaps in these educational and professional realms. For instance, there is a globally bigger representation of women in sciences and mathematics than in engineering and technologies. Alice Eagly (2021) proposes the concept of "inconsistent gender gap" to express this differentiation.

In terms of STEM education, disciplinary-specific methods centred on subjects like biology, physics, technology, engineering, or mathematics remain prominent (UNESCO, 2019).

However, a growing emphasis exists on interdisciplinary, transdisciplinary, and also multidisciplinary pedagogies that bridge these divides and promote holistic learning.

According to UNESCO's proposals to the teaching of "STEM Competences for the 21st Century" (UNESCO, 2019: 28-29), a "multidisciplinary approach uses a theme that appears in each STEM and core course during

> "discipline-specific approach is adopted in the majority of schools, at secondary levels, with perhaps more integration evident at primary level. It tends to be common practice that all students learn the subject areas of science and mathematics. Technology and engineering related subjects such as Design and Technology, ICT, IA, Data Science, Computer Science and Electrical Engineering tend to be offered as electives, especially at secondary schools. STEM-related vocational courses are sometimes provided in secondary schools."
>
> **(UNESCO, 2019: 27)**

the same time period to draw connections among subjects. The subjects, however, may be taught separately and the connections are made through teacher and student reflection"; an "interdisciplinary approach achieves a higher level of integration across subjects, for example, by focusing on a shared concept, such as "cause and effect" (...). In an effective interdisciplinary approach, relevant disciplines come together to blur and overcome any separation of skills and knowledge within the disciplines."; a "transdisciplinary approach goes further than interdisciplinary, by seeking to fully dissolve the boundaries between the conventional disciplines and organises teaching and learning around the construction of meaning in the context of real-world problems or themes".

According to Hsu and Fang (2019 *apud* Sellami *et al.*, 2022) there are two distinct approaches adopted in STEM education. One is both interdisciplinary and transdisciplinary and treats the contents of the different STEM disciplines as integrated and interrelated components. The other employs a multidisciplinary instructional approach that views STEM discipline contents as a cluster or constellation of individual STEM fields of study.

Lately, the acronym STEM has been expanded to encompass the arts, forming STEAM (Science, Technology, Engineering, Arts, and Mathematics). This expansion reflects the growing recognition that real-life problem-solving often requires flexible thinking and creativity, transcending disciplinary boundaries. STEAM approaches aim to enhance students' motivation by providing them with multiple ways to engage with STEM learning, integrating subjects such as design, humanities, and arts. The fact is that both STEM and STEAM education lack a clear conceptual framework with broad consensus within the scientific–educational community (Aguilera & Ortiz-Revilla, 2021).

In this guide and project report, we focus only on STEM, as stipulated in the application, not including Arts and Humanities. Within the framework of STEM education, we embrace a dual perspective: one centred on individual disciplines and the other open to uncovering interdisciplinary and transdisciplinary pedagogical practices and experiences.

There is a need to do a lot more in terms of academic and non-academic work about gender and diversity gaps in STEM education.

Gender-sensitive pedagogy is a transformative approach to education that acknowledges the profound impact of socially and culturally constructed gender differences and asymmetries on societal structures and

power relations. It challenges the naturalisation of these inequalities and empowers educators to foster a learning environment that promotes gender equality and diversity. On our conceptualization, gender-sensitive pedagogy encompasses the following main dimensions:

Recognising gender differences and their impact

Gender-sensitive pedagogy begins with the recognition that gender differences are not inherent but rather constructed through social and cultural interactions. These differences have shaped fundamental organising principles of society and institutions and historically underpinned asymmetrical power relations. This understanding is crucial for educators to critically examine and challenge the often-naturalised gender biases that permeate educational settings.

Deconstructing gender stereotypes and promoting inclusive environments

Gender-sensitive pedagogy actively challenges the rigid categorisation of roles, expectations, and behaviours associated with men and women. It encourages critical thinking and open dialogue to dismantle these stereotypes, revealing their detrimental impact on individuals' self-perception, aspirations, opportunities and achievements. By fostering inclusive and egalitarian learning environments that celebrate diversity and respect all students, regardless of their gender, teachers can create a space where students feel empowered to express themselves authentically and reach their full potential.

Implementing gender-equitable practices and embracing a relational approach to gender

Gender-sensitive teaching extends beyond the classroom, encompassing the development of curricula, assessment methods, and school policies that promote gender equity. It involves a whole-school approach and a critical evaluation of existing practices to identify and eliminate biases or discriminatory elements. This approach acknowledges that gender is not merely about the experiences and needs of women but emerges from complex socio-historical interactions that construct cleavages and hierarchies between "men" and "women."

Incorporating gender-consciousness into initial and continuous teacher training and education systems

While ongoing professional development plays a vital role in fostering gender- sensitive pedagogy, a more systemic approach is necessary. We need to integrate gender-consciousness throughout both initial and continuous teacher training and within education systems themselves. Ongoing professional development for educators involves engaging in workshops, seminars, and self-reflection to deepen their understanding of gender issues and enhance their ability to implement gender-equitable practices in their classrooms and learning environments.

A critical and gender-sensitive pedagogy must incorporate awareness of the economic and social conditions that produce inequality.

Notwithstanding, current EU teacher education policy, with its emphasis on performance metrics and competency frameworks, presents a significant barrier to fostering gender-sensitive pedagogy in their training and performance (Purdy *et al.*, 2023). This focus on performativity overshadows the crucial element of critical reflection on societal constructions of gender.

Margot and Kettler's (2019) systematic review of research exploring the teachers' perception regarding STEM education noted six key barriers that thwart STEM teaching, associated with the curriculum, pedagogy, assessment, teacher support, students, and structural systems. They found hindrances that impede the implementation of effective interdisciplinary modes of teaching STEM – e.g. teachers' beliefs, knowledge, and understanding of STEM; poor teacher preparation, lack of professional development for teachers; shortage of teachers; poor cross-disciplinary content integration; low student motivation; inadequate facilities.

To address these challenges, there is a need for a fundamental shift, towards an alternative pedagogical approach, with a holistic perspective centred on values and equality, more student-centred and that empowers teachers. UNESCO manual on the STEM competences for the 21st century also emphasises that a student-centred approach to STEM education is crucial, focused on students' capabilities and misconceptions about STEM professions and gender roles, connections, real-world and cultural relevance, and on cooperative learning (UNESCO, 2019).

Add an intersectional perspective to teaching

Whilst striving for gender equality in STEM education is crucial, we must also acknowledge that gender is not the sole factor influencing an individual's experiences. Intersecting axes of discrimination can further exacerbate the barriers and unequal treatment faced by women. These intersecting factors include age, class, racial or ethnic background, sexual orientation and gender identity, geographical location, religion, health, disability, poverty, and more.

Consider the example of a young girl with disabilities who belongs to a minority ethnic group. She occupies the intersection of multiple social identities that have been historically marginalised. This intersectionality intensifies the likelihood of encountering mistreatment, neglect, and vulnerability. To ensure her success in STEM education, we must address the unique challenges she faces due to this complex interplay of factors.

CHAPTER 1

The problem – figures and facts

"Educational choices and career expectations of pupils in compulsory education are still strongly influenced by gender stereotypes, with qualitative data showing that in general a more limited effort is made to break down those affecting the choices of boys. Boys are much more likely to choose STEM subjects, while girls typically predominate in subjects such as art, the humanities, care and education. Boys are also more likely to choose vocational rather than academic pathways"

(EC, Directorate-General for Education, Youth, Sport and Culture *et al.*, 2021: 159).

"Gender gaps seem to emerge in secondary education around the educational choices and along the related trajectories that boys and girls undertake"

(EC, Directorate-General for Education, Youth, Sport and Culture & Viarengo, 2021: 13).

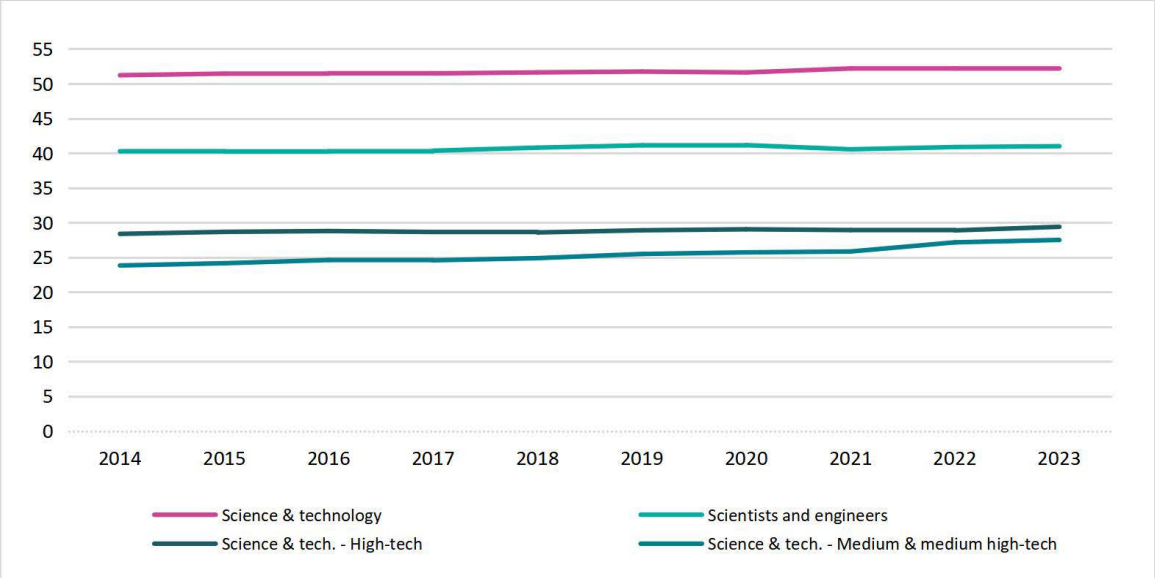
"Gender segregation narrows life choices, education and employment options, leads to unequal pay, further reinforces gender stereotypes, and limits access to certain jobs while also perpetuating unequal gender power relations in the public and private spheres. (...) In the presence of gendered barriers, numerous sectors such as engineering and ICT fail to attract or retain women workers, despite the immense growth prospects and a shortage of specialists. (...) In the fast-changing and digitalising world of work, where every talent count, this undermines the realisation of the EU's full innovative and economic potential"

(EIGE, 2018: 11).

1. Gender segregation in the labour market

Gender segregation in the labour market across both sectors and occupations is pronounced and has remained quite stable in the last years. Women tend to be overrepresented in sectors with average low pay, such as care and education. According to gender stereotypes, the soft skills required for care, such as communication and empathy, tend to be considered skills that would come naturally to women and, as such, society tend to attribute low economic value to such work (European Commission, 2024). At the same time, women are underrepresented in STEM careers. In the EU27, on average about 52% of people employed in science and technology sectors were female in 2023. But women accounted for only 41% of scientists and engineers; just about 29% of scientists and engineers in high-technology sectors and only 27,5% in high and medium high technology-manufacturing (figure 1). Moreover, during the last decade these figures showed negligible change, the most pronounced being an increase in 3.7 percentage points (p.p.) in high and medium high technology-manufacturing.

Figure 1 – Women in STEM careers in the EU27 (%)



Source: Eurostat [hrst_st_nsecsex2]

The gender gap is especially pronounced in the ICT sector. In 2023, just 19.4% of ICT specialists in the EU27 were female, although with some significant variations by country: from a minimum of 12.4% in Czechia to a maximum of 29.1% in Bulgaria[2].

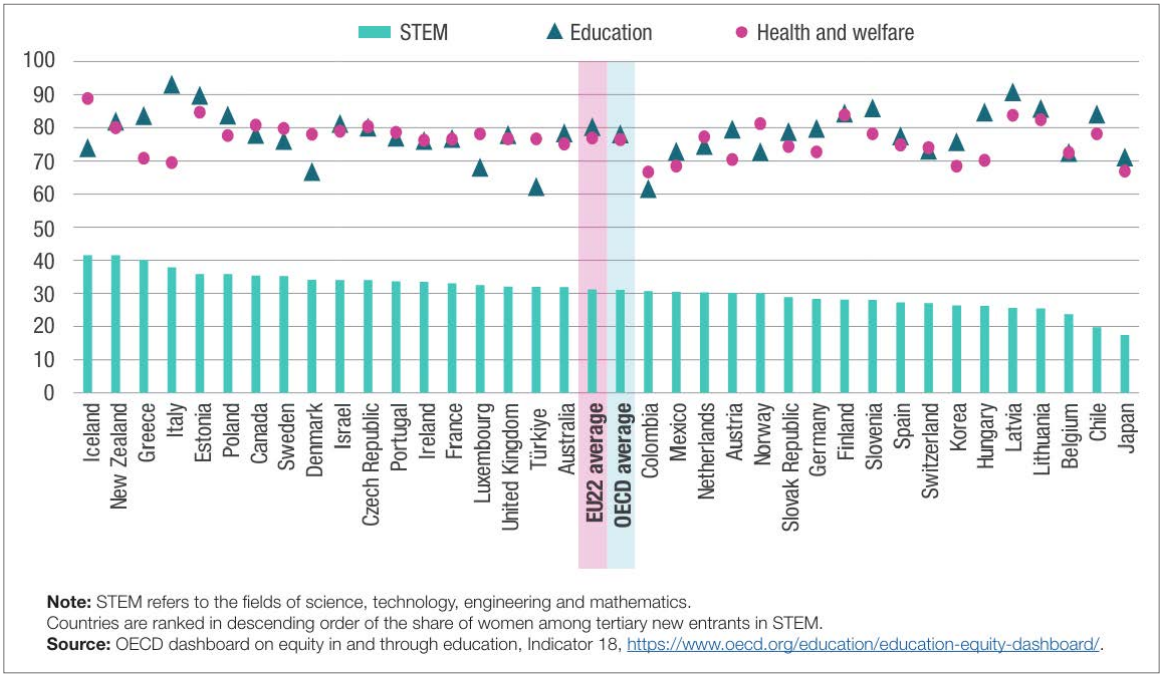
Gender gaps in STEM careers also applies to teaching. The 2018 Teaching and Learning International Survey showed that 31% of upper secondary school male teachers teach STEM subjects compared to 25% of female (OECD, 2021).

2 Eurostat [isoc_sks_itsps]

2. Gender segregation in education

Gender segregation in education keeps on being very pronounced. In OECD countries, on average, women make up over 75% of new entrants in education, health and welfare (OECD, 2024). But in the STEM fields women account for just 31% of new entrants (figure 2).

Figure 2 - Share of women among new entrants to tertiary education, by selected fields of study (2020) (%)



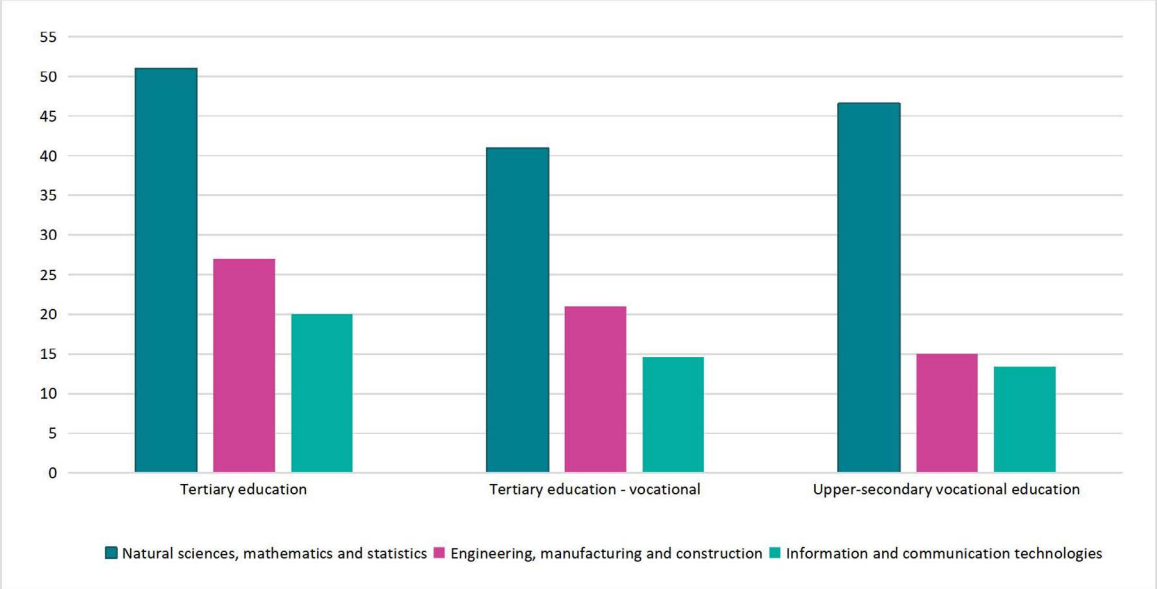
Note: STEM refers to the fields of science, technology, engineering and mathematics.
Countries are ranked in descending order of the share of women among tertiary new entrants in STEM.
Source: OECD dashboard on equity in and through education, Indicator 18, https://www.oecd.org/education/education-equity-dashboard/.

Source: OECD, 2024

In the EU27, about 54% of new entrants in tertiary education were women in 2021. Still, on programmes in STEM-related fields - natural sciences, mathematics and statistics; engineering, manufacturing and construction; and information and communication technologies (ICT) - only 31.6% were female (figure 3). While women represented around 51% of students in natural sciences, mathematics and statistics; only 27% of students in engineering, manufacturing and construction and around 20% of students in ICT were female. Romania and Sweden were the countries doing better in ICT, with around 32% of female entrants, while some other countries did much worse, showing figures under 15% (Belgium, Lithuania, Spain, Slovakia, Netherlands).

In upper vocational education, female participation in STEM fields is even lower (figure 3). While women represented 41% of students in natural sciences, mathematics and statistics, they accounted for just around 21% of students in engineering, manufacturing and construction and 14.6% in ICT.

Figure 3 - Share of female enrolments on programmes in STEM fields, EU27 (%)



Source: Eurostat [educ_uoe_ent02]

While men in the last 10 years were, on average, around 46% of tertiary graduates, they represented just over 80% of total ICT graduates; in other words, women graduates in the ICT sector were less than 2% of female graduates, increasing only by 0.6 percentage points between 2013 and 2021 [3].

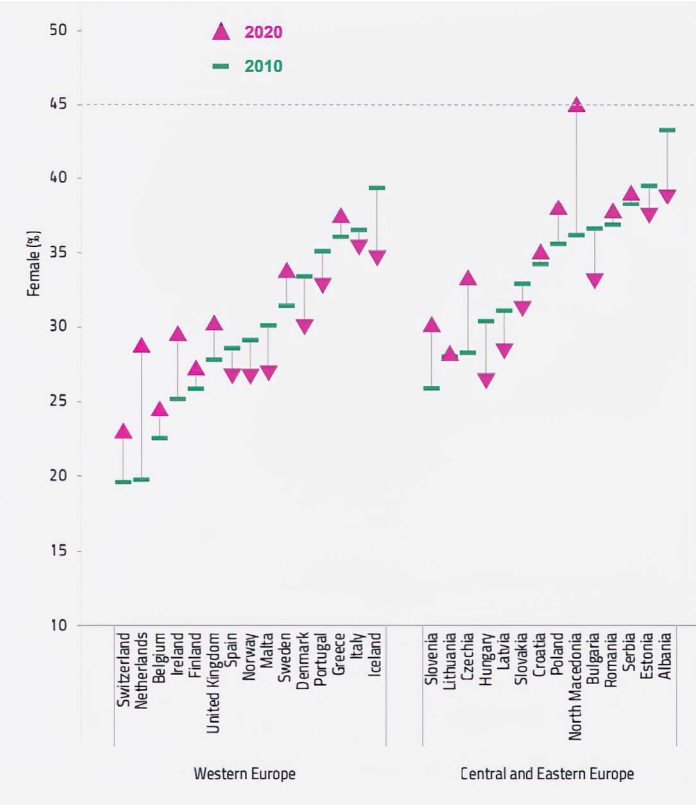
In upper secondary vocational education, girls represented on average 41% of new entrants in 2021. Still, only 15.4% of students in STEM fields were girls (figure 3). However, there were significant variations across disciplines: 46.6% of new entrants in natural sciences, mathematics and statistics were girls; but only 15% of new entrants in engineering, manufacturing and construction and 13.4% in ICT.

Data from the UNESCO Institute for Statistics (UNESCO 2023) shows that, globally, women also made up only 35% of STEM graduates in 2018-23, with no progress over the past ten years. (Figure 4). In European and other high-income countries, the share of women in STEM fields of study drops heavily at the end of secondary school.

Gender disparity in programming skills is also large, especially in rich countries (figure 5). For instance, for every 100 young men with programming skills, there are only 21 young women in Ireland, 24 in Hungary and 28 in Austria with such skills. But this is not a universal pattern: for every 100 young men with programming skills, there are 105 young women in Malaysia, 110 in Saudi Arabia, 118 in Albania and 130 in the State of Palestine with such skills (UNESCO, 2024).

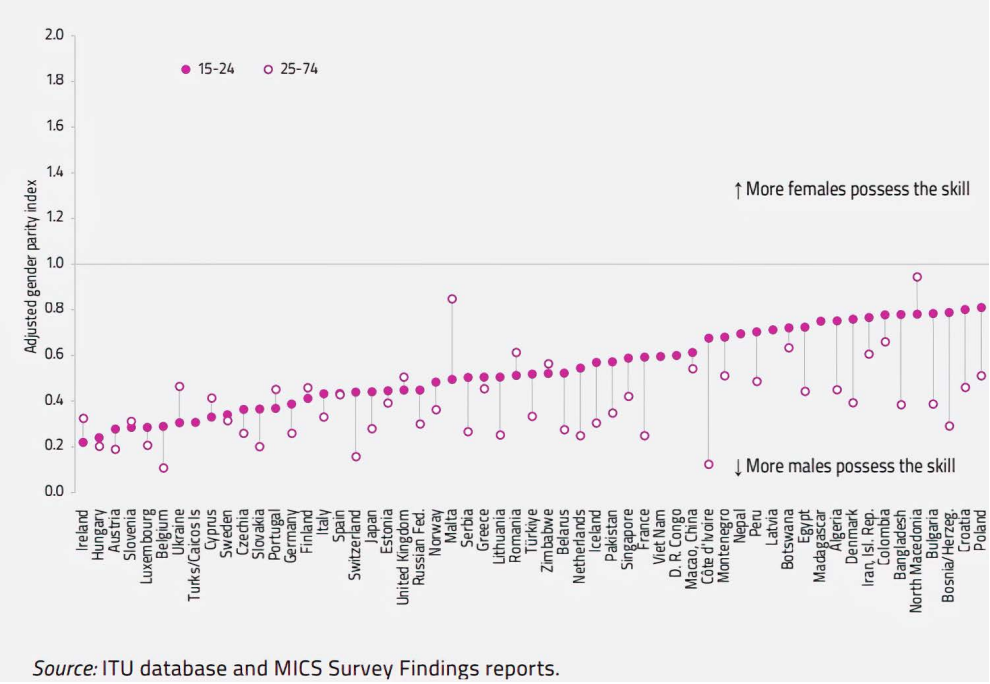
3 Source: Eurostat [educ_uoe_enrt03]]

Figure 4 - Share of female STEM graduates, selected countries, 2010–11 and 2020–21



Source: UIS database. Adapted from UNESCO, 2024:43

Figure 5 - Adjusted gender parity index of the ability to write a computer program using specialised programming language, by age group, 2014–21

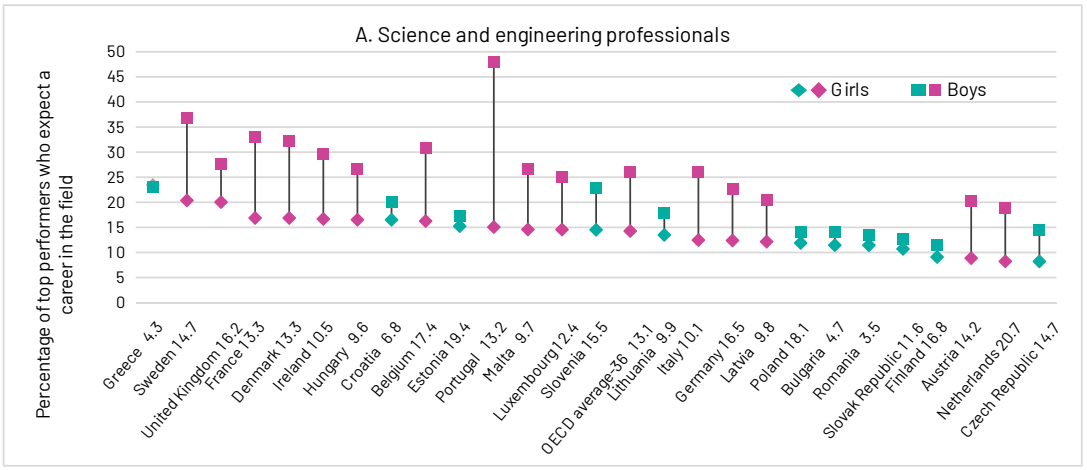


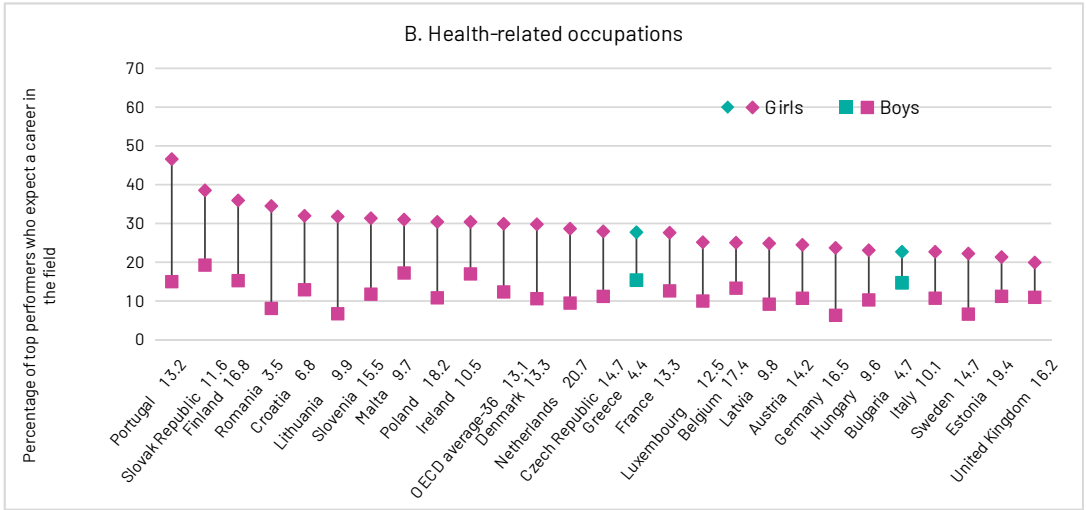
Adapted from UNESCO, 2024:32

3. Career expectations of adolescents

Gendered career preferences show up early in life. Data results from the Program for International Student Assessment (PISA) 2018 shows significant gender differences in career expectations between15-year-olds. Among the top ten occupations 15-year-old girls reported to expect for themselves, seven were in the health-care sector and three related to teaching, law professions and policy and planning management. Instead, boys reported a wider range of occupations, such as athletes, engineering professionals, motor-vehicle mechanics and police officers. Even when boys and girls showed similar performance, fewer girls reported that they want to pursue a science, technology, engineering and math (STEM) career compared to boys (OECD, 2019). These results also apply to top performer students in mathematics and/or science which are critical disciplines for successful STEM paths (figures 6 and 7).

Figure 6 and 7 - Gender gap in career expectations amongst top performers in mathematics and/or science (%)





Notes: Statistically significant differences between girls and boys are show in a darker tone. For students' career expectations, results are only available for the French community in Belgium. "Top performers" refers to students who attain at least Level 2 in all three core subjects and Level 5 or 6 in math and/or science. OECD average-36 refers to the arithmetic mean across OECD countries (and Colombia), excluding Spain. Countries and economies are ranked in descending order of the percentage of top performing girls who expect a career in the field

Source: OECD, PISA 2018 Database, Tables II. B1.8.22 and II. B1.8.23. Source: OECD (2020)

4. Gender differences in proficiency at the end of lower secondary education

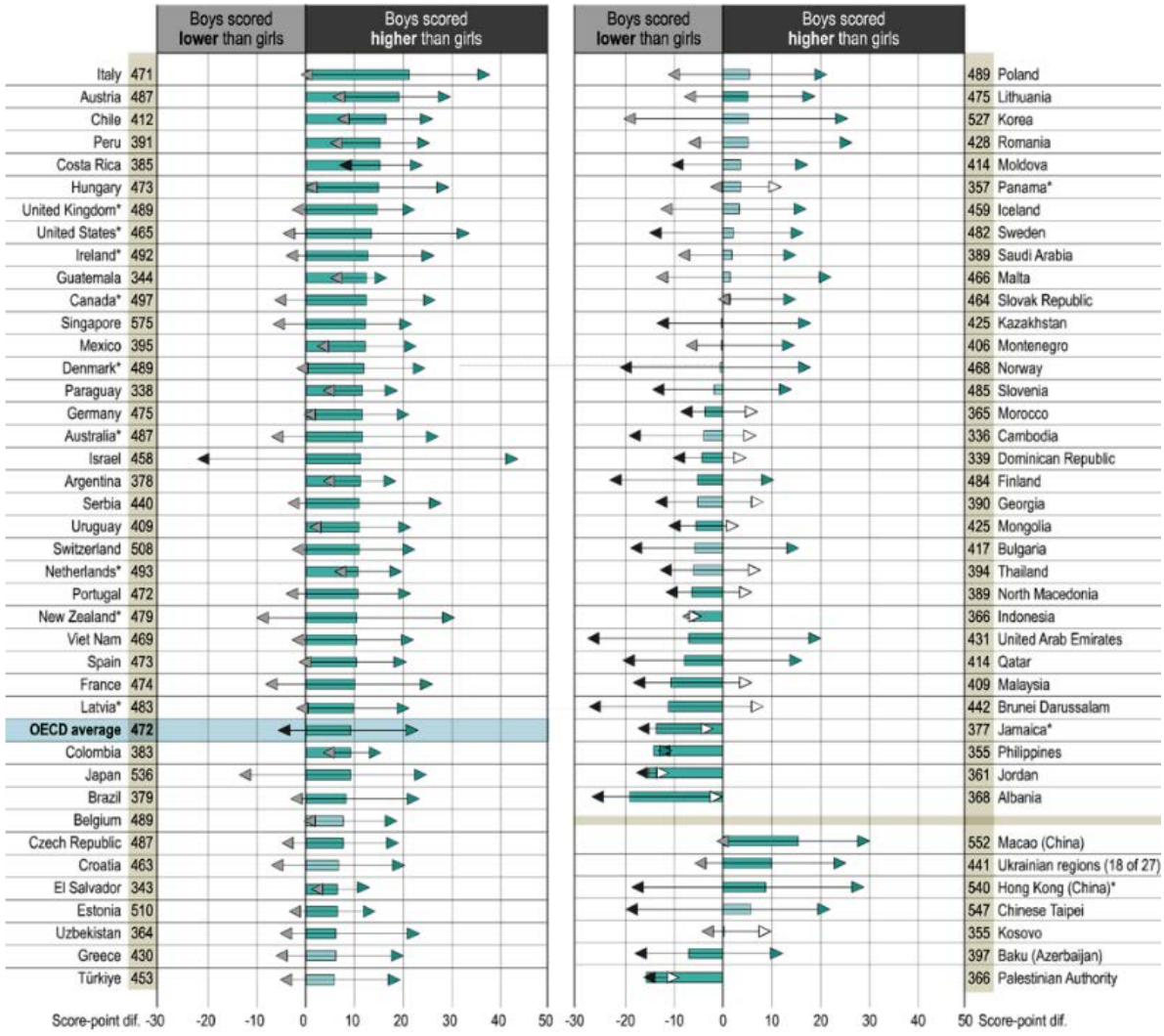
The recent UNESCO report *Global Education Monitoring Report: Gender report – Technology on her terms* (UNESCO, 2024) refers to the gender differences in student performance that result from stereotypical attitudes and behaviours. Boys are significantly more likely than girls to be disengaged from school, get lower marks, repeat grades, and play video games in their free time. Girls tend to behave better in class, get higher marks, spend more time doing homework, and read for enjoyment, particularly complex texts such as fiction, in their free time (OECD, 2019). Girls are also less likely to repeat grades. But the magnitude of the gender gap in student performance varies across countries and, over the past few decades, many countries have made significant progress in narrowing, or even closing, the gender gap in educational attainment (Van Bavel, Schwartz and Esteve, 2018). For instance, on average, OECD countries are close to gender parity in mathematics proficiency but the ratio still favours boys over girls (0.98). But in seven countries (Belgium, Croatia, France, Israel, Latvia, Macao-China and Romania) there is no gap (UNESCO, 2024:106). This means that gender-related disparities in achievement appear to be neither innate nor inevitable (UNESCO, 2024:123) as they are not explained by innate ability but reinforced by social and cultural contexts.

The 2022 PISA results confirmed average gender differences in students results (OECD (2023). As shown in figure 8, boys outperformed girls in mathematics by nine score points on average across OECD countries. While boys outperformed girls in mathematics in 40 countries, girls outperformed boys in another 17 countries or economies. Among European countries the widest gaps in mathematics performance in favour of boys (15 score points or more) were observed in Austria and Italy. In 24 countries, the difference in mathematics performance between boys and girls was not statistically significant.

Moreover, the gender gap in mathematics performance has not changed over the last decade in most PISA participating countries/economies (53 out of the 64 with comparable data). The gender gap has changed over the last decade in another eleven countries/economies. Still, the gap has narrowed in eight of them and it has widened in three of them.

Anyway, in no country the share of top performers in mathematics was larger among girls than boys. And the highest-performing boys in mathematics (10% of top performers) outperformed the highest-performing girls on average across OECD countries (22 score points difference) and in most countries/economies. The under-representation of girls among top performers in science and mathematics can partly explain the persistent gender gap in careers in science, technology, engineering, and mathematics (STEM) fields.

Figure 8 - Gender gap in mathematics performance



Notes: The mean score in mathematics is shown next to the country/economy name. Statistically significant differences are shown in a darker tone (see Annex A3).

Countries and economies are ranked in descending order of the scorepobb difference in mathematics related to gender (boys minus girls).

Source: OECD, PISA 2022 Database, Tables I.131.2.1 and I.B1.4.17.

Source: OECD (2023), Chapter 4 - Equity in education in PISA 2022, Figure I.4.7 [4]

4 https://www.oecd-ilibrary.org/sites/53f23881-en/1/3/5/index.html?itemId=/content/publication/53f23881-en&_csp_=de697f9ada06fe758fbc0d6d8d2c70fa&itemIGO=oecd&itemContentType=book#figure-d1e6557-0ddb24f583

In contrast to mathematics, on average across OECD countries, girls outperformed boys in reading by 24 score points (mean score difference). This result occurs in all countries/ economies, with only two exceptions (figure 9). Moreover, girls outperformed boys in reading at both extremes of the performance distribution. In no country/economy is the share of top performers in reading larger among boys than girls (UNESCO, 2024:124).

Figure 9 - Gender gap in reading performance

**Caution is required when comparing estimates based on PISA 2022 with other countries/economies as a strong linkage to the international PISA reading scale could not be established (see Reader's Guide and Annex A4).

Notes: The mean score in reading is shown next to the country/economy name.

Statistically significant differences are shown in a darker tone (see Annex A3).

Countries and economies are ranked in descending order of the score-point difference in reading related to gender (boys minus girls).

Source: OECD, PISA 2022 Database, Tables 1.41.2.2 and 1.41.4.18.

Source: OECD (2023), Chapter 4 - Equity in education in PISA 2022, Figure I.4.8 [5]

5 https://www.oecd-ilibrary.org/sites/53f23881-en/1/3/5/index.html?itemId=/content/publication/53f23881-en&_csp_=de697f9ada06fe758fbc0d6d8d2c70fa&itemIGO=oecd&itemContentType=book

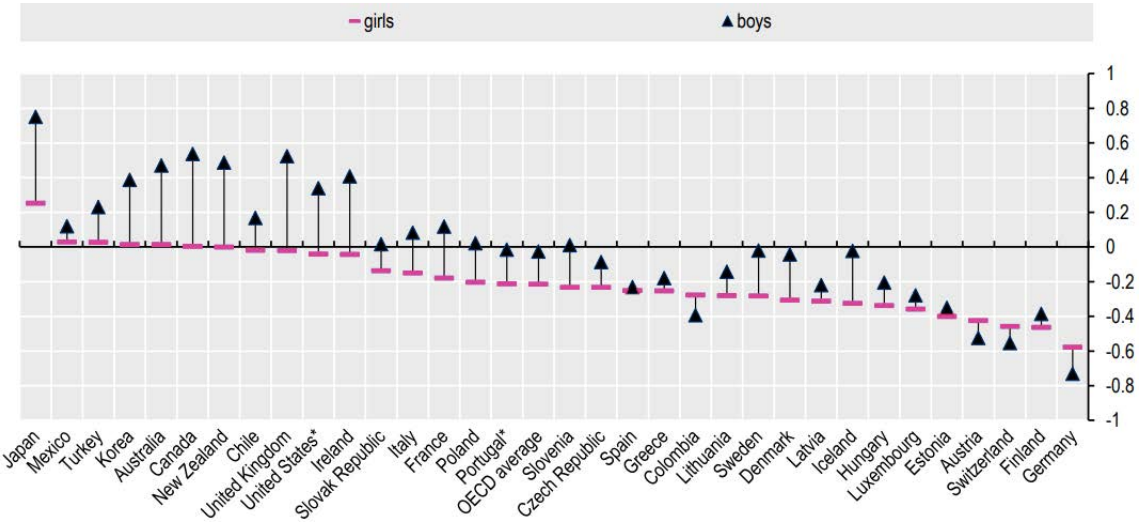
5. Attitudes and emotions

There seems to be a causal relationship between levels of emotional, behavioural, social and school well-being and academic achievement (UNESCO, 2024:36). Cognitive skills, such as attention and memory, are important for learning and are strongly linked to or guided by emotions (LeBlanc & Posner, 2022).

Data from PISA 2018 also shows that, in general, girls and boys have different attitudes towards fear of failure and competition. On average across OECD countries, 15-year-old girls have higher levels of fear of failure than boys do and higher anxiety and lack of confidence in their abilities especially in mathematics (OECD, 2019).

Figure 10 shows the index of fear of failure compiled from PISA 2018 data. High levels of fear of failure can cause students to be less ambitious, with effects on the educational and professional choices they make (Givord, 2020). But there are considerable variations across countries, which suggest that attitudes towards fear of failure are not predetermined.

Figure 10 - Gender differences in index of fear of failure – PISA 2018

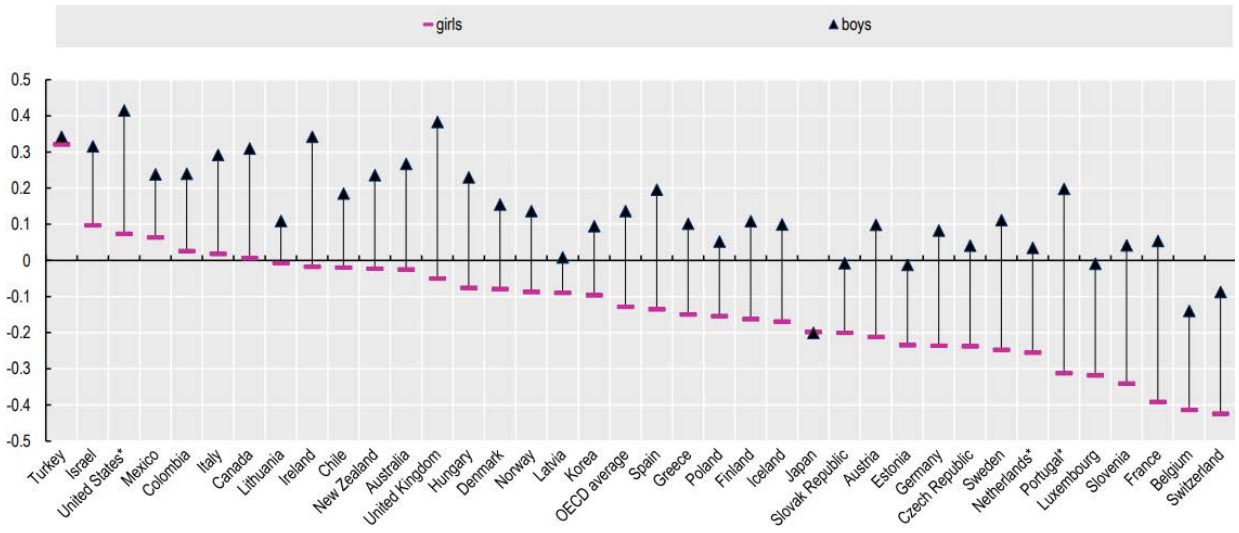


*The Netherlands, Portugal and United States: Data did not meet the PISA technical standards but were accepted as largely comparable (see Annexes A2 and A4 of OECD PISA 2018). Countries and economies are ranked in descending order of the mean index of fear of failure among girls. Source: Adapted from OECD (2018[44]), PISA Database, Table II.B1.8.18, https://www.oecd.org/pisa/data/2018database/ (accessed on 08 February 2022).

Source: Brussino & McBrien, 2022:12

Figure 11 shows the index of attitudes towards competition compiled from PISA 2018 data. On average, boys scored higher than girls in the index of attitudes towards competition across OECD countries. But there is considerable variation across countries, suggesting that attitudes towards competition are not predetermined (Givord, 2020). Having more positive attitudes towards competition can have a strong influence on students' educational and career choices (*ibid*).

Figure 11 - Gender differences in index of attitudes towards competition – PISA 2018

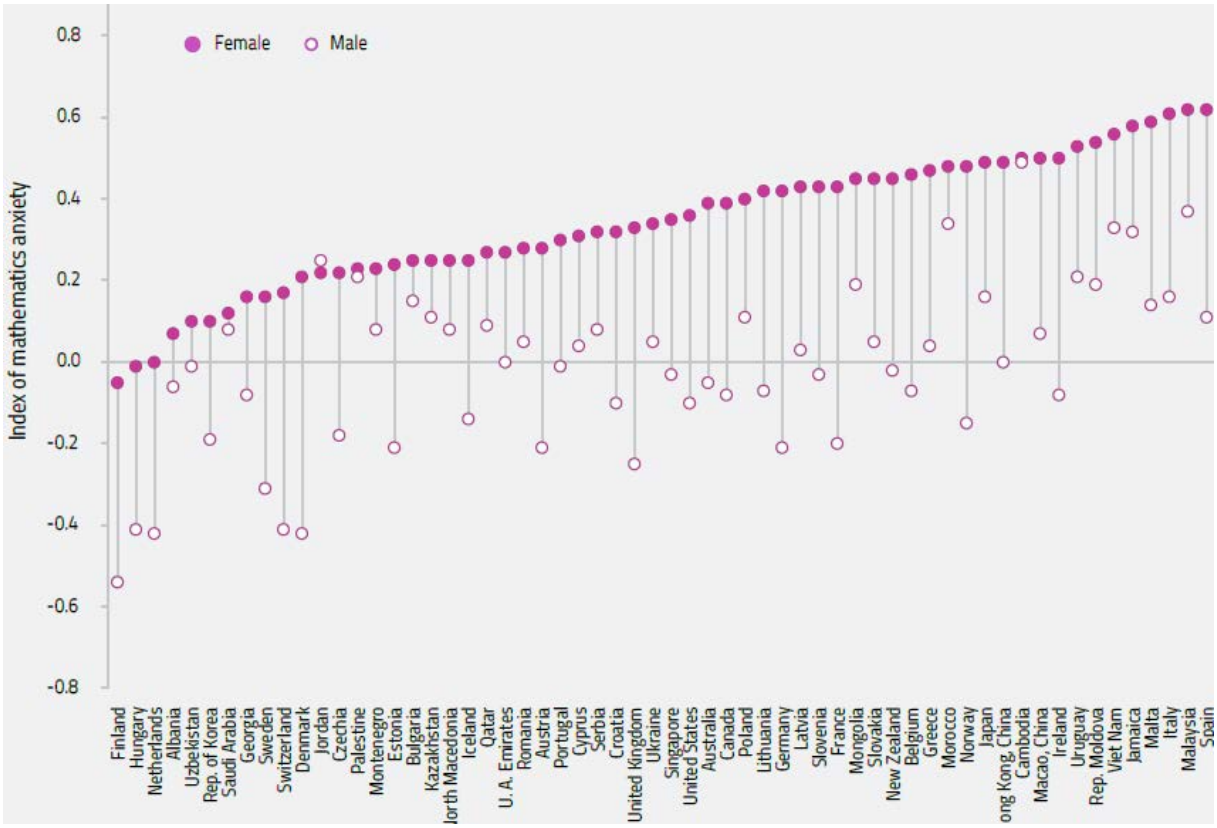


*The Netherlands, Portugal and United States: Data did not meet the PISA technical standards but were accepted as largely comparable (see Annexes A2 and A4 of OECD PISA 2018). Countries and economies are ranked in descending order of the mean index of attitudes towards competition among girls. Source: Adapted from OECD (2018[44]), PISA Database, Table II.B1.8.14, https://www.oecd.org/pisa/data/2018database/ (accessed on 08 February 2022).

Source: Brussino & McBrien, 2022:13

Mathematical capability and knowledge are critical to developing STEM skills and working in STEM fields (Xie & Liu, 2023). Girls are also more likely than boys to also feel anxious about mathematics (UNESCO, 2024:123). In all participating education systems in the 2019 TIMSS, except Bahrain and Egypt, boys reported being significantly more confident in mathematics than girls (Hencke *et al.*, 2022). OECD data confirms this result, showing that girls are less likely than boys to believe they can successfully perform mathematics and science tasks at designated levels, to enrol in technical and vocational programmes or gain "hands-on" experience in potential careers through internships or job shadowing (OECD, 2015). As part of the 2022 PISA survey, an index of mathematics anxiety was developed based on student responses to questions about their emotions regarding mathematics (figure 12). The largest absolute gender gaps in the anxiety index value were reported in Denmark, France, Germany and Norway. And data analysis shows at least a quarter of the total variation in mathematics performance across countries could be explained by the differences in overall mathematics anxiety in each country (OECD, 2023).

Figure 12 - Index of mathematics anxiety, 15-year-old students, selected countries, 2022



Notes: The index of mathematics anxiety was constructed using the six student responses to a question asking students how much they agree ("strongly agreed", "agreed", "disagreed" or "strongly disagreed") with six statements about their feelings when studying mathematics (e.g. "I often worry that it will be difficult for me in mathematics classes", "I get very tense when I have to do mathematics homework"). Positive values in this index mean that students reported greater anxiety towards mathematics than the average student across OECD countries.

Source: GEM Report team analysis of 2022 PISA data.

Adapted from UNESCO, 2024:41

The aforementioned statistical results about differences between girls and boys on attitudes and academic results must be considered in designing measures and policies to promote gender equality in STEM as they show where attention must be paid.

CHAPTER 2

Explaining girls and women exclusion from STEM and STEM education

"Western cultural stereotypes about the nature of STEM work and STEM workers and about the intrinsic qualities of men and women can be powerful drivers of individual aptitudes, aspirations, and affinities"

(Thébaud & Charles, 2018: 1).

There is a dynamic interplay between individual-level traits and the broader sociocultural environments in which they develop that explains girls and women exclusion from STEM education and professions (Thébaud & Charles, 2018).

Gender stereotypes, gender regimes and gender norms have a determinant impact on career choices.

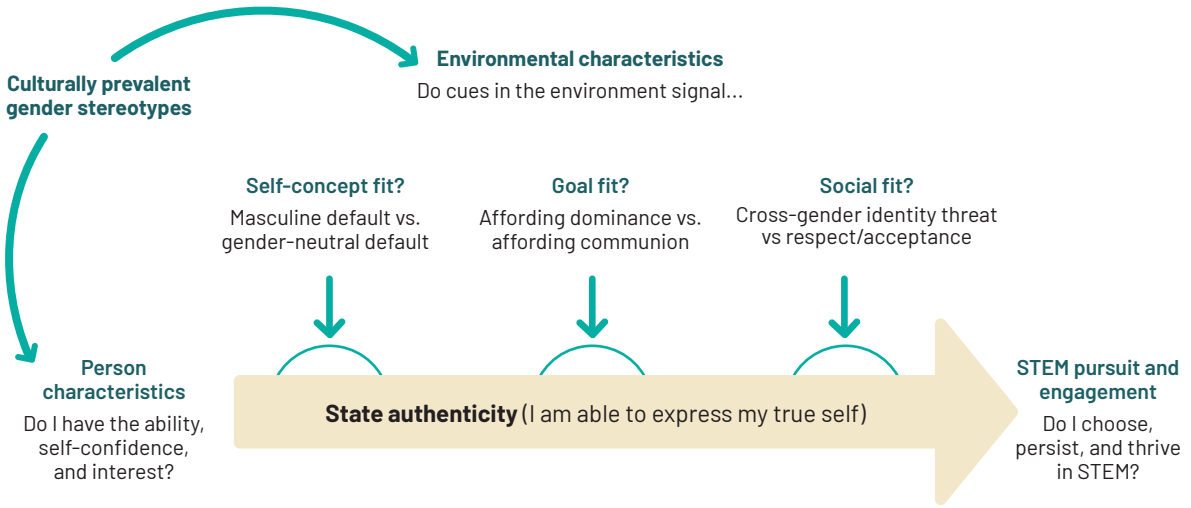
Personal beliefs, tastes and social norms may reinforce each other through interactions with peers, teachers and parents, also varying according to educational and policy approaches.

Girls and boys career' decisions are never purely individual, based on inherent abilities or preferences, but socially and gendered contingent. In fact, evidence does not suggest large differences in ability that would justify women's underrepresentation in STEM fields (Schmader, 2023).

In a recent literature review on women's lower fit and inclusion in STEM, Toni Schmader (2023) answered the following research question – To what degree are gender disparities in STEM due to women's personal characteristics and abilities or rather to environmental constraints that reduce the likelihood of feeling each of these types of fit in STEM? – by means of a model showing that proves that person-level explanations concerning women's abilities, interests, and self-efficacy are insufficient for explaining these gender persistent gaps.

She points out that women's relatively lower interest in male-dominated STEM careers, such as computer science and engineering, is constrained by gender stereotypes. Her explanation model is based on the concept of fit, encompassing complex factors that explain our choices such as "characteristics of the person (abilities, interests, goals, and values) and of the situation (what the career is, where it is done, how work is structured, and who tends to do the work)". The anticipated lack of fit to some areas and work environments or groups justifies self-segregation "options", and the choices to enter some contexts and leave others.

Figure 13 - State authenticity as fit to environment: application to gender inclusion in STEM



Source: Toni Schmader (2023: 223)

According to this model, gender stereotypes erode women's ability to experience self-concept fit, goal fit, and/or social fit. Such effects occur independently of intentional interpersonal biases and discrimination, and yet they create systemic barriers to women's attraction to, integration in, and advancement in STEM.

This model helps in understanding career choice mechanisms and the influence of gender cultural stereotypes.

1. Gender stereotypes and gender-science stereotypes

According to Brussino & McBrien (2022), gender stereotyping occurs when "ascribing certain attributes, characteristics and roles to people based on their gender". More accurately, it involves ascribing traditional gender expectations associated with one's assigned sex at birth. An example is "the expectation that girls will follow career paths to become nurses or teachers, and boys will pursue goals involved with science, engineering or business and will occupy positions of leadership. Gender stereotyping takes place at home, in schools and in society" (Brussino & McBrien, 2022: 11).

Gender stereotypes are shaped by several interacting sociocultural factors, such as messages and images in mass media; opinions of teachers and peers; participation of family members in STEM fields; and/or experiences in learning STEM topics in male-dominated courses. They are also shaped and reinforced by the systematic underrepresentation of certain groups in certain roles, which explains our prevalent tendency to "think STEM, think male", subsequently shared as cultural knowledge.

> "For example, when children are asked to draw a scientist, they are more likely to draw a picture of a man than of a woman (Miller *et al.* 2018). Although this stereotypic representation of science as male has been waning over time, it still exists — especially among boys — and also tends to be stronger in older than in younger children"
>
> **(Schmader, 2023: 224).**

Gender stereotypes are considered primarily as an environmental or cultural factor that has the potential to be internalised, thus shaping women's and men's own self-concepts and personal preferences. They are not only descriptive of the status quo; they also become prescriptive, creating social friction when one steps outside of stereotype-congruent roles" (Schmader, 2023: 224).

Once segregated, occupational gender labels become imprinted in the popular imagination and are absorbed at an early age. "Draw-A-Scientist" studies show, for example, that young American children have taken for granted the masculinity of STEM workers for at least five decades (Thébaud & Charles, 2018).

An example of the occupational stereotyping is the relation between the implicit stereotype of men's brilliance and the extent to which people believe that some occupations require extreme raw intelligence, or brilliance, a belief correlated with occupations' male dominance (Thébaud & Charles, 2018; Eagly, 2021; Comber *et al.* 2021; Schmader, 2023).

Another example is the cultural emphasis and valorisation of stereotypical "masculine qualities" such as strength, assertiveness, and independence.

Both the "geek" and frat-like "brogrammer" cultural images exemplify the agentic qualities that women supposedly lack, and they devalue the communal traits that women supposedly possess: such individuals are thought to lack "social skills," to be disconnected emotionally, and/or to be less caring toward others (Thébaud & Charles, 2018).

Merayo & Ayuso (2023) concluded that girls believe it is more necessary than boys to have qualities to study STEM and less often perceive themselves as intelligent and courageous, reporting higher test anxiety toward mathematics exams. Additionally, gender differences in self-efficacy and self-perception of girls toward STEM performance and brilliance are often not acknowledged by teachers (Ayuso *et al.* 2020).

We may ask how do gender stereotypes act. They act through multiple channels:

- Shaping girls' own subjective and/or implicit self-views and self-concept about their ability and affinity for math and science.
- Shaping the ways parents, teachers, and peers provide affordances that, when accumulated across perceivers and over time, shape girls' developing self-views.
- Girls and women anticipate gender stereotypes – stereotypes' threat - that suggest a lower performance in STEM fields, thus limiting their interest in STEM challenges. They fear being evaluated through the lens of a negative stereotype.
- By means of gendered educational practices and learning environments.
- Shaping societal structures and institutions, thus extending beyond individual perceptions and social interactions.

> "boys are more able to excel in math and science not necessarily due to greater raw talent, but rather because they have greater self-confidence in their abilities and also greater preferences for careers in STEM fields"
>
> **(Schmader, 2023: 226).**

> "experiences of stereotype threat can lead women to underestimate their true abilities"
>
> **(Schmader, 2023: 228).**

In light of the above, it is crucial to relate micro and macro factors to fully understand the complex production of women's exclusion from STEM education and professions.

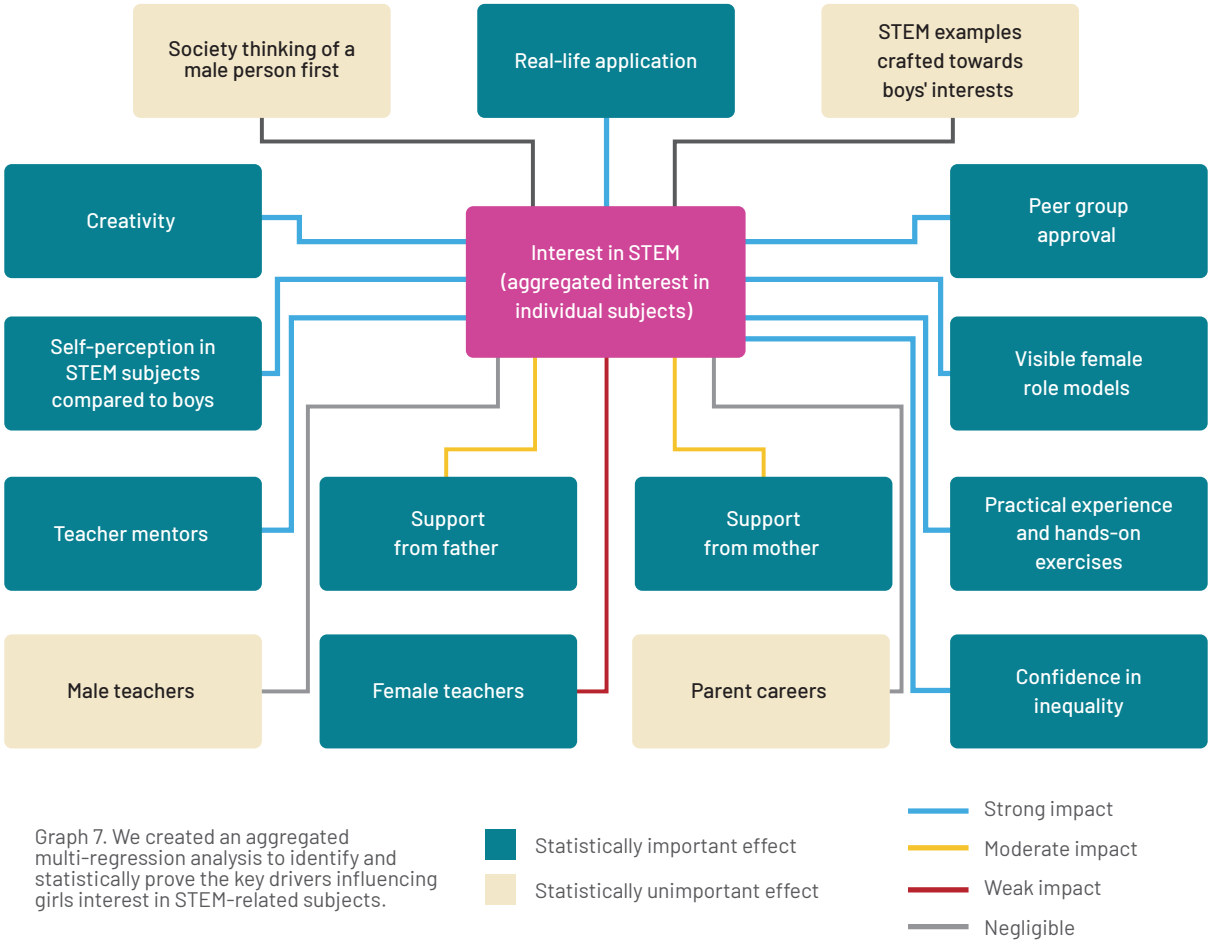
Viarengo (2021) presents explanatory factors for gender differences in educational choices emerging early in secondary schooling: the educational context, the structure of the labour market, and the environment of the workplace, as well as broader gender inequality in cultural values and social norms in society.

In ICT and other technology fields the gender gap is generally explained by factors such as: stereotype biases, lack of female role models, low enrolment of women in technology courses, negative experiences of women and girls in male-dominated environments, cultural background, interests, personality, aptitude, gendered family responsibilities, fewer opportunities for women in STEM, gender biases among teachers and peers, university and college faculty gender bias, limited support to girls from family and peers, and

gender inequalities in leadership positions (Lim & Wang, 2015). Other factors may include the pressure to conform to gender stereotypes, to anticipated family responsibilities and to career expectations.

A study from Microsoft (2017) concluded that there are five major drivers impacting girls' interest in STEM subjects: 1. Having visible female role models; 2. Practical experience and hands-on exercises; 3. Teacher encouragement and mentorship; 4. Real-life applications; 5. Confidence in equality in STEM fields of education and work (see figure 14).

Figure 14 - Why Europe's Girls Aren't Studying STEM



Graph 7. We created an aggregated multi-regression analysis to identify and statistically prove the key drivers influencing girls interest in STEM-related subjects.

Statistically important effect

Statistically unimportant effect

Source: Microsoft (2017: 12)

The European Commission (2021) publication *Girls' career aspirations in STEM* proposes an interesting model to explain the determinants and drivers of girls' career aspirations in STEM, while confirming that girls are less likely than boys to aspire to STEM or ICT professions, while showing more interest in healthcare professions (EU27 Member States).

This study is based on the Social Cognitive Career Theory (SCCT) (Lent *et al.*, 1994 *apud* EC, Directorate-General for Education, Youth, Sport and Culture, 2021), that models and explains three different aspects of career choice: "Interest", "Choice" and "Performance".

- Development of academic and career interests (the **"Interest Model"**)

  "Individual interests in a given academic or professional career are the direct consequence of self-efficacy and outcome expectations (...). People are most likely to develop interest in activities at which they both feel skilled and from which they expect positive outcomes" (EC, 2021: 15).

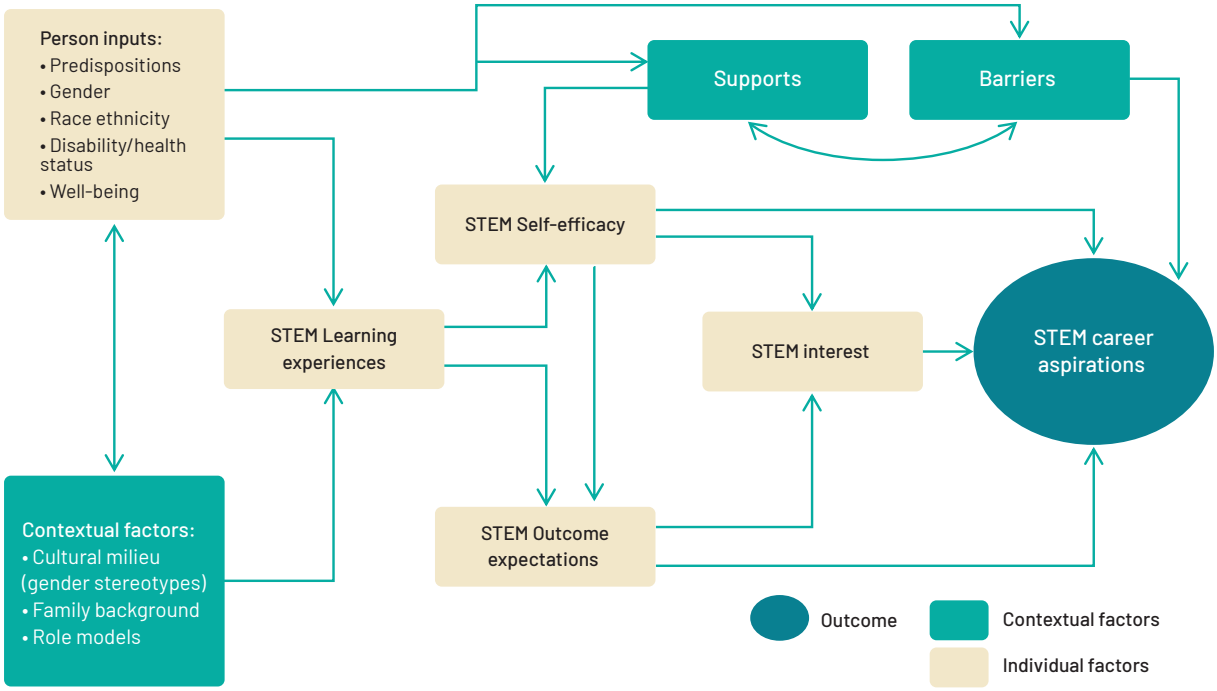
- How career choices are made (the **"Choice Model"**)

  "Individual interests have on the formation of choice goals may be mediated by a number of environmental (or contextual) factors.(...) individuals may compromise and choose goals that are less difficult to achieve based on the external environmental circumstances" (*ibidem*: 16).

- Educational and career performance and achievement (the **"Performance Model"**)

  "Performance explains: the level of success that people attain in educational and occupational pursuits and the degree to which they persist in the face of obstacles. (...). Individuals that have a higher level of ability have a higher probability to be top performers. Moreover, partly thanks to the successes obtained, they can develop higher levels of motivation, in the form of self-efficacy, outcome expectations and performance goals." (*ibidem*).

Figure 15 - The Social-Cognitive Career model for girls' STEM career aspirations



Source: EC, Directorate-General for Education, Youth, Sport and Culture (2021: 12)

Focusing on the gender gap in information technologies, Szlávi & Bernát (2021) organises barriers faced by girls in the sector in three categories, labelling them as Social, Educational, and Labour Markets.

- Social barriers:
  - Traditional role patterns / gender stereotypes.
  - Low self-esteem / lack of encouragement.
- Educational barriers:
  - Non-attractive IT learning environment.
  - Lack of touchpoint with IT.
- Labour market barriers:
  - Negative image and stereotypes of IT jobs.
  - Lack of info and awareness of IT jobs.

2. Gender stereotypes in education and gender gap in STEM

A significant drop in the percentage of women in STEM classes happens at two main points: firstly, during the transition from primary and secondary education to university, it drops by 18 percentage points; lately, during the transition from university to the workforce it drops another 15 p.p. (Blumberg *et al.*, 2023).

Factors such as STEM learning experiences, individual background, contextual influences (including parental and peer support, role models, societal and cultural factors), and school and national policies play significant roles in shaping girls' career aspirations (EC, 2021).

Mizala *et al.* (2023) point to some of the main factors associated with education that contribute to gender gaps in STEM careers aspirations:

- Teachers' gendered expectations can affect students' academic progress.
- Textbooks and classroom materials can convey gender stereotypes.
- Teacher-student interactions in the classroom can be gender biased.
- Gender stereotypes affect academic performance in different fields.
- Gender differences in risk-aversion, willingness to compete, and self-confidence can lead to gender gaps in competitive tests.
- Gender stereotypes can occupy mental resources needed for cognitive tests.
- Test designs are not gender neutral.
- Traditional gender segregation across fields of study.
- Teachers and the school environments at high school are crucial in shaping college-major preferences.

STEM learning experiences must be effective and boost self-esteem and self-efficacy perception. That is why it is recommended to assure: non-biased learning processes; extracurricular STEM activities, inquiry-based STEM teaching; the use of real-life applications and 'hands-on' activities; activities outside school, e.g., summer science camps; female STEM mentoring programmes; and the use of digital and technological tools.

2.1. National and school educational environments matter

The characteristics of schooling systems and their institutional set-up play an important role in explaining the variation in students' educational achievement and learning outcomes across countries.

2.1.1. National institutional settings and the structure of the education system

National education systems vary in important characteristics such as the relevance of general *versus* vocational education and training (VET), curricular characteristics, the organisation of the different education levels, and the framework and requirements for tertiary education (Viarengo, 2021).

Tracking system. Tracking refers to the practice of sorting students into different kinds of streams/schools (e.g. general education vs VET) according to a criterion of similarity (ability, achievement, *etc.*) at a specific age. Early tracking systems increase and widen the inequality in educational achievement. When the selection of tracks happens at an early age it is more likely to reflect stereotypical beliefs on what typical occupations for girls are, rather than girls' interests and skills.

Educational systems with a strong emphasis on vocational education and that compel students to make early and rigid choices about their academic paths tend to exacerbate gender segregation. Choices made during adolescence tend to be more stereotyped because this is a stage of life in which reluctance to transgress gender role norms is high and experience of labour force participation is very limited (Borgonovi *et al.*, 2023). By contrast, a comprehensive and flexible system, allowing for later choices and facilitating access to higher education, provides multidiscipline and wide-ranging education to all children universally (EC, 2021; Viarengo, 2021).

Curricular choices models. Expanded high school graduation requirements - including in mathematics, computer science, and engineering - could help reduce reliance on stereotypes and increase girls' confidence in their mathematical and technical ability (EC, 2021).

Comparative studies show that the gender gap in STEM aspirations and outcomes tends to be smaller in countries and schools where curricular choice is reduced or delayed and where high school science and mathematics curricula are stronger (Thébaud & Charles, 2018).

In India, for example, a strong national mathematics curriculum makes girls more confident in their ability to learn computer skills than their American counterparts (even if they are less likely to have computers at home). Moreover, in the Indian national context, computing is seen as a profession that offers a safe and pleasant indoor working environment that favours girls' choice for it (Thébaud & Charles, 2018).

2.1.2. School gendered environment

Gender occurs within the very functioning of the school and of the education system as an institution where a critical gender analysis has been notably absent (Monteiro *et al.*, 2017).

School environments are influenced by a broad set of practices that can either reinforce or challenge gender stereotypes. Such practices extend beyond textbooks and lectures, encompassing learning strategies, activities, support services, and even parental and community engagement. E.g. a school dominated by male STEM teachers or administrators sends a message that these fields are not welcoming to women.

Sexist prejudices, gender stereotypes and power asymmetries deeply embedded in the collective unconscious, directly give rise to discriminatory practices. These set up a system where gender violence and harassment can be manifested and recognised, also in schools.

That is why schools must develop and implement concrete policies, plans, internal regulations, services and monitoring tools to identify and combat such gender inequalities and discriminatory manifestations. Some very relevant practices are: anti-harassment codes of conduct, student safety and protection measures and support, ongoing gender audits and the gathering of sex-disaggregated data.

The success of those anti-discriminatory practices implies regular communication within and outside school, and relationships with the community, especially families, municipalities and organisations of civil society.

Physical spaces' aspects are also very important. E.g. displaying posters or murals featuring predominantly male scientists, inventors, or athletes can create the impression that STEM fields are primarily for boys. This includes another cross-cutting problem, which concerns the fact that "Even in play and sports, beginning in the home and continuing into school years, items and activities are often gendered in a binary way. Toys intended for boys are often associated with action, aggression, and athletics, and those intended for girls are associated with appearance, nurturing and education" (Brussino & McBrien, 2022: 21).

2.2. Gender-blind pedagogies: curriculum and teaching methodologies

2.2.1. Curriculum

> "Progressive professors working to transform the curriculum so that it does not reflect biases or reinforce systems of domination are most often the individuals willing to take the risks that engaged pedagogy requires and to make their teaching practices a site of resistance"
>
> **(hooks, 1994: 21).**

Curriculum in education refers to the subject matter and content as presented to learners, the stated objectives and student learning outcomes (UNESCO, 2015).

In the realm of education, curricula hold immense power to shape students' perceptions and opportunities. When the curricula fail to acknowledge and address existing gender inequalities, disparities can inadvertently be exacerbated, creating a vicious cycle of disadvantage.

Teaching and learning materials often reinforce gender stereotypes and promote the acceptance of entrenched norms related to stereotypes.

It is crucial to integrate gender perspectives from the very outset, introducing them as integral to the core concepts and boundaries of each discipline. What is omitted from the curriculum is very important, as it can reveal underlying biases and perpetuate stereotypes.

Beyond explicit content, fostering gender sensitivity requires delving into the "hidden curriculum" – the unwritten norms, practices, and shared routines that permeate the learning environment. According to the UNESCO's definition "hidden' (or 'unofficial') curriculum refers to whatever 'involves all the incidental lessons that students learn at school' (UNESCO, 2010). This takes into consideration 'behaviour, personal relationships, the use of power and authority, competition, [and] sources of motivation, among others" (UNESCO, 2015).

Gender's absence in secondary STEM curriculum and pedagogy is a silent exclusion with detrimental impacts, such as:

- Reinforcement of Stereotypes: The lack of gender-inclusive perspectives perpetuates harmful stereotypes that discourage girls from pursuing STEM fields.
- Invisible Role Models: The absence of female role models in STEM education creates a void of inspiration, making it difficult for girls to envision themselves in these careers.
- Disconnection from Reality: Omitting gender-related issues from STEM curriculum fails to connect the subject matter to the real-world challenges and applications.
- Unwelcoming Environment: Gender-biased language and pedagogy can create an unwelcoming environment for students from diverse backgrounds, hindering their participation and achievement in STEM.
- Missed Opportunities for Collaboration: Neglecting gender-inclusive project-based learning deprives students of opportunities to develop critical thinking, teamwork, and problem-solving skills in the context of addressing gender disparities in STEM.

2.2.2. Gendered language

The oral or written language teachers (and school staff in general) use can reinforce negative gender stereotypes or, on the contrary, promote gender inclusion and equality. Language can express the status of being male or female, and the status of being assertive or submissive.

Teachers should strive to use both gender pronouns when citing examples and refer to all students with respect, regardless of their gender.

A vast array of valuable resources and guides are available to empower teachers and schools in adopting inclusive and equitable language practices. Chapter 6.2 provides a comprehensive collection of inclusive language guides, tailored to the specific linguistic needs of each partner country (Belgium, Italy, Portugal and Romania) and English.

Here is a sample of relevant recommendations, taken from the FAWE Toolkit (FAWE, 2018):

Figure 16 - Examples of gender-responsive language practices

GENDER-RESPONSIVE LANGUAGE PRACTICES	EXAMPLES OF *GENDER-BIASED* LANGUAGE	EXAMPLES OF *GENDER-RESPONSIVE* LANGUAGE
Use both pronouns (he or she; her or his)	When everyone contributes his own ideas, the discussion will be a success.	When everyone contributes her or his own ideas, the discussion will be a success.
Use the plural instead of the singular	If a student studies hard, he will succeed.	Students will succeed if they study hard.
Recast a sentence in the passive voice	Each student should hand in his paper promptly.	Papers should be handed in promptly.
Recast the sentence to avoid using the indefinite pronoun.	Does everybody have his book?	Do all of you have your books?
Create gender balance or neutrality in labels or titles.	. Mankind . Man's achievements . All men are created equal . The best man for the job . Chairman . Businessman . Congressman . Policeman . Head master	. Humanity, human beings, people . Human achievements . All people are created equal . The best person for the job . Chair, head, chairperson . Business executive, manager, businessperson . Congressional representative . Police officer . Head teacher

Source: Uworwabayeho, A; Bayisenge, J; Katwaza, E; Umutoni, J; Habumuremyi, J.& Rwabyoma, A. (2018). National Gender-Responsive Teacher Training Package. Ministry of Education of Rwanda.

Source: FAWE Toolkit (2018: 46)

While the structure of language is important, its influence goes far beyond that. Teachers serve as crucial role models for students and the broader community. However, teachers, like everyone else, can hold unconscious gender biases based on their upbringing, education, and experiences. Such biases can unconsciously influence their language, both spoken and unspoken, perpetuating stereotypes about gender roles.

"In verbal communication, for example, teachers might discourage girls from taking science by telling them that such subjects are for boys or are too difficult for girls. If a boy student cries or expresses vulnerable emotions, a teacher might tell him to stop acting like a girl. Nonverbal communication might be rolling one's eyes, raising eyebrows or smirking at a response or question that a girl might share, which can communicate indifference or judgement on the part of the teacher" (FAWE, 2018: 44).

"The way that teachers provide feedback is also an important consideration of language use. If a teacher uses harsh, abusive and threatening language, it may perpetuate gender stereotypes, instil fear in the students and hinder learning. For example, a boy or girl whose teacher tells them "you are stupid" or "you are empty-headed" may come to believe this to be true and have a negative impact on their academic performance or willingness to participate" (*ibidem*).

2.2.3. Gendered textbooks and pedagogical material

Textbooks usually exhibit conservative approaches to gender issues, namely imbalance between male and female authors, characters, and active roles portrayed in the educational materials (Miroiu, 2000).

In what concerns the presence of gender stereotypes in textbooks, female characters are less frequently depicted, particularly in materials related to STEM; they are more likely to be portrayed in fields of action related to family and household; and they tend to be represented as passive and submissive. In turn, male characters not only are more often depicted but are also more likely to be represented at their job and to be portrayed as active, individualistic, competitive, and willing to take risks (Mizala *et al.*, 2023).

The invisibility of women in STEM education and as role models occurs either in teaching materials and textbooks or in classroom practices. There is a pervasive pattern of undervaluing women scientists' contributions, often leading to their work being diminished or even attributed to their male colleagues ('Matilda effect').

> "An analysis carried out by UNESCO of 110 national curriculum frameworks in 78 countries shows that gender biases and stereotypes persist, particularly in math and science textbooks, and images of women are highly under-represented in these fields in the textbooks. (...) including information about Sally Ride, the first American woman in space, in a science textbook provides girls with the opportunity to see themselves as future scientists, engineers or astronauts. Adding the fact that she was also lesbian can provide LGBTQI+ students with a point of pride"
>
> **(Brussino & McBrien, 2022: 17).**

> "Physics textbooks are notorious for giving the impression that the history of physics has been a linear progression of great discoveries made by solitary male scientists [...]. It is unsurprising that individuals feel less capable of contributing to a field when the history of that field does not include members of their group [...]. All these factors lead to the expectation that successful physicists must be solitary and masculine geniuses, who construct new theories and knowledge by the sheer force of their personal intellectual abilities. Many different types of individuals, particularly – though not exclusively – women, are not expected to be capable sources of knowledge in physics. The internalization of this lack of cognitive expectations leads to increased (implicit) discrimination, lower participation, and fewer opportunities for success [...]. Similarly, the internalization of these cognitive expectations not only excludes individuals from the field of physics but can also eliminate different ways of knowing and of constructing knowledge. If knowledge is expected to be the product of a solitary genius [...], then the reality that modern physics is practiced and constructed by communities of scientists working in close collaboration is also denied"
>
> **(Harrell, 2016: 24–25).**

2.2.4. Pedagogies

In a very incisive and relevant analysis of the current state of teachers in relation to their expected responsibilities and training, Purdy *et al.* (2023: 4) stated that "teacher competence has increasingly prioritised the mastery of a pre-defined set of performative technical skills and has largely overlooked values".

More specifically, science education confront teachers with several challenges:

- Combating the fact that interdisciplinary and transdisciplinary approaches to STEM learning remain the exception rather than the rule in schools, recognising that such approaches could be a potential solution for the education sector to make learning more contextually meaningful for students in the future.
- Employ learner-centred pedagogies or student-centred pedagogies.
- Adopting a constructivist and inquiry perspective and usually emphasise practical work, such as field work, laboratory activities, simulation, debates, and the presentation of results. And also employing contextualised learning that consider students' experience and every-day concerns.
- Focus on solving real-world problems, guiding students to think outside the box to identify problems and build or construct solutions.
- Overcome contradictory students' and teachers' perceptions about teachers' practices: studies show that while teachers may believe they are developing constructivist teaching practices, students may disagree (Galvão *et al.*, 2011).

For integrated approaches to the teaching of sciences see, for example, the following proposals from the Support, Teaching, Efficacy and Materials model for teaching integrated STEM education (Stohlmann *et al.*, 2012, *apud* UNESCO, 2019: 34).

Figure 17 - Support, Teaching, Efficacy and Materials (STEM) model

Support

- Partner with a university or nearby school
- Attend professional development
- Teacher collaborative time

Teaching	**Classroom Practices**
▪ Focus on connections ▪ Understand student misconceptions ▪ Understand student capabilities ▪ Problem-solving based ▪ Student-centred ▪ Build on previous knowledge ▪ Focus on big ideas, concepts or themes ▪ Integrate technology ▪ Real world and cultural relevance	▪ Posing questions and making conjectures ▪ Justifying thinking ▪ Writing for reflection ▪ Focus on pattern understanding ▪ Use assessment as part of instruction ▪ Co-operative learning ▪ Effective use of manipulatives ▪ Inquiry

Efficacy

- Content knowledge and pedagogical knowledge contribute to self-efficacy
- Commitment to STEM education is vital
- Planning and organisation are critical

Materials

- Technology resources
- Broad view of technology
- Material kits for activities
- Room space and storage
- Tables for group work

Adapted from UNESCO, 2019

Besides all of this, and attaining to gender, classroom pedagogical practices and teachers-students interactions can reinforce gender stereotypes and girls' discrimination and exclusion. Therefore, it is important to attend some other dimensions such as class management, teaching methodology and teaching techniques with a gender perspective.

There are 'gender dynamics' that reinforce gender bias and the unjust treatment of learners based solely on gender.

Some teachers do not even recognize the gender equality implications and gender stereotyping they embody. Grace and Gravestock (2009) list the following gender-based trends observed among some teachers:

- Call on male students more frequently.
- Wait longer for males to respond to questions.
- Give male students more eye contact following questions.
- Remember the names of male students.
- Use these names when calling on male students.
- Attribute male students' comments in class discussion.
- Interrupt female students before the end of their response.
- Ask males more questions that call for 'higher-order' critical thinking as opposed to 'lower-order' recounting of facts.

(UNESCO, 2015: 66)

Another wrong practice in classroom dynamics is to emphasise brilliance and raw intelligence as exceptional attributes of STEM students, particularly when associating those qualities with boys and men. It is fundamental to consider intelligence as a muscle that grows if trained and worked, and not as an innate quality. The overarching objective is to cultivate a learning environment that fosters collaboration, self-efficacy, and a growth mindset among students, thereby reducing competition and emphasising teamwork.

Teachers and parents' behaviours are critical drives of girls' interest and confidence in educational and professional choices.

2.3. Teachers' and Parents' role

Teachers are key actors in terms of their support, their example as role models, their teaching methods and interactions with students and families, their digital and technological skills and their capacity to develop activities beyond the classroom, for example.

"girls perform worse when they are assigned to a biased teacher"

(Viarengo, 2021: 19)

Margot and Kettler's (2019) systematic review of research on teachers' perception regarding STEM education noted six key barriers that thwart STEM teaching, associated with curriculum, pedagogy, assessment, teacher support, students, and structural systems. Several hindrances impede the implementation of effective interdisciplinary modes of teaching STEM such as teachers' beliefs, knowledge, and understanding of STEM; poor teacher preparation and lack of professional development for teachers; shortage of teachers; poor cross-disciplinary content integration; low student motivation; inadequate facilities.

Many teachers believe that school, teaching and learning activities are all gender-neutral.

All teachers have gender stereotypes to a lesser or greater degree. See, for example, the following list of teachers' stated behaviours, attitudes and/or beliefs (FAWE, 2018: 45):

"I praise, encourage and help boys more than girls.
I am usually more critical of girls than boys.
I am surprised when girls give the right answer.
I usually assign boys to be leaders in group work.
I tell girl students to not act like a boy when she is being assertive.
I tell boy students to stop acting like a girl when he shows emotion.
I call on male students more than female students.
I don't expect girls will do well in math and science.
I don't expect boys will do well in reading.
I don't expect girls to do as well in school as boys.
I think that boys should do heavier chores or physical work around the school, such as moving desks and chairs.
I think that girls should do the "domestic" chores, such as sweeping the classroom, or making tea."

Consequently, "it is very important that teachers become aware of any gender-biased beliefs, attitudes, or stereotypes they may have learned and work to overcome them. They can accomplish this through self-reflection, training, reading, peer support, exposing themselves to examples and stories that defy gender assumptions and implementing national and school policies on gender equality" (FAWE, 2018: 45).

Literature shows that teachers lack specific gender equality objectives in their curriculum, and a notable portion don't actively incorporate these themes into their subjects and activities. This lack of integration is particularly concerning in STEM fields, where girls' participation and interest often lag behind their male counterparts (Merayo & Ayuso, 2022: 1492).

Regarding teachers' roles, it is also important to consider teacher's self-efficacy beliefs in their capabilities to provide a more equitable and gender-sensitive STEM education.

Teaching in STEM self-efficacy is a useful concept for understanding the motivations and behaviours of teachers, and their difficulties in teaching STEM (Vossen *et al.*, 2021; Miralles-Cardona *et al.*, 2023). It can vary across teachers, subject matter, different types of learners, and even across specific fields or domains of teaching.

Developing a teaching practice in STEM committed to gender equality is quite challenging. In addition to individual biases, most teachers have never received initial or ongoing training to feel capable and motivated to teach STEM with a gender perspective (Merayo & Ayuso, 2023).

Studies report a "moderately low" level of self-efficacy, a fact that deserves special attention within the initial and continuous training of teachers. Lack of knowledge and competencies in gender related skills are not surprising, given that gender mainstreaming in STEM education is usually extremely limited and misaligned with the existing curriculum (Miralles-Cardona *et al.*, 2023). This trend contradicts government reports indicating that gender equality is integrated into national curricula, suggesting a potential gap between policy and classroom practices.

To deal with this problem it is of utmost importance to acknowledge teachers' needs in terms of self-efficacy. The Teacher Efficacy for Gender Equality Practice (TEGEP) scale, developed by Miralles-Cardona *et al.* (2023), is a good example of a tool to measuring self-efficacy for teaching with a gender-sensitive approach. This scale explores three different dimensions: "(1) cognitive, referring to the ability of future teachers to develop knowledge of gender concepts and awareness of inequalities; (2) attitudinal, referring to the ability to help others develop gender empathy and break gender discrimination and violence; and (3) behavioural, comprising the ability to plan, implement, support and evaluate gender-sensitive teaching and learning processes" (Miralles-Cardona *et al.*, 2023: 25).

In teaching gender, self-efficacy translates into having a greater capacity (knowledge, behaviours, and dispositions) in developing a teaching practice committed to gender equity. Hence, training for gender equality in STEM is fundamental.

But it is also important to acknowledge STEM teachers may face critical external obstacles and barriers, which limit their capacity to teach effectively, foster a passion for STEM subjects in their students, or integrate a gender perspective into teaching. Several categories of obstacles have been identified in the literature (Sellami *et al.*, 2022; Vossen *et al.*, 2021), namely:

Workload and resources

- High teaching hours.
- Outdated or malfunctioning school computers.
- Overcrowded classrooms.
- Budget constraints for acquiring suitable teaching materials.
- Administrative hurdles in accessing necessary content.

Teaching and learning environment and training

- Poor school space organisation and furniture limitations.
- Lack of pedagogical models specific to STEM education.
- Difficulty understanding the curriculum.
- Insufficient technical and pedagogical support.

Teacher support and motivation

- Lack of adequate training for effective STEM and gender sensitive teaching.
- Insufficient support from colleagues within the school.
- Low teacher interest in STEM education.
- Absence of learning materials in the national language.

Factors affecting the decline of students' interest

- Lack of parental and family involvement.
- Lack of confidence.
- A negative perception of STEM-related careers.
- Lack of use (or misuse of) technology.
- Difficulty with homework.

The Eurydice report "Promoting diversity and inclusion in European schools" (EC, 2023) highlights a general lack of knowledge among teachers regarding effective inclusive teaching practices, and insufficient or non-existent data on inequality and discrimination in schools across most countries. This means there is a need to change the model of teacher's training. The prevailing performance-based approach to teacher's education in Europe, which primarily emphasises technical-pedagogical skills for the classroom, is deemed insufficient to fully realise the teaching profession's potential to foster inclusion, equity, and social justice (Purdy *et al.*, 2023). This critique stems from several limitations inherent in the performance-based framework: the narrow focus on technical skills, the overreliance on standardised measures, the limited attention to social justice and inclusion, the underestimation of teacher professionalism, and the inadequate preparation for complex educational challenges (Purdy *et al.*, 2023).

Lately, the rise of anti-gender movements, having the integration of gender equality in education as one of their main targets, emerged as another relevant obstacle, by causing the fear of reactions and opposition by colleagues, parents and other groups (Kuhar & Paternotte, 2017; Norocel *et al.*, 2021).

Schools must also work with children's families, particularly parents, for the deconstruction of STEM gender stereotypes.

As found in the literature, parental influence can be of two main types.

The first type may be called 'intergenerational transmission of STEM education' (Chise *et al.*, 2021) and highlights the influence of a parent who is employed in a STEM occupation: "the day-to-day exposure to STEM at home helps teenagers think of STEM subjects and careers as achievable targets. Second, parents are role models to their children, and it is more likely that boys and girls develop an interest in STEM if they are trying to follow the example of one of their parents" (EC, 2021: 21). This can also refer to the "so-called 'co-activity' behaviours, which comprise playing maths games, looking at science websites with children, watching science shows, going to science museums, and more (*ibidem*).

The second type, perhaps more widespread and influential, is the (dis)encouragement parents can give to a girl's aspirations and motivations to pursue education in STEM, caused by gender stereotypes. This can occur through conscious and unconscious behaviours, such as the 'intrusive support', *i.e.*, parents' uninvited help and monitoring with homework. The idea is that, by giving uninvited support, parents express their belief that their children cannot succeed in a subject" (EC, 2021: 24).

It is also very important to underline the influence of "curriculum and extracurricular activities promoted by schools and teachers on parents' perceptions and expectations about their children. If these elements reinforce gender stereotypes or limit girls' opportunities in STEM, they can affect the support and encouragement they receive from their family" (Mizala *et al.*, 2023). That is why it is so important to involve parents and help them eradicate gender stereotypes about STEM education and professions.

Girls often exhibit lower confidence in their STEM capabilities than boys. This lack of confidence can stem from societal and parental biases. Studies reveal that parents may have different expectations for the future of their daughters and sons, regardless of their actual performance in mathematics. These unconscious biases can contribute to girls' self-censorship and ultimately lead to lower engagement in STEM and ICT fields.

CHAPTER 3

European Policies and Regulations

The EU Gender Equality Strategy 2020-2025 aims for "a Union where women and men, girls and boys, in all their diversity, are free to pursue their chosen path of life, have equal opportunities to strive, and can equally participate in and lead our European society"

(EC, Directorate-General for Education, Youth, Sport and Culture *et al.*, 2023: 8).

Gender equality is enshrined in the Treaties of the European Union, constituting a fundamental value, a fundamental right, and a key principle of the recently established European Pillar of Social Rights.

Between 1997 and 2002, "equal opportunities" was one of the four pillars of the Economic and Employment Strategy (EEE), created in 1997.

In 2000, the ETAN Report on women in science, engineering, and technology in Europe (Rees, 2007) recognised the increasing loss of women abandoning academic careers at various levels and disciplines in the fields of Science, Technology, Engineering, and Mathematics (STEM).

Also in 2000, the European Council defined the objective of making the Union the "most competitive and dynamic knowledge-based economy in the world," a hallmark of the so-called Lisbon Strategy.

In that same year, within the frame of the Lisbon Strategy, and its Open Coordination Method (OCM),

- the European Research Area (ERA) was created, with the purpose of addressing the problem of fragmentation of European Research & Innovation (R&I) systems;
- the European Education Area (EEA) was created by the European Commission, to be achieved by 2025 (a commitment renewed in 2020; see further below). The EEA defines as objectives for national reforms and European cooperation in education and training, among others: (1) developing a better gender sensitivity in education processes and institutions; (2) challenging and dissolving gender stereotypes; and (3) working towards a proper gender balance in leadership positions, including in higher education institutions.

Adopted in 2007, the Council of Europe Recommendation CM/Rec (2007) 13 of the Committee of Ministers to member states on gender mainstreaming in education constitutes a very important milestone in guiding educational policy for gender mainstreaming in education. As such, it is aligned with the commitment under the United Nations Convention on the Elimination of All Forms of Discrimination against Women (CEDAW, 1979). The Recommendation presents a comprehensive set of measures that Member States were to implement to ensure the effective integration of the gender perspective in education. Such measures encompass legal frameworks, school governance and organisation, initial and continuous training for teachers and trainers, course programs, school curricula, subjects and exams, teaching materials, teaching methods and practices, education for democratic citizenship and human rights, educational and career guidance, prevention and combating sexist violence, vulnerable groups, media, and research on gender and education issues.

Also in 2007, the Council of Europe Recommendation CM/Rec (2007)17 of the Committee of Ministers to member states on gender equality standards and mechanisms prescribed the need for Member States to effectively implement international legal instruments regarding education, such as those provided for in the Beijing Platform for Action and CEDAW.

In 2020, the European Commission launched the Gender Equality Strategy 2020-2025, called "A Union of Equality" (COM (2020) 152), commits to the following objectives:[6]

6 https://wikis.ec.europa.eu/display/EAC/Equality+and+Values+Documents?preview=/55903445/80970575/Gender%20Equality%20Strategy%202020-2025.pdf

Figure 18 - extracts from the Gender Equality Strategy 2020-2025

Achieving equal participation across different sectors of the economy

While there are **more women university graduates in Europe than men graduates**, women remain underrepresented in higher paid professions[46]. More women than men work in low-paid jobs and sectors, and in lower positions[47]. Discriminatory social norms and stereotypes about women's and men's skills, and the undervaluation of women's work are some of the contributing factors.

Out of high-performing students in maths or science in OECD countries, **1 in 4** boys expect a career as an engineer or scientist, compared to **1 in 6** girls; **1 in 3** girls expect to work as health professionals, compared to **1 in 8** boys.

The share of men working in the digital sector is **3.1 times** greater than the share of women.

Only **22%** of AI programmers are women.

The digital transition is of utmost importance in this context. With rapid transformation and digitisation of the economy and the labour market, today 90% of jobs require basic digital skills[48]. Women only represent 17% of people in ICT[49] studies and careers in the EU[50] and only 36% of STEM[51] graduates[52], despite the fact that girls outperform boys in digital literacy[53]. This gap and this paradox will be addressed in the updated **Digital Education Action Plan** and through the implementation of the **Ministerial declaration of commitment on 'Women in Digital'**[54]. The '**Women in Digital' scoreboard** will be used more systematically.

The **Updated Skills Agenda for Europe** will help address horizontal segregation, stereotyping and gender gaps in education and training. The Commission proposal for a **Council recommendation on vocational education and training** will support improving gender balance in traditionally male or female-dominated professions and address gender stereotypes. The **reinforced Youth Guarantee** will also specifically address women that are not in education, employment or training to ensure equal opportunities.

In the Commission's forthcoming **communication on the European Education Area,** gender equality will be put forward as one of the key elements. The renewed **strategic framework for gender equality in sport** will promote women's and girls' participation in sport and physical activity and gender balance in leadership positions within sport organisations.

Source: "A Union of Equality" (COM (2020) 152)

In 2020, the Communication *A new ERA for Research and Innovation*, COM (2020) 628, 30 September 2020, reinforced the need for:

> "In line with the Skills Agenda, the Communication on the European Education Area, and the new Digital Education Action Plan, the ERA will reinforce its emphasis on women's participation in the fields of science, technology, engineering, and mathematics (STEM) and will promote entrepreneurship. It is also necessary to address diversity by opening up policies to intersections with other social categories, such as ethnicity, disability (including accessibility and inclusion), and sexual orientation, as well as discrimination and gender-based violence in R&I organizations."
>
> **(COM/2020/628:18)**

Also in 2020, the EU set the goal to achieve the new EEA – European Education Area until 2025, in order to help European Union Member States to work together to build more resilient and inclusive education and training systems.

The EEA comprises five focus areas:

- improving quality and equity in education and training
- teachers, trainers, and school leaders
- digital education
- green education
- the EEA in the world

Digital Education Action Plan 2021-2027 https://education.ec.europa.eu/focus-topics/digital-education/action-plan

It defines and monitors actions in different education levels:

- early childhood education and care
- school education
- higher education
- adult learning
- vocational education and training

It is organised in the following working groups:

- Early childhood education and care
- Schools, including sub-groups on
  - Pathways to School Success
  - Learning for Sustainability

- Higher education
- Vocational education and training and the green transition
- Adult learning: opening up opportunities for all
- Digital education: learning, training, and assessment
- Equality and values in education and training

"This working group focuses on structural reforms to promote equality in education and training. It builds on the EU's values (including anti-radicalisation, citizenship education and training, the European dimension of education, disinformation and the inclusion of refugees and migrants in education and training). The working group examines relevant areas related to equality, bearing in mind the dual approach of inclusive education for all while targeting specific population groups. Along with using group-focused approaches (such as gender equality, anti-racism, the equality of Roma, people with migrant background, LGBTQI persons and people living with disabilities) the working group also examines cross-cutting issues with societal benefits and of high importance to all discriminated and disadvantaged groups (such as fighting segregation in education and managing diversity)."

Source: https://education.ec.europa.eu/about-eea/working-groups

The EEA Working group on Equality and values in education and training is integrated by representatives from Member States and Candidate countries, as well as from relevant EU agencies, stakeholder associations, social partners and international organisations. The working group already produced the following documents:

- EC (2023a): Issue Paper Tackling different forms of discrimination in and through education and training Working Group on Equality and Values in Education and Training (2021-2025). Edited by: Vicki Donlevy, Barry van Driel, Selina Komers, Maria Melstveit Roseme, based on the work of the Working Group Equality and Values in Education and Training (2021-2025). doi: 10.2766/798464

It doesn't have a specific focus on gender equality, but addresses six main themes relating to tackling different forms of discrimination and disadvantage in and through education: Tackling discrimination based on ethnic or racial origin, including discrimination against Roma; Tackling discrimination relating to religion and beliefs; Tackling discrimination based on disability; Tackling discrimination relating to sexual orientation, gender identity or expression and sex characteristics; Tackling social and territorial inequalities; Tackling multiple discrimination: an intersectional approach.

- EU (2023b): Issue Paper on Gender Equality in and through Education. edited by Barry van Driel, Vicki Donlevy and Maria Melstveit Roseme (Ecorys) based on the work of the Working Group Equality and Values in Education and Training (2021-2025). doi:10.2766/915001.

This is a fundamental document, presenting diagnosis and statistical overviews and relevant areas/dimensions of intervention, such as those referred to herein.

"b) Non-traditional education and career pathways

- Career expectations among boys and girls have changed very little in the last two decades.
- Too many initiatives to address non-traditional career pathways have an ad hoc nature and are not sustainable or structural.
- Whole school approaches have been found to be effective vehicles to promote non-traditional career choices. They are still rare.
- Teachers gender biases (both conscious and unconscious) can impact grading and career choices. For example, teachers tend to have (often subtle) positive stereotypes of boys when it comes to STEM related subjects and girls when it comes to reading and the humanities. These stereotypes impact performance and scores.
- Men have low participation rates in careers associated with education, care and the humanities.
- Although women tend to choose careers in education more often than men, they continue to be underrepresented in higher level managerial positions and broader decision-making structures at the level of school leadership. • School initiatives aimed at promoting non-traditional pathways may encounter opposition from parents or society at large.
- Women and girls tend to have less confidence when entering fields of study that have been traditionally male dominated.
- On the whole, women and girls have relatively low participation rates in STEM fields of education.
- There is still limited evidence on why the gap in STEM between males and females, mentioned above, has been pervasive.

c) Textbooks and learning materials

(...)

- Although some research has been conducted on gender stereotypes in textbooks, teachers and students increasingly use online materials. It is still unclear as to what the opportunities and threats this poses and how policymakers can best address this issue.
- Apart from unbalanced gender representation in textbooks, women and men are still often portrayed in stereotypical manner. Many of the gender stereotypes in learning materials appear to be subtle and not blatant. They are not always recognised though they do have an impact on school students. Some initiatives to combat gender stereotypes involve removing (classic) texts, which promote such stereotypes, from reading lists and/or libraries. The question is whether this is an appropriate measure and what the alternatives, if any, are.
- Terminology and inclusive language matters. Too often the terminology in various resources is either outdated biased and/or inappropriate."

Source: EC, Directorate-General for Education, Youth, Sport and Culture *et al.*, 2023: 20-21

The paper recommends as points of attention:

- The adoption of a dual approach, comprising both gender mainstreaming in all areas and targeted actions, with intersectionality (the consideration of the impact of different forms of disadvantage) as a horizontal principle in implementation.
- The adoption of holistic strategies and practices are key to fighting gender inequality in education.
- Exchanges of best practices, scientific studies and rigorous policy evaluations.
- Targeted interventions based on local needs can be an effective solution, but must be combined with strategic, transversal action at national policy level.
- Gender equality should be a transversal focus of all policies and programmes in the field of education. Such gender mainstreaming would both promote a renewed focus on gender equality, and also avoid policies and programmes that are 'gender blind', which can reinforce existing (including subconscious) inequalities and stereotypes.
- The adoption of a sustained and structural whole school approach, that can sustainably change people's attitudes, behaviours, school's culture and learning materials.


CPU

CHAPTER 4

Teacher's experiences, attitudes and needs

1. Methodological aspects

We designed a questionnaire that was administered to STEM teachers in the four partner countries. The questionnaire includes 43 questions, largely inspired by the literature review carried out, and is organised into four parts. In addition to the sociodemographic characterisation of the respondents, we sought to find out about the teachers' digital skills and use of teaching technologies, and whether they had received training in the areas of citizenship, gender equality, STEM teaching and technologies in teaching; we also asked them perspectives about STEM teaching programs and the integration of the equality perspective in teaching in each country. Additionally, we sought to find out about existing initiatives in their schools to promote gender equality in STEM; their perceptions on the sexual segregation of STEM educational areas and the manifestation of gender stereotypes in education; the most relevant measures and actors in combating the phenomenon of sexual segregation in STEM; self-efficacy and capacity for teaching STEM from a gender perspective. Finally, we also asked about their experiences and the main barriers they identify to gender equality in STEM education.

The questionnaire was disseminated online, between February and March 2024, via the Lime Survey platform. It was translated from English to each country language: French, Italian, Portuguese, and Romanian. Answers were again translated to English for the analysis. The target audience (secondary school teachers and STEM and/or gender specialists) was contacted through school management, direct contacts with public and private school teachers, existing projects, the Scientix teachers' network, social networks, and even personal contacts with teachers and schools.

2. The sample

We managed to reach a sample of 210 teachers (see Table 1), 26.7% of whom from Belgium, 23.8% from Italy, 25.2% from Portugal and 24.3% from Romania. Results revealed an equitable distribution of responses among the languages. Women constitute the majority of the sample (68.1%), while men represent 31.4%, and there is one non-binary person (0.5%). The predominance of women is observed in all countries, particularly in Portugal (81%) and Romania (75%), while Italy has the only representation of a non-binary person (2%).

The age distribution is wide, with an average of 44.9 years. Most participants are in the 40-49 age group (31.9%), followed by the 50-59 age group (28.1%). The younger (20-29 years) and older (60-69 years) age groups represent 12.9% and 8.6%, respectively. Only 0.5% of responds were over 69 years old.

Regarding education, most participants hold a master's (48.6%) or bachelor's degree or equivalent (36.2%). Some hold a PhD (6.2%). Only 2.4% hold only a secondary education diploma.

Table 1 - Sociodemographic characterization of respondents by country and total

	Belgium	Italy	Portugal	Romania	Total
N=	56 (26.7%)	50 (23.8%)	53 (25.2%)	51 (24.3%)	**210**
Gender	143 Women; 66 Men; 1 non-binary person				
Woman	57%	60%	81%	75%	**68.1%**
Man	43%	38%	19%	26%	**31.4%**
Non-binary person	0%	2%	0%	0%	**0.5%**
Age					
20 - 29 years	21.4%	10%	1.9%	17.6%	**12.9%**
30 – 39 years	23.2%	32%	5.7%	11.8%	**18.1%**
40 – 49 years	26.8%	30%	32.1%	39.2%	**31.9%**
50 – 59 years	23.2%	20%	43.4%	25.5%	**28.1%**
60 – 69 years	3.6%	8%	17%	5.9%	**8.6%**
70 years or more	1.8%	0%	0%	0%	**0.5%**
Level of education					
Secondary	5.4%	2%	1.9%	0%	**2.4%**
Short-term higher	25%	0%	0%	0%	**6.7%**
Bachelor's degree or equivalent	21.4%	10%	56.6%	56.9%	**36.2%**
Master's Degree	39.3%	78%	37.7%	41.2%	**48.6%**
Ph.D.	8.9%	10%	3.8%	2%	**6.2%**
Scientix ambassador	19 Yes (9%)		191 No (91%)		
Carrying out other school duties	101 Yes (48.1%)		109 No (51.9%)		
Teaching experience in years	Less than 1 year		6.2%		
	1 to 4 years		14.3%		
	5 to 9 years		11.9%		
	10 to 14 years		10.5%		
	15 to 19 years		11.9%		
	20 to 24 years		15.7%		
	25 to 29 years		10%		
	30 to 34 years		10%		
	35 years or more		9.5%		

Length of time teaching at current school	Less than 1 year	11.9%
	1 to 4 years	22.4%
	5 to 9 years	19.1%
	10 to 14 years	11.9%
	15 to 19 years	8.6%
	20 to 24 years	11%
	25 to 29 years	8.6%
	30 to 34 years	1.9%
	35 years or more	4.8%

Teaching experience varies, with a relatively balanced distribution. Those with 20-24 years of experience make up the largest group (15.7%), while the smallest is of teachers with less than 1 year of experience (6.2%). Regarding tenure at their current school, most respondents indicated less than a decade (41,5%), and a significant percentage less than a year (6.2%).

Nearly half of the respondents (48.1%) reported involvement in supplementary tasks within the school, highlighting additional commitment beyond teaching tasks. Only 9% of the participants said to be ambassadors of the Scientix community (https://www.scientix.eu/)

3. Teachers digital skills and competences

The majority of respondents (76.7%) consider themselves "Good" or "Very Good" in terms of digital skills, suggesting a high level of confidence and competence (Figure 19). However, 18.6% consider themselves merely "Sufficient" and 4.8% feel their skills are insufficient, which may indicate the need for additional training or resources to further improve their digital skills.

However, when asked about the type of teaching technologies they actually use (Figure 20), we noticed a tendency to use less interactive and even more conventional tools. Most teachers regularly utilise digital resources, such as internet searches and teaching platforms, alongside traditional tools like PowerPoint presentations and sharing online documents. The use of AI and participation in online forums are less frequent. Notably, the less commonly used digital resources are AI or other digital tools to interact with students, both in class preparation and assessment, indicating a lack of interactive engagement with students.

Figure 19 - Level of digital skills and competences for teaching and learning (%)

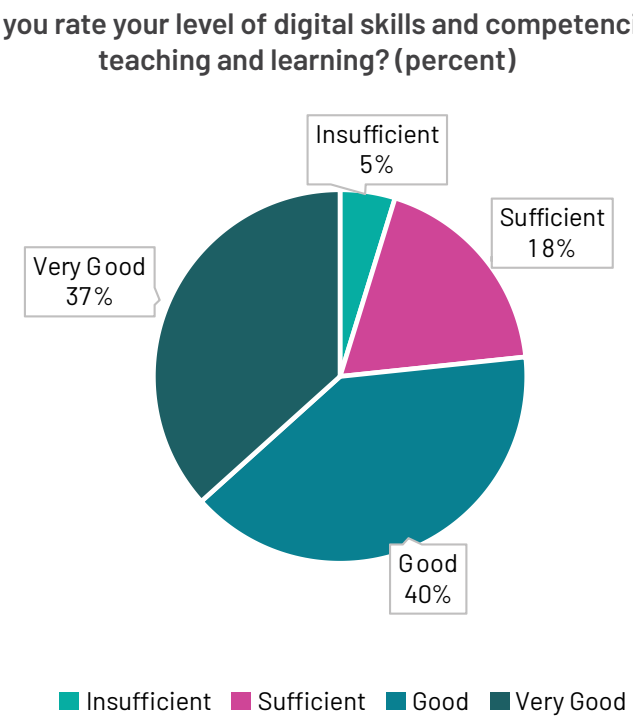
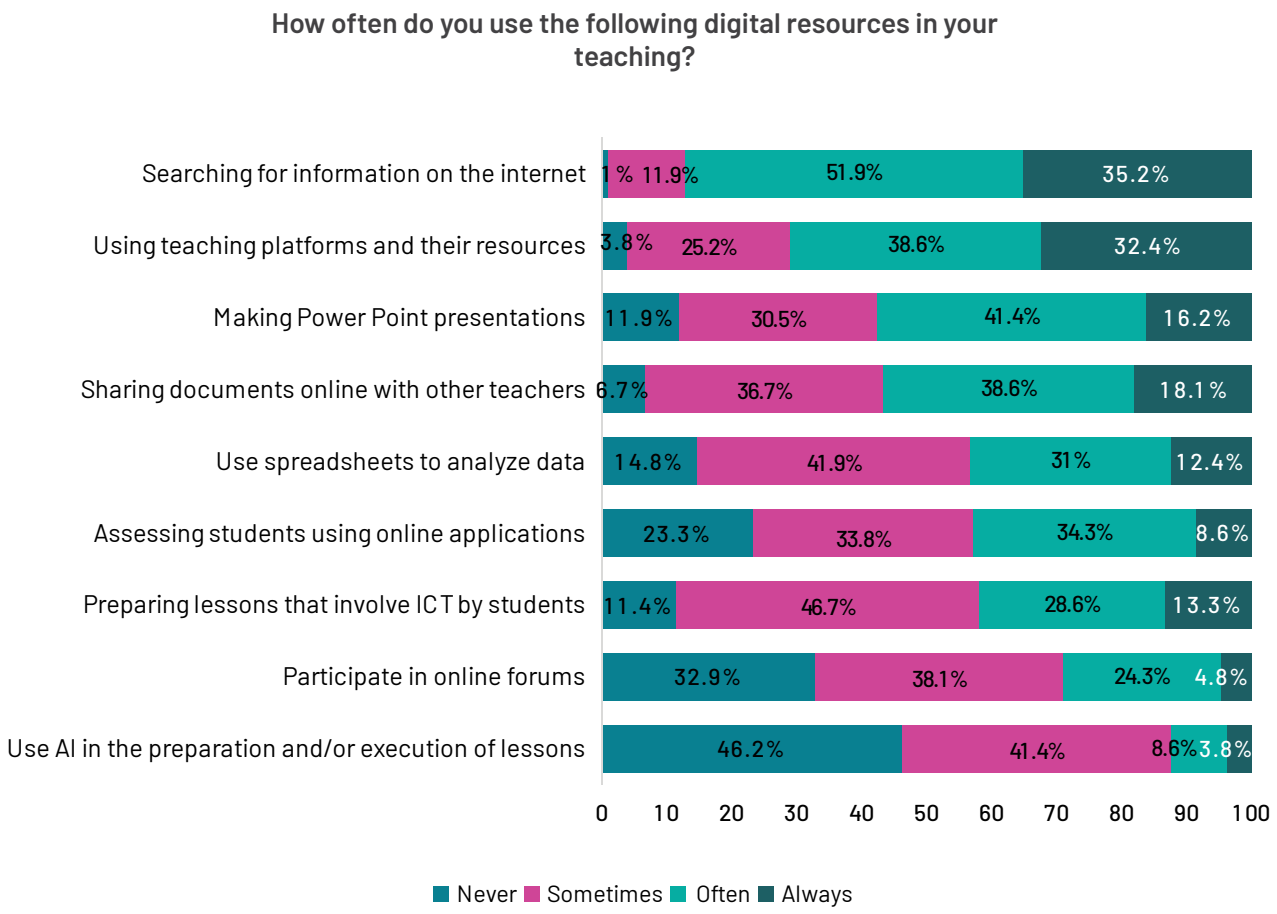


Figure 20 - Frequency of use of digital resources in teaching (%)



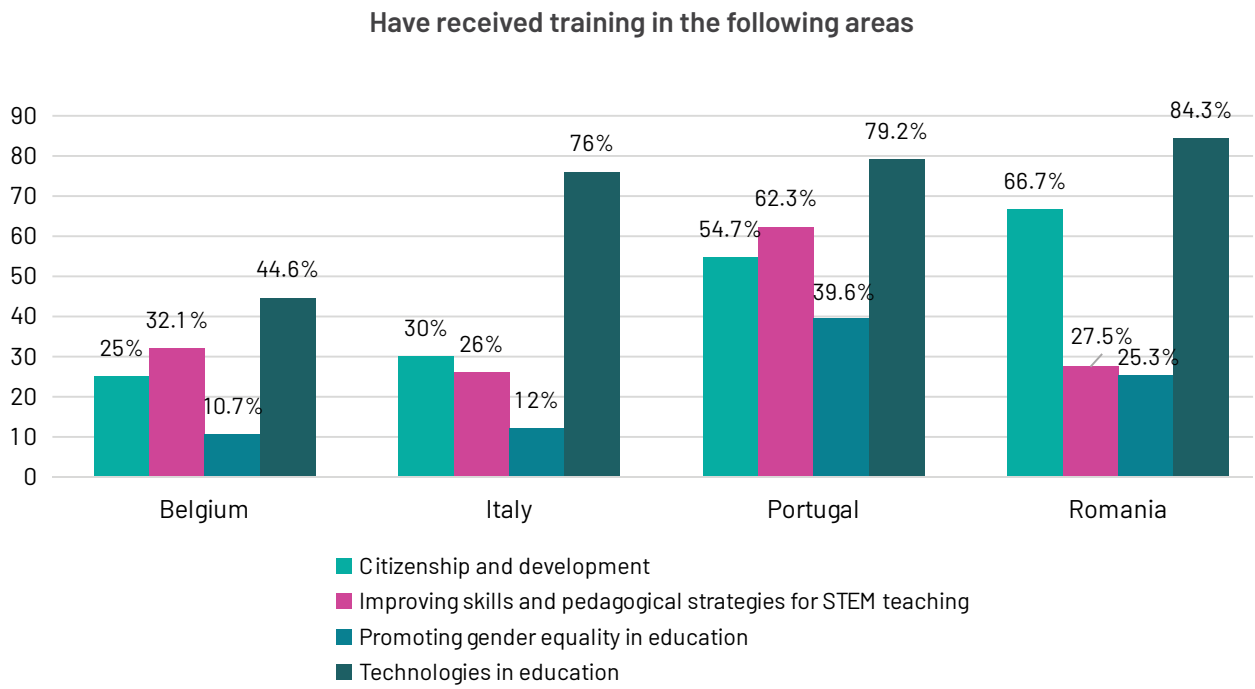
4. Teachers training and assessment of gender equality initiatives

A large majority of teachers in the sample (70.5%) received training in educational technologies, indicating a significant emphasis in this area (Table 2). Still, less than half (43.8%) received training in citizenship and development, and only 37.1% received specific training to improve skills and pedagogical strategies for STEM teaching. Promoting gender equality in education (only 21.4%) shows the lowest percentage of training received. This low percentage highlights a critical area, requiring more attention and resources to ensure gender equality is effectively promoted in schools.

Table 2 - Teacher training areas (%)

Have you received training in any of the following areas?	Yes	No
Technologies in education	70.5%	29.5%
Citizenship and development	43.8%	56.2%
Improving skills and pedagogical strategies for STEM teaching	37.1%	62.9%
Promoting gender equality in education	21.4%	78.6%

Figure 21 - Teacher training areas by country (%)



As illustrated in Figure 21, Technologies in Education shows the highest training percentages across all countries, with Romania leading (84.3%), followed by Portugal (79.2%), Italy (76%), and Belgium (44.6%), suggesting a strong emphasis on integrating technology in education. In contrast, training for Promoting Gender Equality in Education is relatively low, with Belgium at the lowest (10.7%) and Portugal the highest (39.6%), indicating a critical need for increased focus and resources in this area. Regarding Improving Skills for STEM Teaching, Portugal stands out (62.3%), demonstrating a robust effort in STEM education. In Citizenship and Development, Romania (66.7%) and Portugal (54.7%) show higher percentages of trained teachers, compared to Italy (30%) and Belgium (25%).

Teachers were also asked whether the education curriculum in their country includes objectives to promote gender equality in STEM degree choices, whether the STEM courses' programmes pay attention to gender equality, whether there is gender equality training for teachers, and whether they had ever received training with a gender perspective during their undergraduate studies, postgraduate studies, or lifelong education (Table 3).

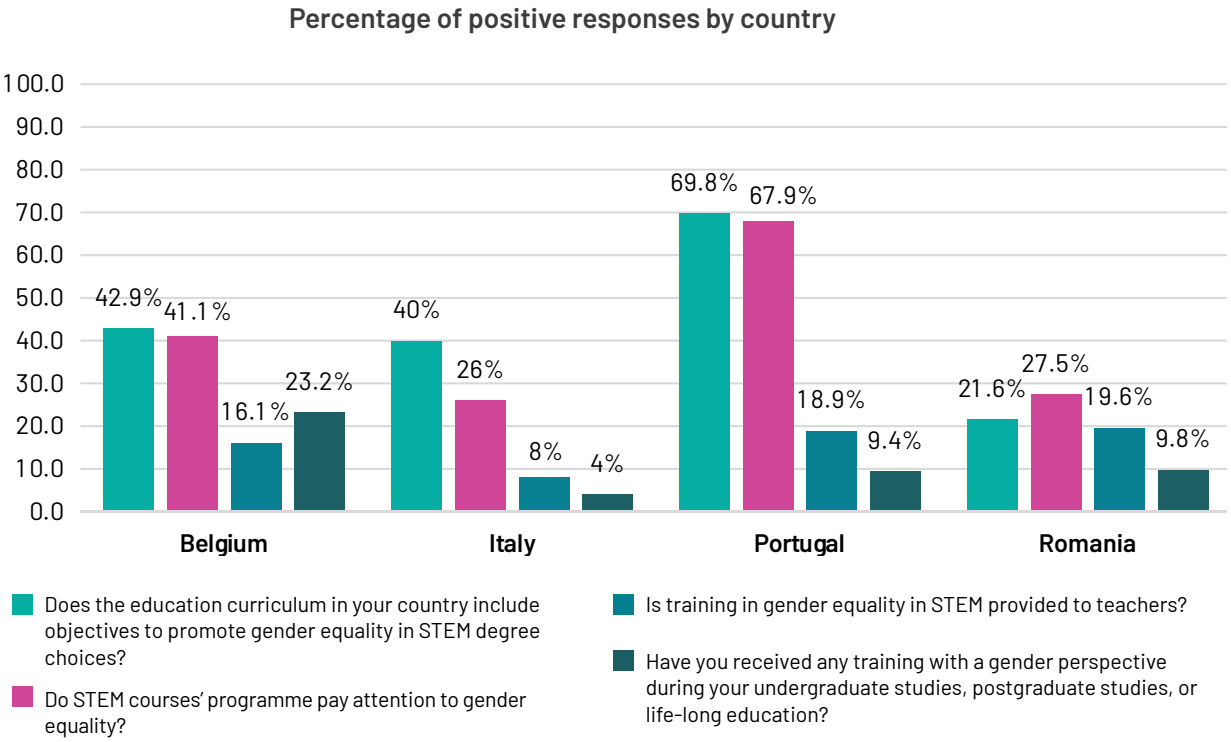
Table 3 - Assessment of gender equality initiatives in STEM education programs (%)

Questions	Yes	No
Does the education curriculum in your country include objectives to promote gender equality in STEM degree choices?	43.8%	56.2%
Do STEM courses' programme pay attention to gender equality?	41%	59%
Is training in gender equality in STEM provided to teachers?	15.7%	84.3%
Have you received any training with a gender perspective during your undergraduate studies, postgraduate studies, or life-long education?	11.9%	88.1%

Less than half of the teachers (43.8%) indicated that the education curriculum in their country includes objectives to promote gender equality in STEM degree choices. This suggests a significant proportion of curricula may not actively address gender equality in STEM. Only 41% of teachers reported that STEM course programmes pay attention to gender equality, indicating that most STEM programmes do not prioritise or sufficiently address gender equality issues. A small percentage (15.7%) have received training in gender equality specifically for STEM education, highlighting a critical gap in professional development that needs to be addressed to foster gender equality in STEM fields. Furthermore, only 11.9% of teachers have received any training with a gender perspective during undergraduate and postgraduate studies, or in lifelong education. This result underscores the lack of emphasis on gender perspectives throughout the teachers' educational journey. Overall, there is an insufficient focus on gender equality in STEM education. The percentages of teachers who reported affirmative responses are relatively low, ranging from 11.9% to 43.8%. Data suggests a pressing need to incorporate more objectives promoting gender equality in the education curricula and to provide more extensive training in gender equality for teachers, particularly regarding STEM education.

The percentage distribution of positive responses by country in shown in Figure 22.

Figure 22 - Assessment of gender equality initiatives in STEM education programs by country (%)



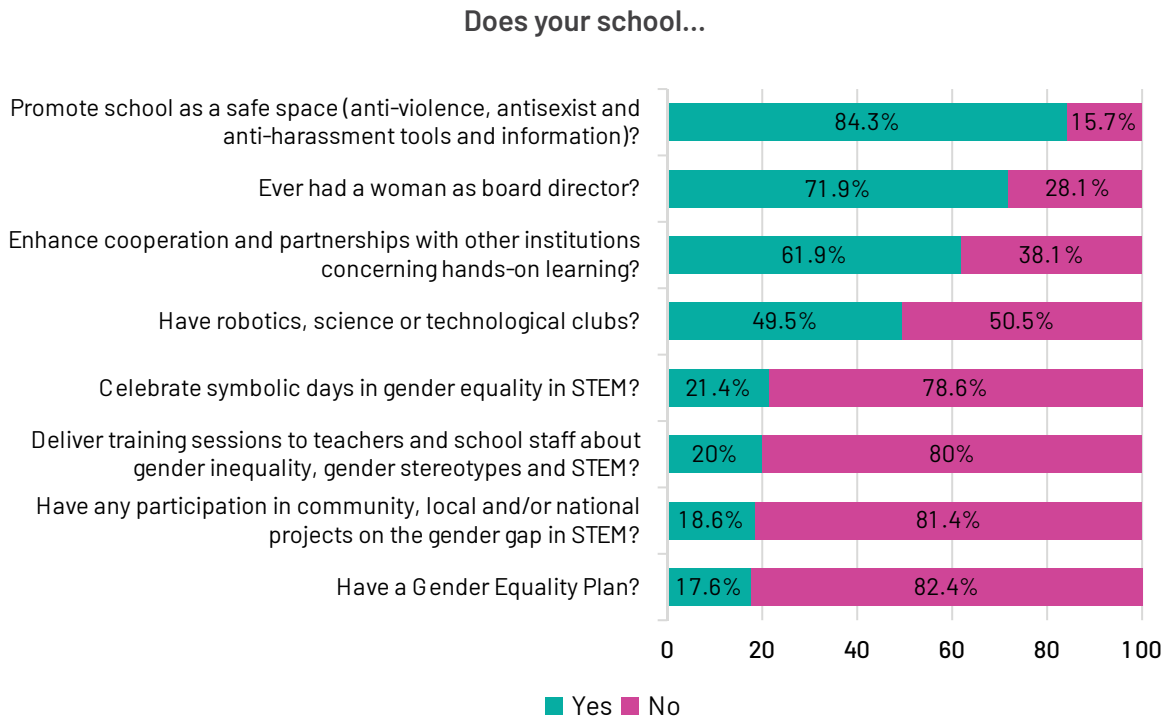
Portuguese teachers' answers show the highest percentages in both the inclusion of gender equality objectives in the curriculum (69.8%) and the attention to gender equality in STEM courses (67.9%). However, the percentage drops when it comes to actual training in gender equality for STEM teachers (18.9%) and gender perspective training during the teachers' educational journey (9.4%). Belgium demonstrates relatively balanced but moderate responses across all questions, the highest being 42.9% for curriculum inclusion and the lowest gender equality training in STEM (16.1%). Italy shows lower percentages, especially in training with a gender perspective during the educational journey (4%), indicating significant gaps in gender-focused education and training. Romanian teachers' answers show a similar trend, with low percentages overall, but slightly better in training with a gender perspective during teachers' educational journeys (9.8%).

In summary, despite significant variations in the promotion and training of gender equality in STEM education across the four countries, the teachers surveyed reveal that all countries need greater emphasis on providing specific training in gender equality for STEM teachers and incorporating gender perspectives throughout teachers' educational journeys.

Additionally, the data reveals a contradiction: 43.8% of teachers state that the educational curriculum in their countries includes objectives to promote gender equality in STEM choices, and 41% report that STEM course programmes pay attention to gender equality; however, 84.3% of teachers said there is no gender equality training in their schools, and 88.1% have never received any type of gender perspective training during their studies, postgraduate education, or lifelong learning. When observing the percentage distribution by country, Belgium shows the highest percentage of teachers claiming not to have received any type of gender perspective training during their studies, postgraduate education, or lifelong learning (23.2%), followed by Romania (9.8%) and Portugal (9.4%). This indicates the need for a greater focus on training teachers in specific STEM areas across the countries, and much more attention to gender equality issues.

5. School initiatives and practices

Figure 23 - School initiatives and practices to promote gender equality in STEM (%)

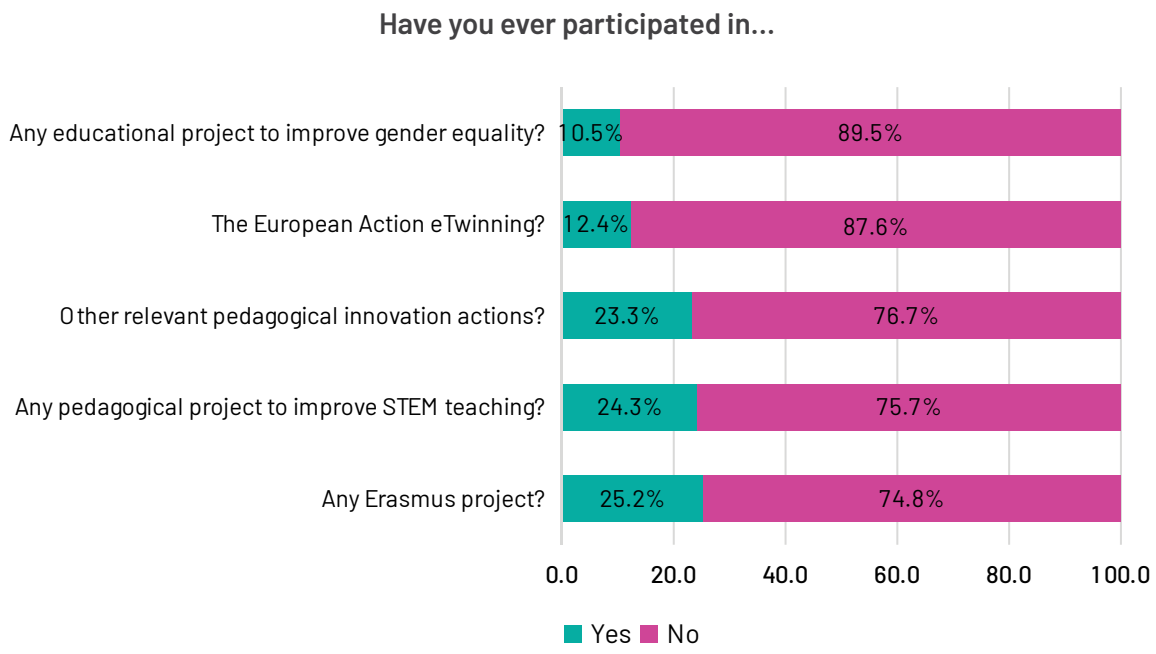


When invited to look at their schools, teachers revealed a worrying absence of concrete measures to include a gender perspective in STEM education. Most schools do not celebrate symbolic girls on ICT days (78.6%), do not have an equality plan (82.4%) or participate in community, local, and/or national projects on the gender gap in STEM (81.4%), and do not train their staff on gender equality issues (80%). On the positive side, a majority of teachers report that their schools (84.3%) promote themselves as safe spaces by implementing anti-violence, anti-sexist, and anti-harassment measures and information; and 71.9% of schools have had a woman as a board director at some point, indicating the participation of women in leadership roles. All in all, results indicate a significant room for improvement in schools' commitment to formalising and promoting gender equality initiatives.

The absence of measures to integrate a gender perspective in STEM education contrasts with a significative presence of auspicious measures in STEM pedagogies, as 61.9% of schools engage in cooperation and partnerships with other institutions regarding hands-on learning; and around half of schools (49.5%) have robotics, science, or technological clubs.

Figure 24 illustrates the percentage of respondents who have participated in relevant educational and pedagogical projects and initiatives.

Figure 24 - Participation in educational projects and initiatives (%)



Data indicates that participation in educational and pedagogical initiatives is generally low across the sample, with a particularly notable lack of involvement in projects aimed at improving gender equality and in the European Action eTwinning. These areas present opportunities for increased engagement and involvement.

Participation in Erasmus projects is relatively low, with only about 25% of respondents having taken part. Similarly, participation in pedagogical projects to improve STEM teaching and other relevant pedagogical innovation actions is also low (around 24% in both cases). The European Action eTwinning sees a low participation rate (12.4%). Lastly, participation in educational projects to improve gender equality is the lowest (only 10.5%).

6. Teachers perceptions about gender balance in STEM classes

Results indicate that a majority of STEM classes do not have a gender imbalance, with 57.1% of the inquired teachers reporting no majority of boys. According to their justification this is mostly attributed to the mandatory nature of STEM classes for all students. In the reported cases of optional STEM classes there is a significant gap, with fewer girls choosing to participate.

Table 4 - Gender distribution and participation reasons in STEM classes (%)

		Do you have a majority of boys in your STEM classes?	
		Yes 90 (42.9%)	**No 120** (57.1%)
Why?	STEM classes are mandatory for all students	**55 (61.1%)**	**79 (65.8%)**
	STEM classes are optional, so girls chose it less than boys	**22 (24.4%)**	**13 (10.8%)**
	Other	**13 (14.4%)**	**28 (23.3%)**

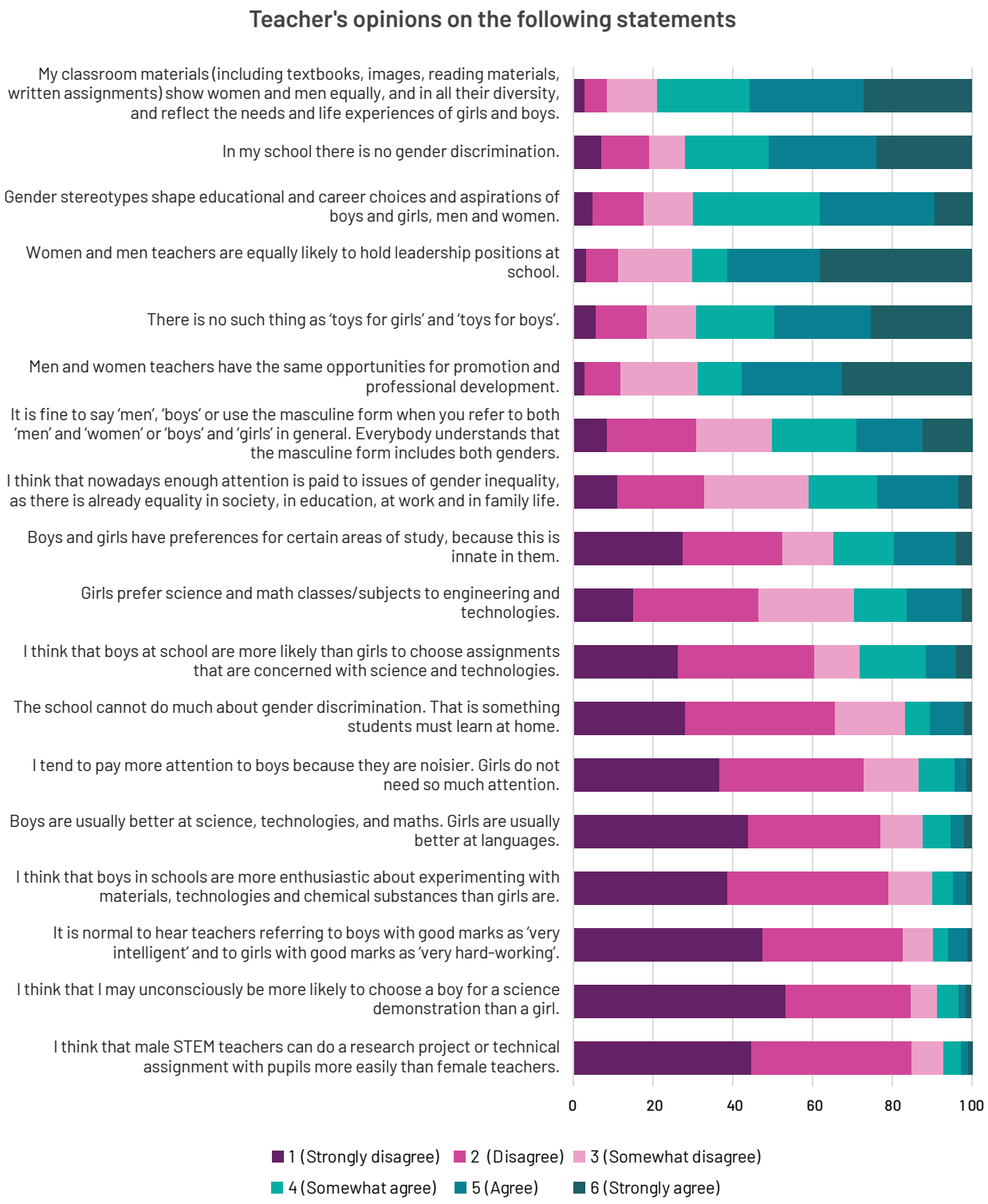
Table 5 - Perceptions on gender imbalance in STEM classes (%)

Do you have a majority of boys in your STEM classes?			
Yes 90 (42.9%)		**No 120 (57.1%)**	
Is this a problem to you?		**Is this a problem to you?**	
Yes 10 (11.1%)	No 80 (88.9%)	Yes 3 (2.5%)	No 117 (97.5%)

Most respondents do not view gender imbalance in STEM classes as a problem. This suggests that while gender imbalance exists in some STEM classes, it is not widely perceived as an issue by the educators surveyed.

7. Gender equality and stereotypes in education – Teachers' Awareness

Figure 25 - Teachers' opinions on gender equality and stereotypes in education (%)



For the purpose of this analysis, the answers have been grouped into two broad categories of disagreement and agreement. In other words, "Strongly Disagree", "Disagree", and "Somewhat Disagree" were grouped under "Disagree", while "Somewhat Agree", "Agree", and "Strongly Agree" were grouped under "Agree".

A large portion of teachers agree that their classroom materials equally represent women and men (79%). Most teachers also believe there is no gender discrimination in their schools (71.9%), that men and women are equally likely to hold leadership positions in schools (70%), and that male and female teachers have equal opportunities for promotion and professional development (68.6%). It is positive to observe that there is notable disagreement with the statement that schools cannot do much about gender discrimination (83.3%), indicating teachers believe schools have a role to play.

However, most think gender stereotypes shape educational and career choices (70%), and many agree more attention should be paid to gender inequality issues, suggesting this is an area needing improvement (59.1%). Notwithstanding those answers, 34.7% of the respondents agree that preferences for specific areas of study stem from something innate in boys and girls; and that girls prefer science and maths (29.5%) while boys prefer engineering and technologies (28.1%). Only 28,1% of the teachers think boys are more likely than girls to choose assignments concerned with science and technologies. This may well be because the survey was answered by teachers of low grades where STEM courses are mostly mandatory.

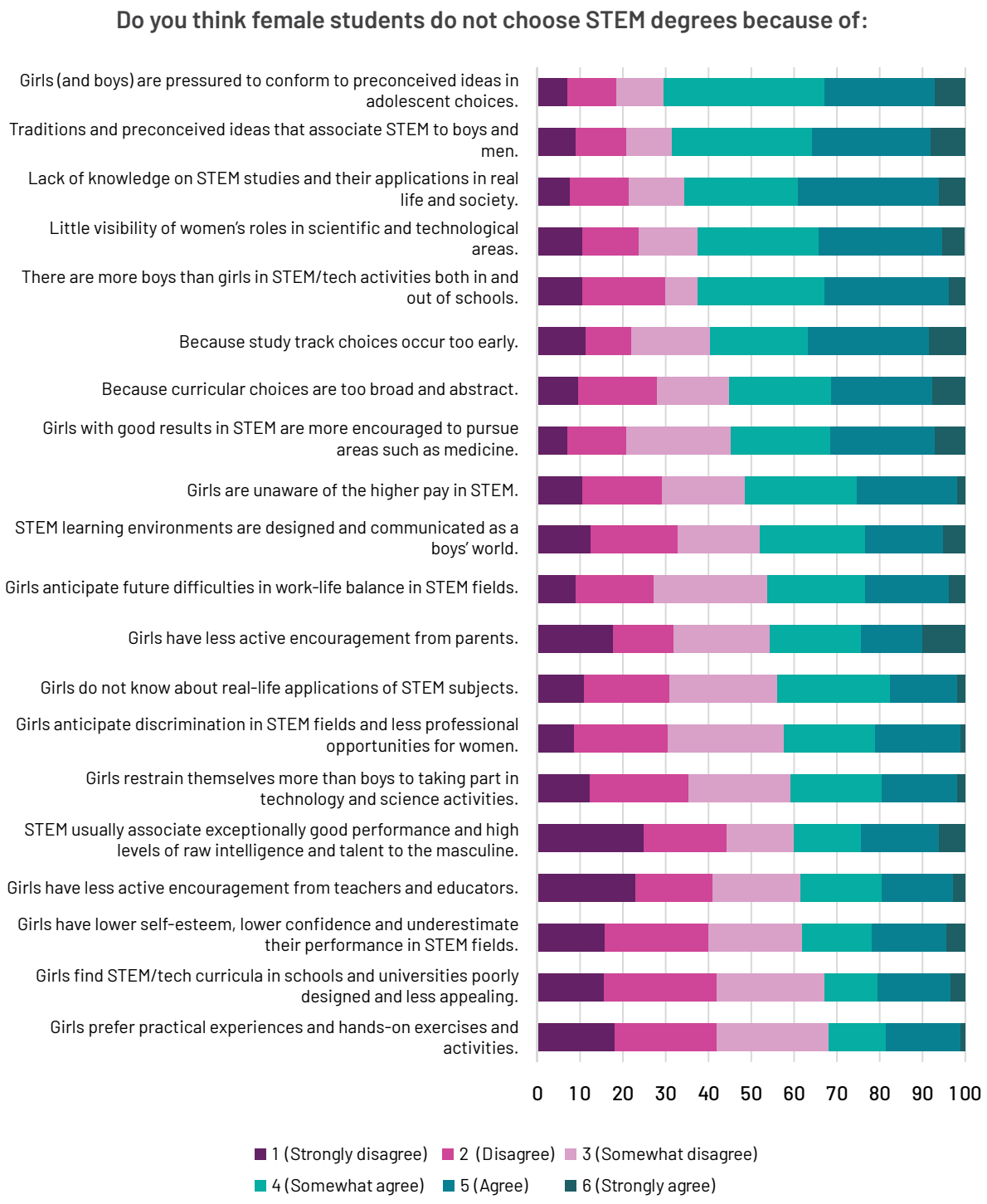
There is a strong recognition of the undesirability of the idea that there are toys for girls and toys for boys toys (69%) and a notable disagreement that male STEM teachers can more easily engage students in research projects (92.9%).

Opinions are mixed on using masculine forms to refer to both genders (50%). In pedagogical terms, only a few teachers agree that boys need more attention because they are noisier (13.3%) or that boys are better at STEM subjects and girls at languages (12.3%). There is strong disagreement with the notion that boys with good marks are seen as more intelligent and girls with good marks as more hardworking (90.4%), indicating a rejection of this stereotype. Teachers also strongly disagree that they may unconsciously prefer boys for science demonstrations (91.4%).

Such results highlight that, while many teachers strive for gender equality and recognise the importance of addressing gender stereotypes, there still is a significant lack of awareness of gender stereotypes and biases. Although there is a general consensus that schools have a role in addressing gender discrimination, mixed opinions indicate a need for further professional development and awareness to effectively combat gender inequality.

Figure 26 refers to the eventual reasons for girls not choosing STEM degrees.

Figure 26 - Reasons female students may avoid choosing STEM degrees (%)



There is noticeable agreement that more boys than girls engage in STEM/tech activities both in and out of school (62.3%), and that this imbalance affects girls' choices. Regarding the causes for the alienation of girls from the study of STEM subjects, most teachers agree that girls (and boys) are pressured to conform to preconceived ideas in adolescent choices (70.4%), and that traditions associate STEM to boys and men (68.6%). Most also believe the lack of knowledge about STEM studies and their real-life applications contributes to the lower number of girls choosing STEM degrees (65.8%). Also, the limited visibility of women's roles

in scientific and technological areas discourages girls from pursuing STEM degrees (62.3%). Many teachers think that study track choices occur too early (59.6%) and that curricular choices are too broad and abstract (55.2%), making it harder for girls to see a clear path in STEM. Slightly over half of respondents agree that girls with good results in STEM are more encouraged to pursue areas such as medicine rather than engineering or technology (54.7%) and that girls are unaware of the higher pay in STEM fields (51.4%).

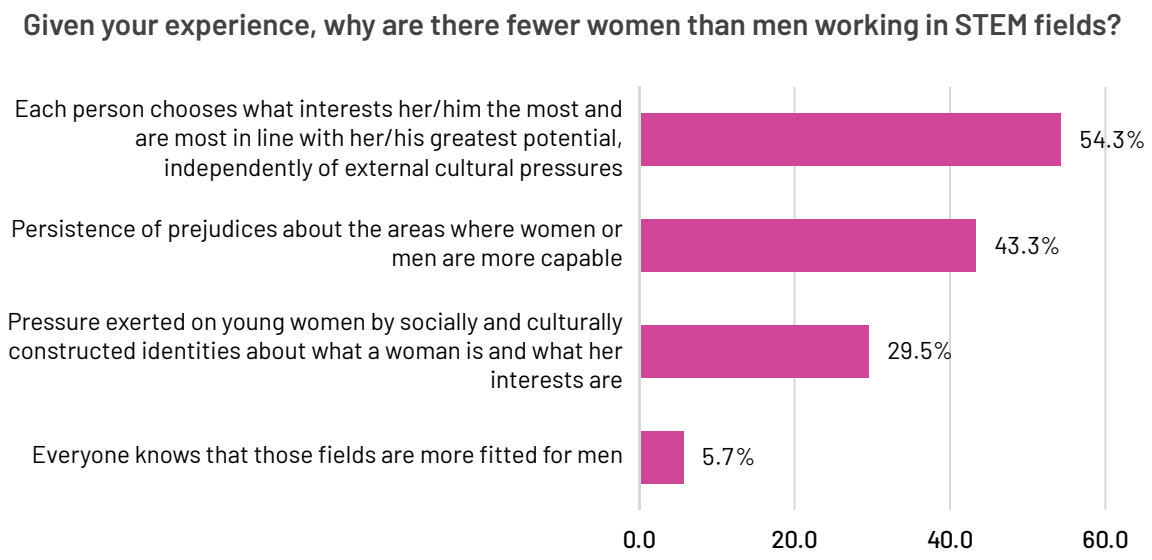
Respondents seem less aware of the gendered nature of learning environments as a factor influencing the gender gap and discouraging girls. Around half think that STEM learning environments are often designed and communicated as a boys' world (48.1%). The majority do not agree that STEM usually associates exceptionally good performance and high levels of raw intelligence and talent with the masculine (60%) and that girls receive less active encouragement from teachers and educators (61.4%). Also, regarding pedagogical factors, only about a third of respondents think girls find STEM/tech curricula in schools and universities poorly designed and less appealing (32.8%); and only 31.9% believe girls prefer practical experiences and hands-on exercises and activities over theoretical STEM subjects.

There seems to be a lack of recognition of the difficulties girls anticipate in a future career or studies in STEM fields. Only 38.1% of teachers recognise that girls have lower self-esteem and confidence and tend to underestimate their performance in STEM fields. Around 46.2% believe that girls anticipate future difficulties in work-life balance in STEM fields. There is less agreement to the idea that girls anticipate discrimination in STEM fields and fewer professional opportunities for women (42.4%), leading them to restrain themselves more than boys from taking part in technology and science activities (40.9%).

Many also agree that girls receive less active encouragement from parents (45.7%) and are less aware of the real-life applications of STEM subjects (43.8%).

Figure 27 refers to the eventual reasons for women's lower participation in STEM occupations in the labour market.

Figure 27 - Reasons for women's lower participation in STEM (%)

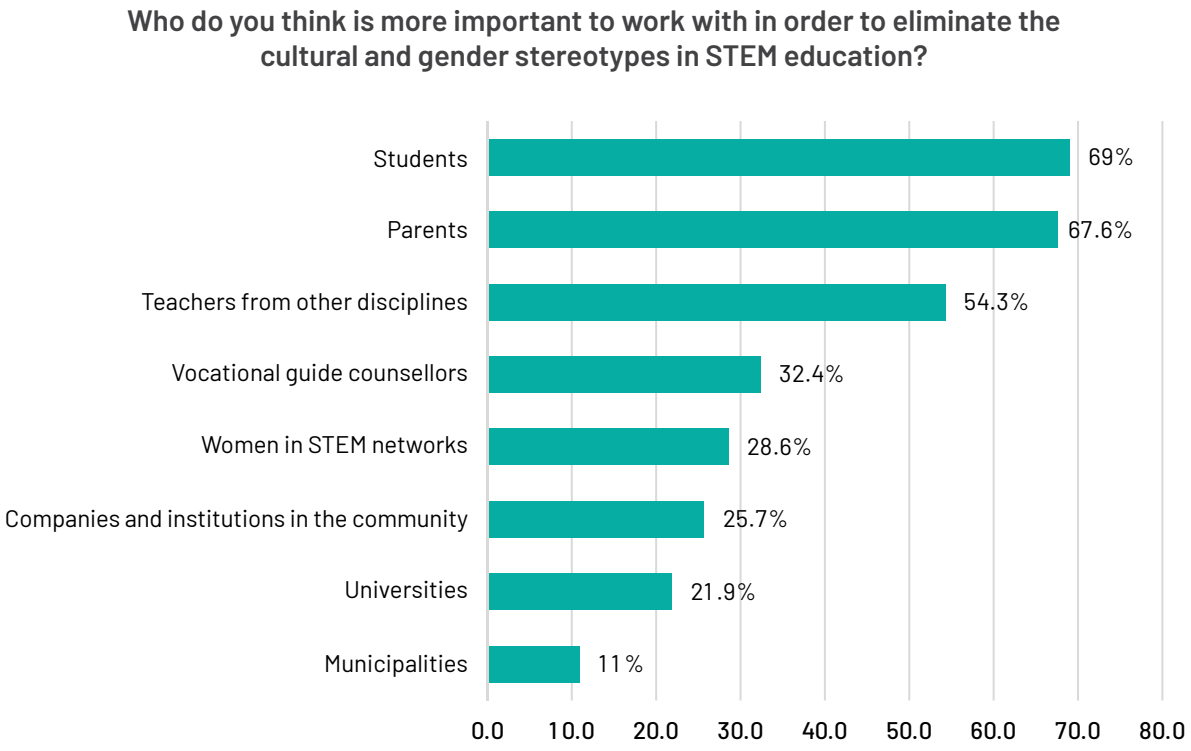


We found a prevalent individualised justification for the lower participation of women in STEM occupational fields, based on the free choice of men and women, and much less recognition of cultural and gendered determinants and pressures. The main reason given by 54.3% of respondents is that individuals choose what interests them most and aligns with their potential, regardless of gender. Additionally, 43.3% of respondents believe the persistence of prejudices about the areas where women and men are most capable influences this disparity. Social and cultural pressure on young women, shaping their identities and expectations, was chosen only by 29.5% of respondents.

8. Teachers' perspectives on combating gender stereotypes in STEM

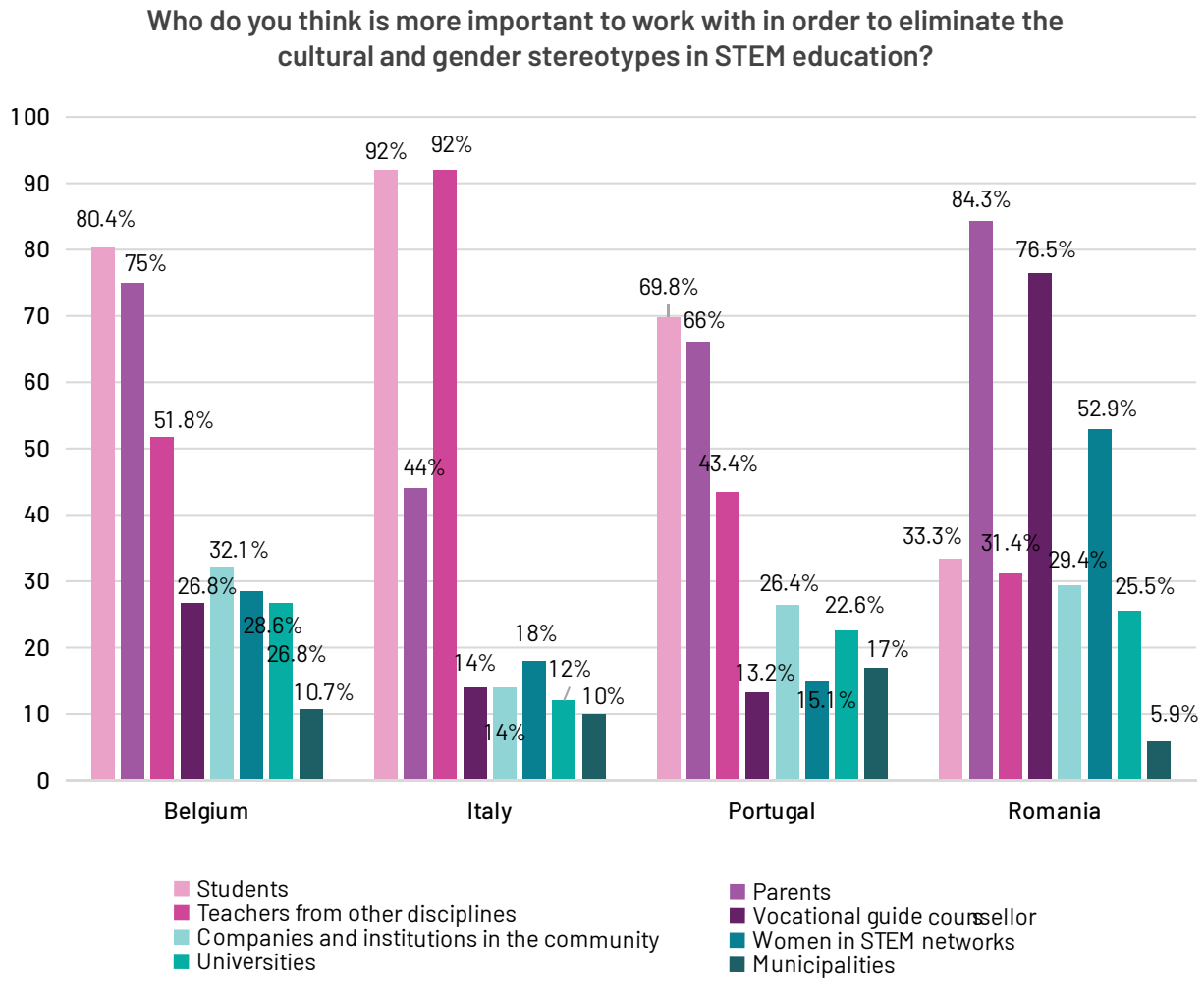
Figure 28 shows results on the most important recognised players in combating cultural and gender stereotypes in STEM education.

Figure 28 - Important agents for combating gender stereotypes in STEM (%)



Regarding the most important agents for collaborating in the elimination of cultural and gender stereotypes in STEM education, the majority of teachers indicate students (69%) and parents (67.6%), considering that family support and influence are crucial. Teachers of other subjects are also considered significant (54.3%). Career guidance counsellors (32.4%), networks of women in STEM (28.6%), companies and community institutions (25.7%), universities (21.9%), and municipalities (11%) are seen as less important, but still somewhat relevant to the fight against stereotypes. Figure 29 shows the variations between the four countries.

Figure 29 - Important agents for combating gender stereotypes in STEM by country (%)



In Belgium, students (80.4%) and parents (75%) are the most considered, followed by teachers from other disciplines (51.8%). The majority of respondents do not indicate vocational guidance counsellors, women in STEM networks, and universities as important actors (below 30%). Companies and community institutions (32.1%) are more often indicated than municipalities (10.7%).

In Italy, both students and teachers from other disciplines are considered important (92% each), with parents being less chosen (44%). Other actors, such as companies, community institutions and vocational guidance counsellors (14% each), women in STEM networks (18%), universities (12%), and municipalities (10%) are valued as less relevant.

In Portugal, students (69.8%) and parents (66%) are seen as the most important, followed by teachers from other disciplines (43.4%). Companies and community institutions (26.4%) and universities (22.6%) were chosen by less than a quarter of respondents, followed by municipalities (17%), vocational guidance counsellors (13.2%), and women in STEM networks (15.1%).

In Romania, parents (84.3%) and vocational guidance counsellors (76.5%) are viewed as the most important, with women in STEM networks (52.9%) and students (33.3%) also being chosen by a significant part of the

respondents. Teachers from other disciplines (31.4%), companies and community institutions (29.4%), and universities (25.5%) were less valued. In this country, a large majority of teachers do not consider municipalities as important actors in this field (5.9%).

Table 6 - Perspectives and experiences of gender equality in STEM education (%)

Questions	Yes	No
Do you think that the low participation of women and girls in education and STEM professions is a worrying issue?	63.3%	36.7%
Are you enrolled in any pedagogical project or programme to improve gender equality in STEM teaching?	5.7%	94.3%
Have you experienced any opposition or resistance to teaching with a gender perspective in STEM?	19.5%	80.5%
From whom?		
Parents	14.8%	85.2%
Anti-gender movements in the community	6.2%	93.8%
Students (in general)	5.2%	94.8%
School personnel	3.8%	96.2%
School directors	2.9%	97.1%
Female students	1%	99%
Male students	1%	99%
Do you consider teaching STEM with a gender perspective:		
Difficult	39%	61%
Useful	86.2%	13.8%

Results reveal various perceptions and experiences related to gender equality in STEM education (Table 6). Firstly, a majority of respondents (63.3%) believe that the low participation of women and girls in STEM education and professions is a concerning issue, but more than a third (36.7%) do not view it as a problem.

When it comes to involvement in pedagogical projects or programs aimed at improving gender equality in STEM teaching, only 5.7% of respondents said to be enrolled in such initiatives. This confirms the conclusion presented in Figure 24, that active participation in efforts or projects to reinforce pedagogical competencies and to address gender inequalities is very low.

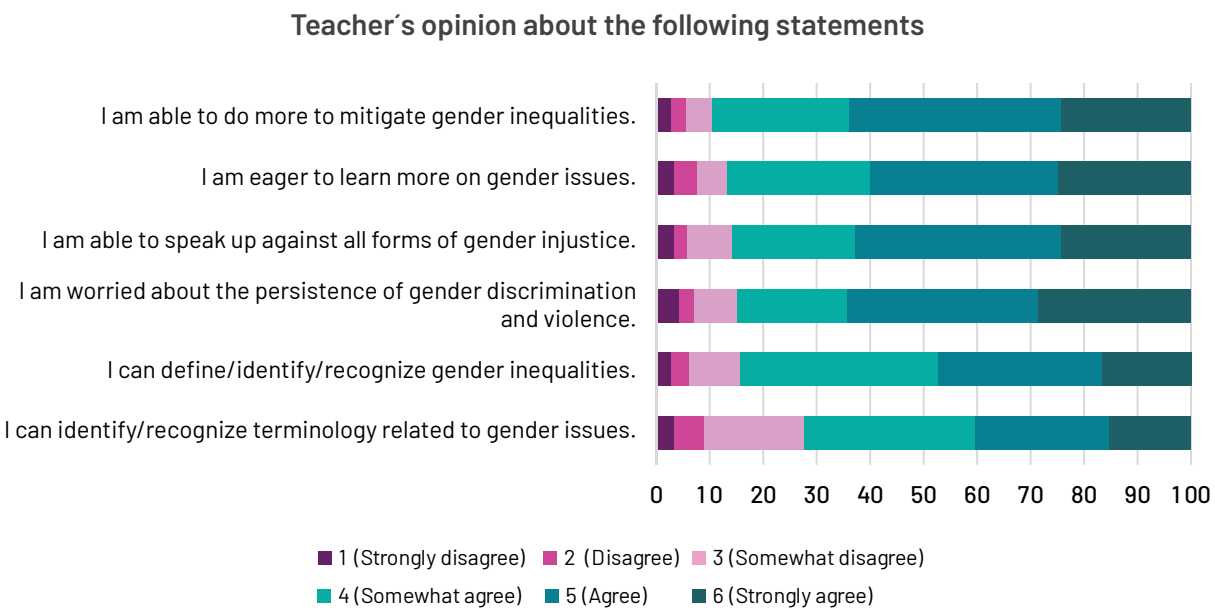
As a consequence of this low enrolment in active gender-sensitive teaching STEM activities, only 19.5% of the respondents reveal facing some resistance to teaching STEM with a gender perspective. Among those, the main opponents identified were parents (14.8%), followed by anti-gender movements in the community (6.2%), students in general (5.2%), school personnel (3.8%), and school directors (2.9%)[7]. This indicates that resistance mainly comes from the context of schools, particularly from parents.

Teaching STEM with a gender perspective is considered a difficult task by 39% of respondents (Table 7). Still, a large majority consider this type of teaching useful (86.2%). This suggests that, although many acknowledge the challenges, most see significant value in integrating a gender perspective in STEM education. In brief, the data reveal significant awareness of gender inequality in STEM and recognition of the usefulness of addressing this issue in teaching. However, it also reveals limited participation in concrete empowerment and training initiatives.

Table 7 - STEM teaching with a gender perspective

Do you consider teaching STEM with a gender perspective:	**Yes**
Difficult	39%
Useful	86.2%

Figure 30 - Teachers' self- confidence and perspectives on addressing gender inequalities (%)



7 It is important to note that, due to an oversight, the "from whom" question was not restricted to those who answered "yes" to the previous question ("Have you experienced any opposition or resistance to teaching with a gender perspective in STEM?") but was instead presented to all respondents. When filtering answers to include only those who answered "yes" to the prior question, we found contradictions in the answers. Some teachers who indicated they had not encountered resistance nonetheless selected one or more options in the "from whom" question.

Regarding their self-confidence in mitigating gender inequalities (Figure 30), most teachers feel confident in their capacity to do more (89.5%). Over two-thirds of the respondents indicate agreement or strong agreement on this matter, and there is minimal disagreement, suggesting a general willingness among educators to act against gender disparities. When it comes to eagerness to learn more about gender issues, the chart shows educators are highly motivated. A significative 87.7% of respondents express agreement or strong agreement, indicating a strong desire for further education and training in this area. Disagreement is minimal, thus confirming a widespread interest in enhancing their knowledge and skills related to gender equality.

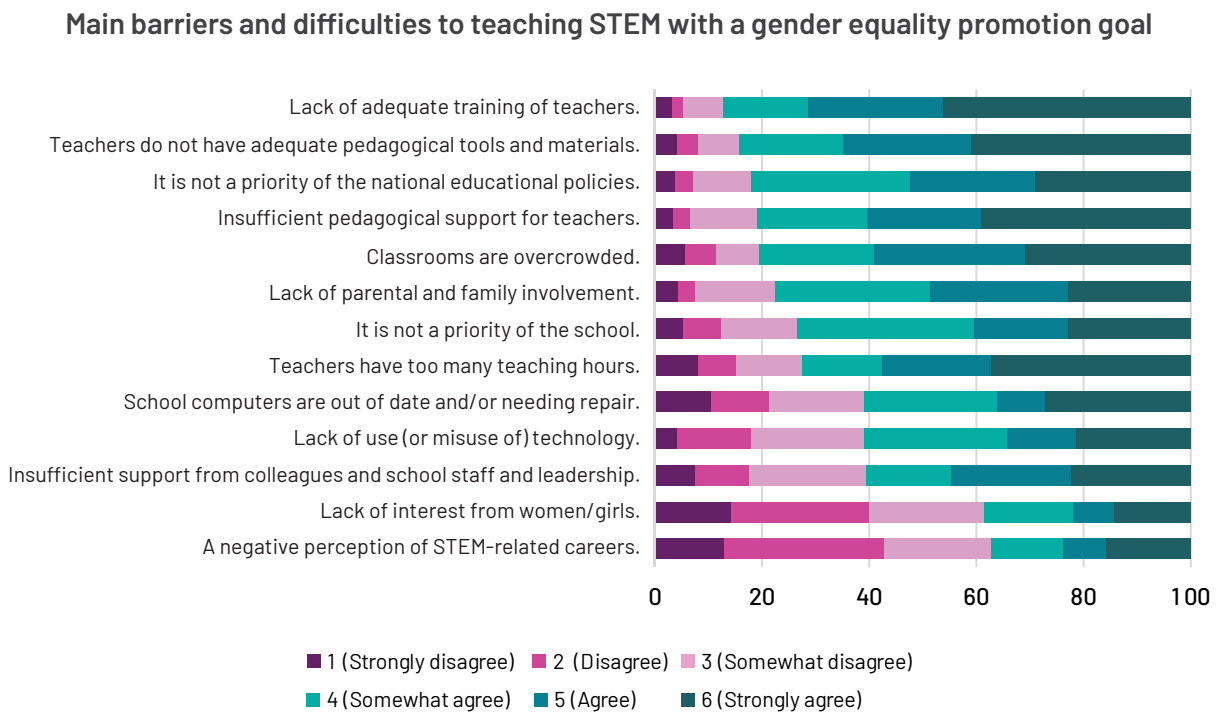
In terms of ability to speak up against all forms of gender injustice, most teachers feel capable and ready to do so. Around two-thirds agree or strongly agree they can address gender injustices, with only a small fraction disagreeing. This suggests that educators are generally confident in their ability to advocate for gender equality. Teachers also show significant concern about the persistence of gender discrimination and violence. With over 80% agreeing or strongly agreeing, this is a major concern for many educators. Very few respondents disagree, indicating a broad recognition of the importance of addressing these issues.

Regarding ability to define, identify, and recognise gender inequalities, only around 47% of teachers clearly feel confident in their ability and 37% declare themselves somehow able to. This confirms some difficulties detected in previous results (Figures 25 and 26). While teachers broadly seem to believe they have the knowledge to identify gender disparities effectively (maybe this answer results from a strategy of social conformation), a significant group recognise they need increased awareness and training on it. The same applies to the language and concepts necessary to discuss and address gender inequalities, a matter that fewer teachers feel confident with.

9. Perceived barriers and difficulties to gender-sensitive STEM teaching

Responses about the main barriers and difficulties to teaching STEM to promote gender equality reveal various challenges faced by educators (Figure 31).

Figure 31 - Barriers and difficulties to teaching STEM with a gender equality promotion goal (%)



The analysis of the answers indicates that the main barriers to gender-sensitive STEM teaching are not related to students'/girls' interests or perceptions, but mainly to structural causes.

A large majority of teachers point out factors like: lack of adequate training (87.1%); lack of adequate pedagogical tools and materials (84.3%); insufficient pedagogical support for teachers (81%); overcrowded classrooms hindering effective teaching (80.5%); and overloaded teaching schedules (72.4%).

Added to these structural aspects there some more material ones, like outdated or damaged school computers (61%) and the improper use or lack of technology (61%).

In global terms, there is recognition that neither national policies nor schools put enough effort into this issue: 81.9% of respondents acknowledge that national educational policies are insufficiently prioritising gender equality in STEM; and 73.3% strongly agree that schools themselves do not prioritise this goal.

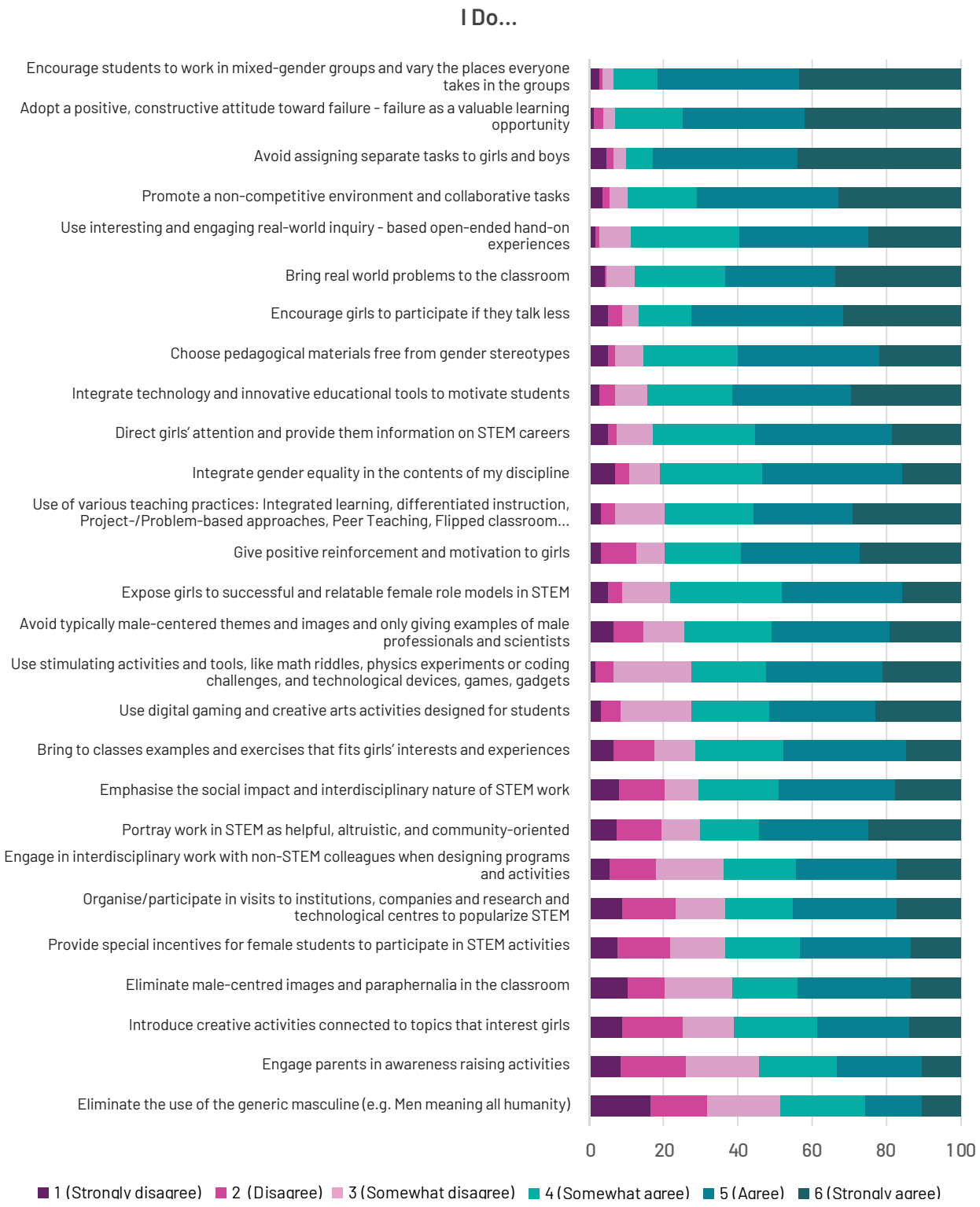
The lack of support by other educational actors is also a relevant barrier, with 77.6% pointing to the lack of parental and family involvement, and 60.5% to insufficient support from colleagues, school staff, and leadership.

Overall, the data reveals that educators perceive a wide range of barriers for promoting gender equality in STEM education, from systemic issues (e.g. policy priorities and resource availability) to social factors such as family involvement.

10. Teacher's practices

Regarding practices for developing a gender-inclusive STEM teaching, teachers were asked to indicate their current practices by answering "I do" (Figure 32), and also to indicate whether they recognise the importance of implementing these practices in the future - by answering "I think it's important to do so in the future" (Figure 33).

Figure 32 - Current practices in developing a gender inclusive STEM teaching (%)

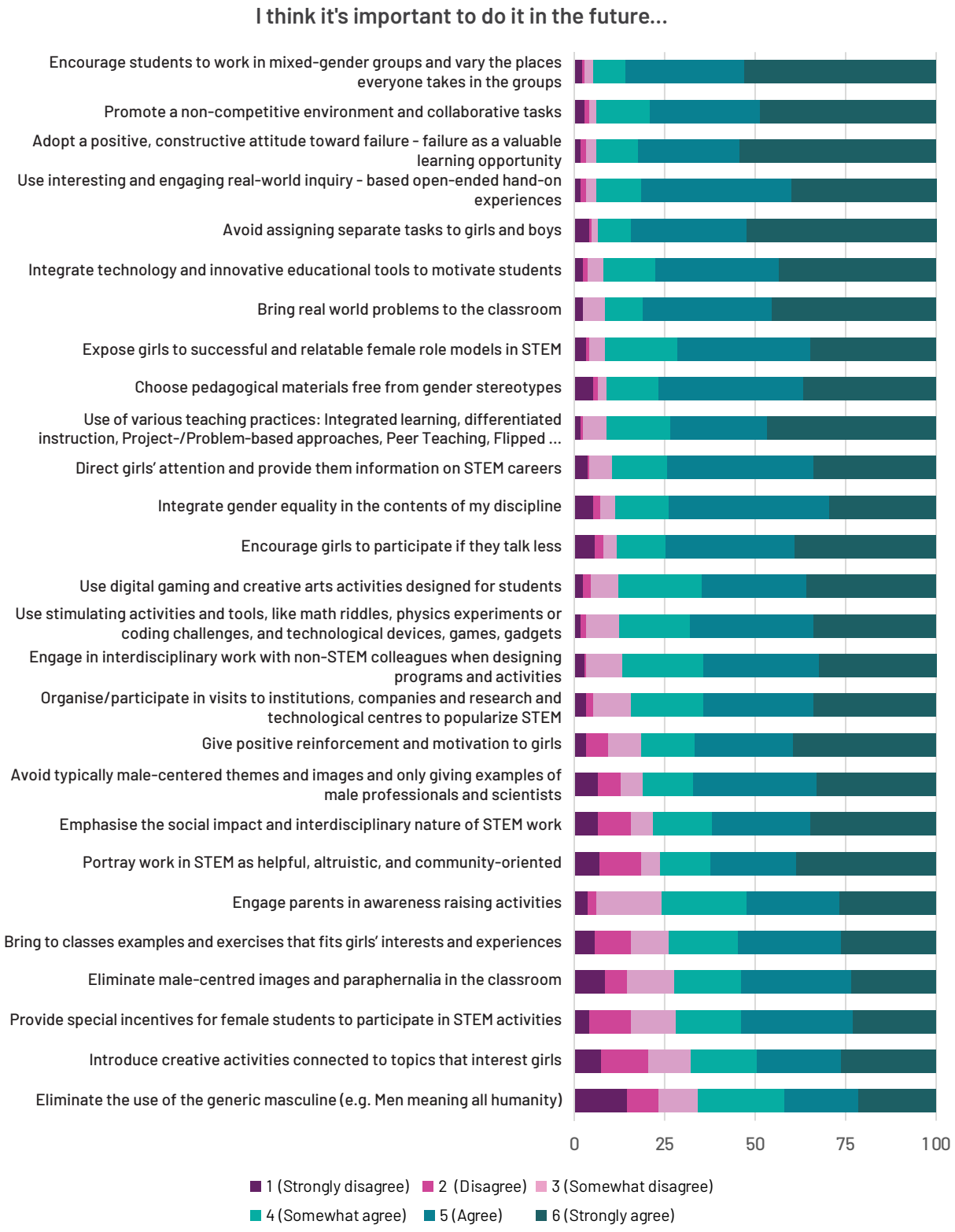


The practices teachers assume do the least in their STEM teaching are related to the use of inclusive language and the involvement of parents and families. Nevertheless, 54.3% promote the engagement of parents in raising awareness about gender equality in STEM and 48.6% avoid generic masculine terms in their language.

Globally, we found a very surprising positive tendency of answers given by teachers, pointing to the development of pedagogical practices to include a gender perspective in STEM teaching. Although this might result from a social conformity bias, that can occur within questionnaire research techniques, we must take these responses into account, emphasising the need to deepen them through qualitative techniques in future research.

Firstly, most respondents say they encourage mixed-gender group work and vary the roles within the groups (93.3%), while also viewing failure as a valuable learning opportunity, thus indicating a positive attitude towards failure (92.9%). Additionally, they widely confirm avoiding gender-segregated tasks (90%), promoting a non-competitive, collaborative classroom environment to foster inclusivity (89.5%), incorporating real-world problems (87.6%) and adopting hands-on experiences in their teaching using engaging, real-world inquiry-based experiences (88.6%). Other very common practices are: encouraging girls to participate if they talk less (86.7%), choosing pedagogical materials free from gender stereotypes (85,2%), using technology and innovative tools to motivate students (84.3%), informing girls about STEM career opportunities (82.9%), and integrating gender equality into their teaching content (81%). Most also say they employ various teaching methods, such as integrating learning and project-based approaches (79.5%), giving positive reinforcement to female students (79.5%) and showcasing successful female role models in STEM (78.1%). Most avoid male-centric themes and examples (74.3%) and use engaging activities and tools like maths riddles and physics experiments (72.4%), digital games and creative arts (72.4%), and tailor examples and exercises to girls' interests and experiences (71.4%).

Figure 33 - Eventual practices in developing a gender inclusive STEM teaching (%)



When asked about the good practices they consider important to adopt in the future, teachers clearly agree all the listed practices are desirable, with very high levels of support. Even the practice they mostly had declared not to apply – not using the generic masculine terms – is agreed to be desirable for the future by around two thirds of respondents (65.7%).

11. Main conclusions

Analysing the data extracted from the questionnaires we conclude that, in general, teachers recognise the impact of cultural factors, specifically gender stereotypes influencing girls' and boys' school and career choices. But there are also strong misconceptions about gendered conditions in school and teaching environments and their real impact on girls' and women's lower participation in STEM. Data also show a worrying lack of training, enrolment in empowering projects, and poor structural and material conditions for pursuing a confident and capable pedagogical action to teach STEM with a gender perspective.

There is a major lack of contextual factors for enabling teachers to do differently in teaching STEM, avoiding gender biases and gaps. From national educational programs, incentives, and curricula to the absence of school-level practices, as equality plans or specific training actions to promote gender equality in STEM, we noticed that there is a lot to do in the four countries involved.

In conclusion, data from the questionnaires, along with the insights from the literature review, underscore the critical need for targeted interventions to bridge the gender gap in STEM education. By addressing the identified barriers and leveraging the support, educators and policymakers can create a more egalitarian and supportive environment. The literature highlights the multifaceted approach required to combat gender stereotypes in STEM. It is not only about changing perceptions within the classroom but also about creating a broader cultural shift that values and promotes gender equality in all aspects of education and career development.

One of the main tasks of the project STEMGenderIN (WP2) is the identification and characterisation of at least 20 good practices on STEM and gender in public secondary schools, that can inspire and support the creation of original and innovative tools for teachers and schools.

To accomplish this task, we developed systematisation instruments that harmonised the process of data collection, according to common and comparable classification and characterisation criteria. A grid of indicators was made and subsequently a questionnaire in the Lime Survey Platform was created to be completed in each partner's country.

In this chapter, we began by presenting the conceptual framework adopted for the practices. Then, we present the practices collected by the project, by country.

CHAPTER 5

Inspiring practices on STEM and gender dedicated to teachers and schools

1. Whole-school Approach as a conceptual framework

To acquire and study what makes a good practice in STEM and gender in secondary schools, there are two primary questions to consider, namely:

1. **What definition of practices are we looking for?**
2. **What scale of practices are we looking for?**

In response to the first question, we decided to include in the collection of "good practices" the pedagogical practices that improve the teaching of STEM whilst also combating gender stereotypes and inequality, irrespective of the type of school in which it occurs, provided it can be adopted by lower secondary teachers or schools.

Regarding the second question, on the scale of practices, we consider that a gender-sensitive pedagogical approach in STEM education should not be confined to STEM teaching practices or to the disciplinary and curricular dimensions. A successful implementation of gender equality and non-violence in education requires a holistic teaching approach that engages the management of the entire educational and school functioning universe.

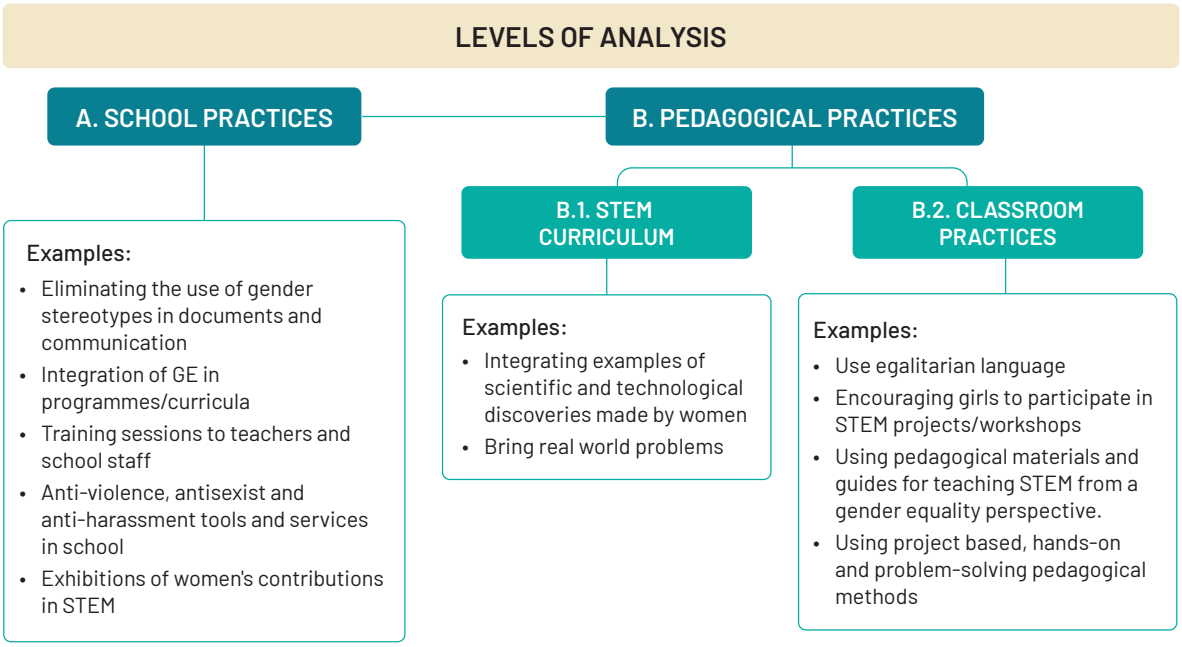
A gender-sensitive pedagogy is a mission for the entire school, as proposed by the Whole-School Approach. Equality, non-discrimination and citizenship should be embedded in the school's culture itself, based on a logic of participation and shared responsibility, as gender sensitivity is absent not only in classroom practices, but also in the functioning of the school and the education system as a whole.

According to Monteiro *et al.* (2017: 6) the whole-school approach must embrace the following objectives:

- "It stems from sustained practices over time, rather than mere isolated interventions.
- It is integrated into the curriculum, in both instructional and non-instructional activities, in the daily practices of school life and its connection with the community.
- It is based on educational practices that promote inclusion.
- It relies on the continuous professional development of teachers.
- It involves students in active methodologies and provides opportunities for the development of personal and social skills.
- It is integrated into the policies and practices of a democratic school, engaging the entire school community.
- It promotes individual and collective well-being and health.
- It involves working in partnership with families and communities.
- It is aligned with the specific needs of students and the priorities of the educational community.
- It is supported by monitoring and evaluation to ensure effectiveness and participation."

In addition to the Whole-School Approach, we will also attempt to categorise the inspiring practices according to various degrees of analysis, from the macro to the micro level. As shown in the analysis grid below (see figure 34), the various degrees of analysis span from school practices to pedagogical practices, which are further divided into STEM Curriculum and Classroom practices.

Figure 34 - Analysis grid of practices prepared



Following an in-depth literature review, an analysis grid was built, establishing the typology of characteristics to be considered in each practice, namely:

- Coordinating/ Responsible organisation.
- Type of activities: context, format, detailed description.
- School Involvement.
- Duration/Length of the practice.
- Type of Equality Approach.
- Target Audience/Students targeted: age, gender, number of participants.
- Goals.
- Pedagogical Materials used.
- Actions to impact on family and parents.
- Resistances/difficulties.
- Disciplines or courses enrolled in this practice.

In the next pages we present a broad aggregated view of the 20 good practices collected. Then, each practice will be described in detail referring to how they operate, their goals and impacts.

Table 8 - Practices Collected

Name	Country	Number
Technovation Girls	Portugal	1
Women Engineers for a Day	Portugal	2
Gender and Citizenship Education Guides	Portugal	3
"Education" Project	Portugal	4
PARI lo imPARI a SCUOLA	Italy	5
"Girls & Science": female inclusion in STEM subjects	Italy	6
Robotics laboratory for scientific exploration	Italy	7
Stem Paths On Gender Difference In Science And Beyond	Italy	8
Stem Pathways On Gender Equality: Women To Know	Italy	9
"StemDays-il camp delle ragazze" (StemDays-the girls' camp)	Italy	10
Girls Day, Boys Day	Belgium	11
Filles-garçons : brisons les stéréotypes de genre à l'école	Belgium	12
Physics Project Days programme	Belgium	13
STEM4Her	Belgium	14
GE-STEAM: she chooses stem for the future	Romania	15
WiSTEM 2D	Romania	16
Female Legends of Science	Romania	17
"IT is for me"	Romania	18
Hypatia	Other	19
Girls Go Circular	Other	20

The majority of these 20 inspiring practices are integrated into major national (5) and international (13) programmes, while only 4 are self-initiated by schools or teachers.

Figure 35 - Project Initiator

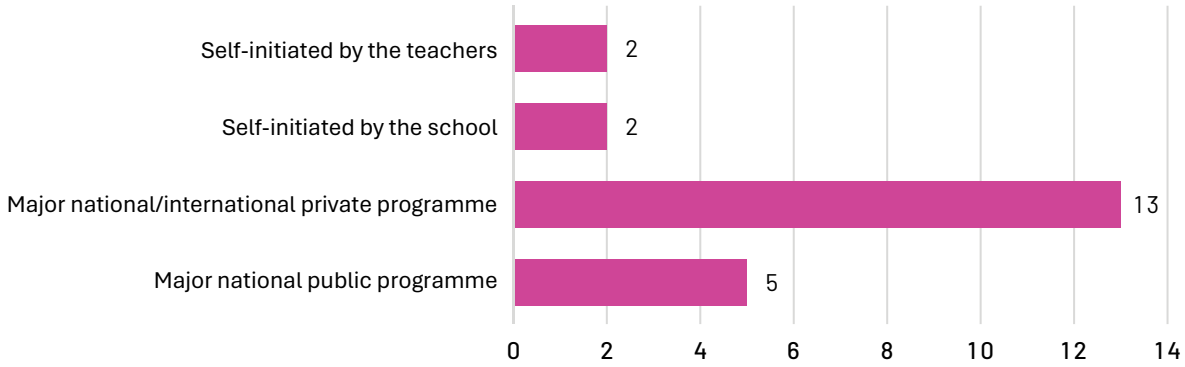
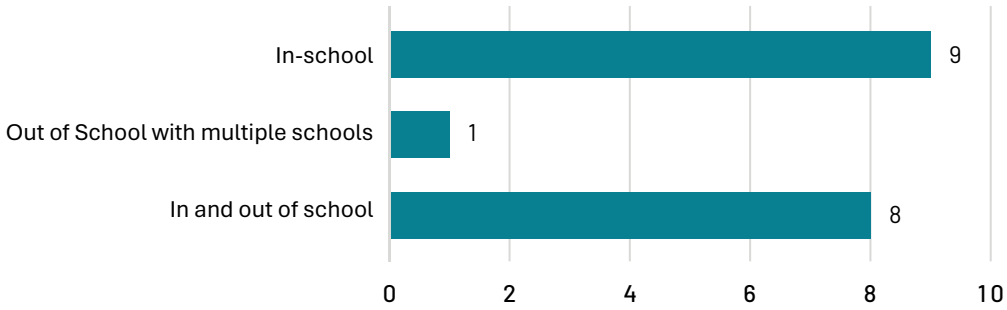


Figure 36 - Setting of the Activities



Most practices are developed in schools (18), and only 2 of them present activities or dynamics outside school settings.

Female students are the main group targeted by the activities, followed by male students, in both cases including students from all disciplines and not just STEM students (figure 37). 8 of the practices are targeted at STEM teachers and 6 of them are directed to school directors, which is very promising. However, only a small number of the practices involves working with career or vocational guidance counsellors, which seems to be a limitation in their scope, considering the importance of those professionals in guidance activities and in students' decisions.

Another critical aspect is the limited involvement and participation of external entities such as universities, women's networks, municipalities, or companies. This calls into question one of the main features for the success and scope of the practices, already identified in the literature, namely the partnership and alliance with women in ICT networks, and the multilevel and multi-actor approach (Monteiro & Lopes, 2022). It should be emphasised that one of the main challenges to the sustainability of these efforts is the continuity of an integrated action including expertise in STEM education with a gender perspective, whether from feminist networks, universities, companies, or other organisations. Partnership is crucial, not least because it promotes activities outside the school environment and applied scientific knowledge that are essential for STEM gender-inclusive pedagogies.

Figure 37 - Targeted Participants

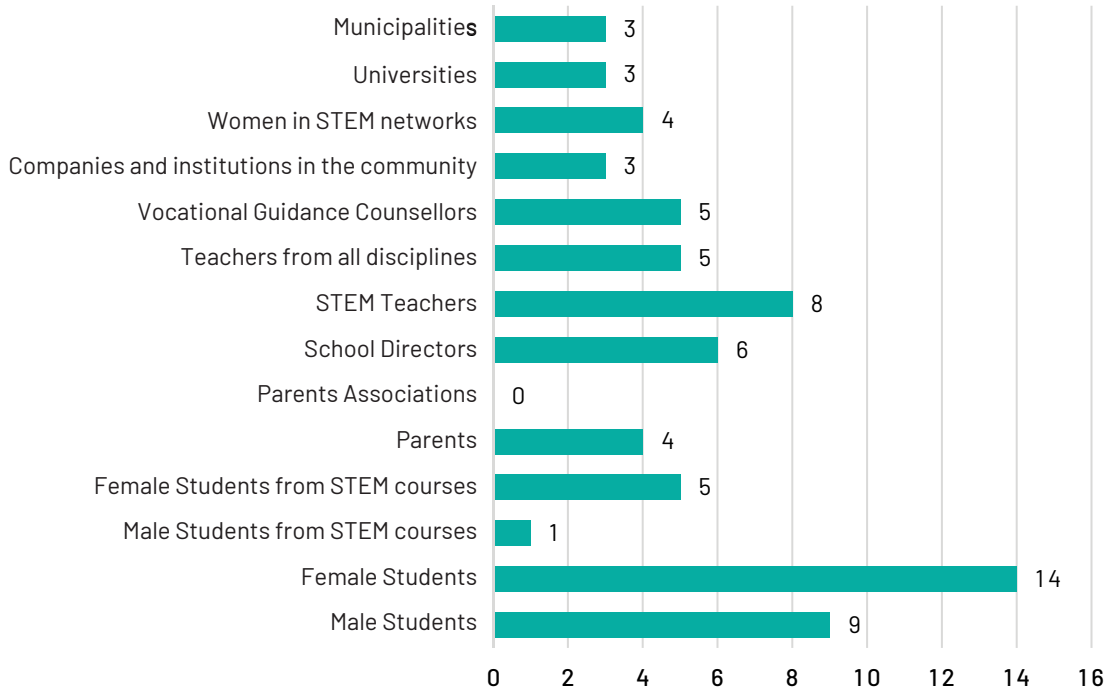
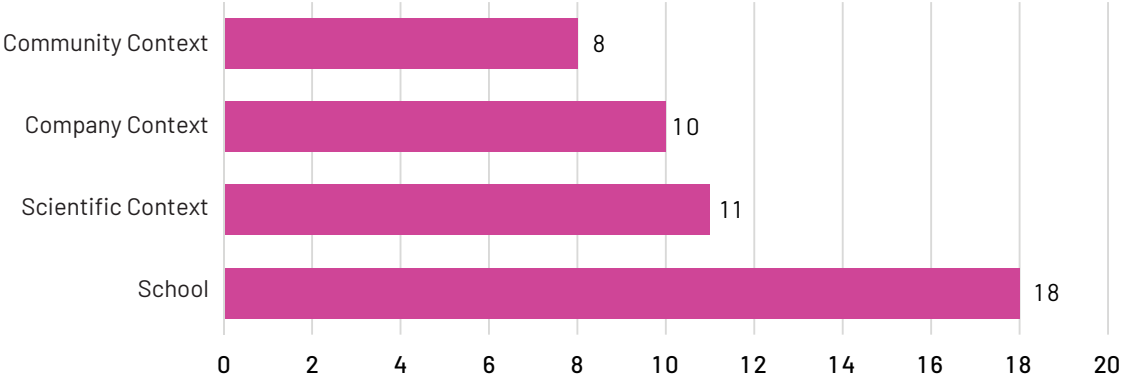


Figure 38 - Context of the Activities



Most of the practices focus on long-lasting interventions rather than one-off events and short projects, which is very important for ensuring that the effects are sustainable and effective for students and teachers (Figure 39).

Figure 39 - Duration/Frequency of the activity

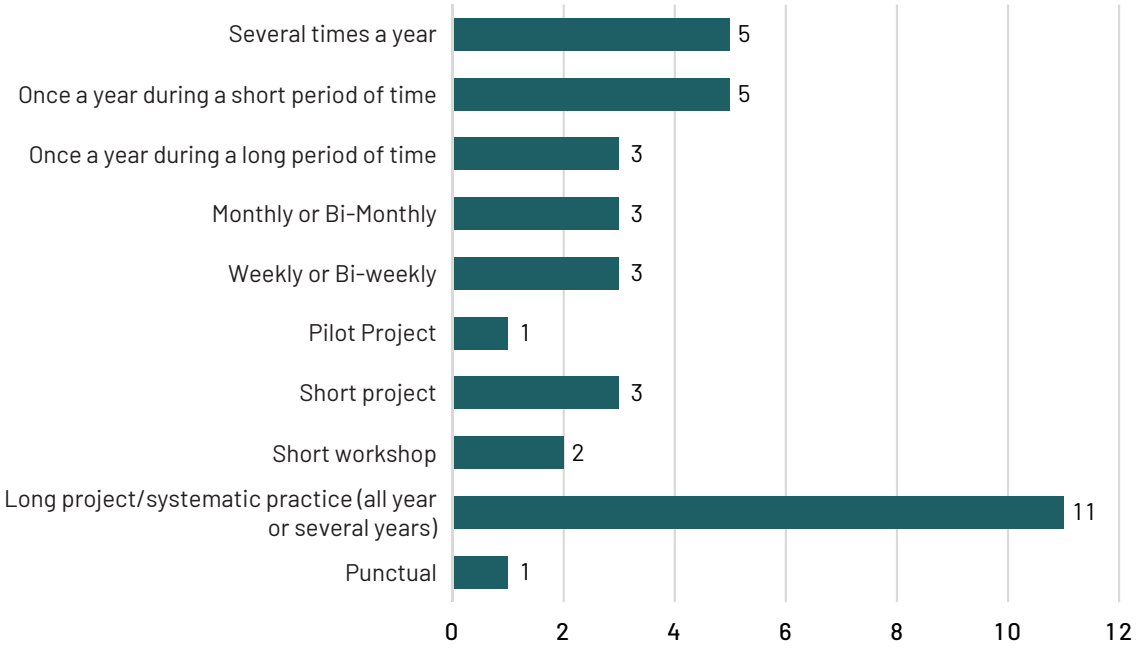


Table 14 presents a comparative overview of all the practices that were identified by the STEMGenderIN partners. It shows that their main goals are to raise students' and teachers' awareness about gender stereotypes. Despite being considered highly relevant and inspiring practices, we note that only a small number of them aim to intervene in a more transformative way by integrating a gender perspective into curricula and textbooks. Furthermore, only a few practices involve intervening with families and parents or are intended for the specific training of teachers in gender and STEM.

Next, we will describe in detail each of the selected inspiring practices by demonstrating how they operate, their goals and their impacts until the present moment (May 2024).

Table 9 - Comparative overview of the practices collected

PRACTICE NUMBER:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	T
GOALS																					
Teachers training in gender and STEM			x			x	x					x			x		x		x	x	8
Gender stereotypes awareness	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	18
Students' awareness	x	x		x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	17
Parents awareness	x				x				x		x		x		x	x			x		8
Teachers' awareness	x	x	x	x	x	x	x				x	x	x	x	x	x	x		x	x	16
Information, vocational orientation	x	x	x	x	x				x		x				x	x	x	x	x		12
Enhance girls' interest in STEM	x	x		x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	18
Enhance all students interest in STEM		x			x	x	x	x	x		x					x	x	x	x	x	12
Develop new visions of STEM professionals	x	x		x		x	x	x	x	x	x		x	x		x	x			x	14
Integrating gender sensitive materials in curricula		x	x		x	x						x				x			x	x	8
Integrating gender sensitive approaches in classes		x	x		x	x	x	x	x			x			x	x			x	x	12
Integrating gender sensitive approaches in educational books			x									x				x			x	x	5
Give visibility to women in STEM	x	x	x	x	x	x		x	x	x				x	x		x		x	x	14
ACTIONS TO IMPACT ON FAMILIES AND PARENTS																					
None			x	x				x		x		x		x			x	x		x	9
Awareness-raising to break stereotypes	x	x				x			x		x		x			x			x		8
Direct Information	x	x			x										x						4
Indirect information through children	x	x				x	x		x							x					6
Participation in initiatives	x	x			x								x		x	x					6
DISCIPLINES OR COURSES ENROLLED/INTEGRATION																					
Integrative Approach (e.g. Gender across discipline tasks and integrated as part of the subject)		x	x		x	x	x		x	x					x	x	x		x	x	12
Cross-discipline approach (e.g., inclusion of a gender module for several courses)			x			x		x	x		x								x	x	7
Other	x	x		x								x	x	x				x	x		8
PRIMARY FOCUS OF THE PRACTICE																					
STEM in General		x	x		x	x		x	x	x	x	x	x	x	x	x	x		x	x	16
ICT	x	x	x	x			x					x						x			7
Other			x				x					x								x	4

2. Inspiring practices collected by country

2.1. Inspiring Portuguese Practices

- Technovation Girls (1)
- Women Engineers for a Day programme (2)
- Gender and Citizenship Education Guides (3)
- "Education" Project (4)

PRACTICE 1 - TECHNOVATION GIRLS

Description: International programme for educating girls (aged 8 to 18) to become confident STEAM-ers, leaders in identifying and raising awareness of relevant current problems, and creators of technological solutions. For around 4 months, participants work in teams, with the support of mentors, select a problem in their community, and develop an application for mobile devices or train an artificial intelligence model to contribute to solving that problem.

Responsible Entity in Portugal: Technovation Girls Portugal /Happy Code Portugal.

Responsible Entity Internationally: Technovation, a non-profit established in the United States of America with representation in 120 countries worldwide.

Goals: Gender stereotypes awareness; Students Awareness; Parents awareness; Teacher's awareness; Information, vocational orientation; Enhance girls' interest in STEM; Develop new visions of STEM professionals; Promote female STEM professionals; Give visibility to women in STEM.

Target Audience: Female students; Parents; STEM teachers; Teachers from all disciplines; Companies and institutions in the community; Women in STEM networks.

School/Teacher's Involvement: Schools can either be invited to take part in the programme, or they can express their interest to join it. Students can also participate by themselves in case their respective school doesn't participate. Each participation modality encompasses different type of activities depending on the schools and/or teacher's interest: extracurricular activities (clubs), curricular programmes or school projects.

Edition: 3rd Edition.

Website: https://technovation.pt/

Instagram: https://www.instagram.com/technovationportugal/

YouTube: https://www.youtube.com/@technovationgirlsportugal6607

Technovation Girls is an international programme for mobilising and educating girls (aged 8 to 18) to become confident STEAMers and leaders capable of identifying relevant problems and create technological solutions for them. Technovation Girls exists in around 120 countries (e.g. Brazil, Uruguay, Turkey, Nigeria). Technovation Girls is coordinated by Technovation, a global tech education nonprofit, founded in 2006, that empowers girls to become leaders, creators, and problem-solvers. It prioritises girls' education, bearing in mind the importance of this to achieve and fulfil some of the United Nations Sustainable Development Goals, such as SDG 4 (Quality education); SDG 5 (Gender equality); and SDG 10 (Reduced inequalities). Internationally, Technovation has partnerships with 27 different organisations and multinationals that provide time, talent, and funding (e.g. Shopify, eBay Foundation, and Cisco Foundation).

Technovation Girls has been operating in Portugal since 2018. However, it wasn't until 2021 that Happy Code Portugal began coordinating this programme, having already organised two national editions (2022 and 2023) and currently planning the third (2024).

Happy Code Portugal is a technology and programming school that also teaches digital citizenship and entrepreneurship to children from 6 to 18 years old. With a teaching methodology based on the STEAM concept ("Science, Technology, Engineering, Arts and Math"), the courses focus on computer programming, game and application development and robotics, as well as video production and editing for YouTube. In Portugal, Happy Code has impacted more than 10,000 children and young people.

The team behind Technovation Girls Portugal has extensive experience in teaching and implementing STEM activities in a variety of settings (formal, non-formal, and informal education), and expertise in educational sciences and educational technology, as well as extensive experience educating both students and teachers in STEM fields.

In Portugal, the Technovation Girls programme works with several partners that actively contribute to the improvement of communities and gender equality in STEAM areas - which might involve sponsorship of training, mentoring, and even the formation of teams of young entrepreneurs. Currently, Technovation Girls Portugal is financed by private entities (e.g. BNP Paribas, Critical Software and Celfocus). It also partners with some municipalities (e.g. Oporto, Lagoa, Santo Tirso). For every school where it participates and develops activities, Technovation Girls services are free of charge.

Activities Promoted

There are three different ways that schools can collaborate or participate:

1. Extracurricular activities - Technovation Clubs. A small group of students or teachers who are eager to take part in the programme take the initiative to create, for instance, school clubs for those interested.
2. Interdisciplinary work - Technovation School Project. In these cases, the Technovation project is carried out across the entire school.
3. Classroom work - Technovation Curricular Programme. The Technovation Girls Curriculum is implemented in one or more disciplines (e.g. Computer Applications B, Education for Citizenship, and Information and Communication Technologies).

The activities involve female students from ages 8 to 18, during 3 to 5 months of each school year. The work is organised in students' teams, that work a minimum of 40 hours on the programme, whether in the form of clubs, curricular programmes, or whole school projects. During that time, girls work with the support of mentors and are expected to select a problem in their community and develop an application for mobile devices or train an artificial intelligence model to contribute to solving that problem.

To help with the application of the aforementioned activities, Technovation Girls provides a freely available curriculum, with lessons and activities to guide and train students in ideation, technology, entrepreneurship, and communication, as well as many other resources such as templates, tutorials, inspirational and explanatory videos, support documents for teachers and mentors, international and national training sessions, doubt clearing sessions, examples of finalist projects from previous years and a project evaluation section.

During the length of the programme, Technovation Girls Portugal also organises several events to disseminate, empower, include and inspire present and future female participants, teachers, and parents. Those events include: online launch events; in-person kick-off event; online and in-person coding workshops; online hands-on classes (ideation, technology – App Inventor and AI, entrepreneurship, communication), local in-person meet-ups for teams to gather and work on their projects with their mentors; national final pitch and celebration event.

Thus, Technovation Girls comprises multiple weekly activities, that fulfil some of the main criteria of a gender sensitive STEM pedagogy, namely:

- Mentoring and role modelling program and sessions with girls.
- An integrative and adaptive approach to the whole school dynamics.
- Teaching innovative materials for young women to become tech entrepreneurs and leaders (e.g. dedicated curriculum, classes, lessons).
- Use of technologies.
- Project-based learning using a three-part model to help girls develop greater self-efficacy and change their attitudes towards STEM:
    - Identify real-world problems - Participants find a problem in their community and develop technical solution to it.
    - Build a team - Participants work in teams supported by a mentor (and parents/families).
    - Get the teachers and vocational guidance counsellors involved. Teachers and vocational guidance counsellors divulge the programme and support the working teams with mentorship and guidance. They also partake in information sessions.
    - Get the families involved through information sessions for awareness raising to break gender stereotypes.
    - Get the community involved. Participants test and communicate ideas with/within their communities out of school.
- Hands-on and self-confidence building activities, like workshops on coding and communication.

- Visits to tech companies and universities.
- National pitch events.
- Feedback from judges on the projects created by the participants.

Figures 40 and 41 - Photos from 3rd edition of the National Pitch Event of Technovation Girls Portugal

Impact

The programme is evaluated through several indicators to identify its impact and results:

- More than 160 mentors volunteered their time.
- More than 100 schools with participating students, with 20 schools having an active participation in the programme.
- More than 20 partners promoted the programme.
- More than 600 female students enrolled in the programme.
- More than 100 teams submitted a project.
- More than 20 judges from various professional fields have evaluated projects.
- 12 Portuguese teams made it through to the world semi-finalist stage and 1 team got to the world final.
- Around 30 returning mentors and students each year.
- Represented in around 14 districts and 60 localities.
- More than 300 parents reached.
- 20 female teachers and 15 male teachers.
- 5 vocational guidance counsellors.
- The programme increased participation by around 30% from 2022 to 2023.

Testimony of Use

Technovation Girls Portugal appears to be an effective good practice that allows young girls, ages 8 to 18, to experience STEM, more specifically technology, in all its facets. Girls state that they learnt both technical and socioemotional skills (as well as greater awareness for STEM and Sustainable Development Goals) during this experience.

Nonetheless, despite all the success, this practice faces some challenges. The following testimony of use, by girls themselves, provides an overall assessment referring to both the negative and positive aspects of this programme.

"**Best practices:** strong communication with schools, involvement of families, sharing of testimonies and experiences from previous participants, mentor training sessions, partnerships with companies, free online classes for all, holding multiple presentation sessions and clarification of doubts, partnerships with some schools to implement the project within ICT subjects with our support and training, creating a sense of belonging and community, nominating two girls as student ambassadors.

Challenges: recruiting more girls for the senior division (they have many activities and are very focused on the school's responsibilities), attaining a greater national coverage/greater decentralisation (although teams come from various parts of the country, most still come from the main cities - Lisbon and Porto), operation of the platform and registration (e.g. location, parent emails, and consents), parental involvement

(especially in the cases girls participate through the school), girls not submitting their projects because they think it is not good enough.

Successes: Attraction (teams and mentors); Retention (submission rate); Quality (of projects and communications in the RPEs); Feedback (overall experience of students and mentors); Repetition (students and mentors returning to the programme year after year)."

Figures 42 and 43 - Photos from 3rd edition of the National Pitch Event of Technovation Girls Portugal

SUMMARISED INFORMATION	
School Involvement	▪ In and out of school.
Time of the activities	▪ During regular class hours. ▪ In extracurricular hours.
Context of the activities	▪ School (whole and classroom). ▪ Community Context. ▪ Company Context.
Activities format	▪ Mixed (in-person/in-person with streaming, online).
Type of equality approach	▪ Specific Action (only women involved).
Actions to impact on families and parents	▪ Awareness-raising to break gender stereotypes. ▪ Direct information. ▪ Indirect information through children. ▪ Participation in initiatives.
Disciplines or courses enrolled/integration	▪ Representativeness in ICT/STEM. ▪ Various other disciplines and/or courses depending on the schools and on the student's needs within the project (e.g. English).
Pedagogical Materials and resources used	▪ Team of volunteers. ▪ Educational platform. ▪ Didactic worksheets. ▪ Educational videos. ▪ Several technological platforms and software.
School Practices & Pedagogical Practices	▪ Inclusion of a gender equality perspective in programs/curricula. ▪ Integration of community, local and/or national projects on gender gap in STEM. ▪ Celebrating symbolic days (e.g. International Day of Girls in ICT, Girls in ICT Days). ▪ Implement innovative beyond the classroom pedagogical practices to promote a gender perspective in STEM teaching such as mentoring and role modelling programs and sessions with female STEM professionals, teachers, and students; study visits to stem companies, technology centres and universities; and school community links to promote hands-on learning initiatives. ▪ Problem solving, hands-on, inquiry based, real world pedagogies. ▪ Self-efficacy approach.

PRACTICE 2 - WOMEN ENGINEERS FOR A DAY

Description: An initiative of the Portuguese Government, coordinated by the Commission for Citizenship and Gender Equality and INCoDe.2030, in partnership with the Portuguese Association for Diversity and Inclusion, Instituto Superior Técnico (Lisbon Technical University) and the Portuguese Engineers Order. It is integrated in the Portuguese Nacional Strategy for Equality and Non-Discrimination and in the National Action Plan for Digital Transition. Since its creation, in 2017, the Programme has reached 18964 students from basic and high schools nationwide, with 731 activities organised during the first 6 editions (2017-2023).

Responsible Entity: Portuguese Association for Diversity and Inclusion (APPDI).

Goals: Integrate gender sensitive materials in curricula; Integrate gender sensitive approaches in classes; Gender stereotypes awareness; Students awareness; Teacher's awareness; Information, vocational orientation; Enhance girls and all students interest in STEM; Develop new visions of STEM professionals; Give visibility to women in STEM:

Target Audience: Students, in general; Male and Female students from STEM courses; School directors; STEM teachers; Teachers from all disciplines; Vocational guidance counsellors; Companies and institutions in the community; Women in STEM networks; Universities; Municipalities.

School/Teacher's Involvement: This programme partners with several entities, including basic and secondary schools. The participant schools and their teachers engage in the many activities of the programme which can include engineering hands-on challenges, training and awareness sessions for both teachers and students, field trips to companies and universities... These activities allow both schools and teachers to mainstream a gender perspective in educational environment and pedagogical and classroom practices.

Edition: 7th Edition.

Website: https://engenheirasporumdia.pt/

Instagram: https://www.instagram.com/engenheiras1dia/

Facebook: https://www.facebook.com/Engenheirasporumdia/

Women Engineers for A Day is a public policy measure adopted by the Portuguese Government, with the goal of promoting various engineering and technology related activities all around Portugal, involving as core organisations:

- Portuguese Association for Diversity and Inclusion (APPDI).
- Portuguese Commission for Citizenship and Gender Equality (CIG).

- INCoDe.2023 (National Digital Skills Initiative e.2030)[8].
- Instituto Superior Técnico (Lisbon Technical University, the oldest school of Engineering, Architecture, Science & Technology in Portugal).
- Portuguese Order of Engineers.

The programme was created in 2017 by the Secretary of State for Citizenship and Equality, through the Commission for Citizenship and Gender Equality (CIG), with the purpose of promoting female students' participation in STEM areas, from elementary and secondary schools, by deconstructing the gender and STEM stereotypes. Engineers for a Day is based on three strategical axes:

- Demystifying gender and STEM stereotypes.
- Creating systemic networks of pedagogical intervention and promoting partnerships.
- Communicating its mission through practical activities that aim to empower girls to choose their future profession based on their interests, reflecting on gender-based stereotypes that limit girls' and boys' career choices.

From 2017 to 2024, the programme has had 7 editions.

AAPDI, the institution in charge of the executive coordination and implementation of the programme is a non-profit association dedicated to promoting Diversity and Inclusion (D&I) in organisations and civil society.

Women Engineers for a Day is subsidised by the Portuguese government and collaborates with nearly 200 public and private partners, municipalities, schools, and universities that actively contribute to the attraction and retention of girls in ICT and engineering in all the communities in which activities and actions are implemented. Among these, we can find a network of 101 partner entities: 15 municipalities, 62 elementary and secondary schools, technological companies and networks (e.g. CISCO; Microsoft; Bosch; IEEE Women in Engineering; Women in Tech; IBM) and 23 higher education institutions.

Activities promoted

Women Engineers for a Day works with elementary and secondary schools and their female students, mainly girls in the lower and upper secondary levels, up to the age of 18. Although girls are the programme's main target, boys also can benefit from this initiative. Schools and teachers are mobilised to engage in the activities, to mainstream a gender perspective in educational environment and pedagogical and classroom practices.

The programme is free of charge for all its participants and takes place throughout the school year.

8 INCoDE.2030 presents itself as a conglomeration of various initiatives with similar objectives and is organised around 5 lines of action, ensuring the promotion of gender equality, the deconstruction of stereotypes in the technological field and the advancement of equal opportunities. The 5 lines of action are: 1. Education, 2. Training, Qualification and Re-qualification, 3. Inclusion, 4. Advanced Training, 5. Research and Innovation.

In what concerns schools, there are a myriad of practical activities fulfilling the main criteria of a gender sensitive STEM pedagogy, namely:

- Engineering hands-on challenges.
- STEM labs.
- Deconstruction of gender and STEM stereotypes.
- Field trips to companies and universities.
- Role model and mentoring actions.
- The use of technologies in education.
- Exhibitions about the contributions of women in STEM.
- Workshops on engineering and technology.
- Promotion of the involvement of companies, schools, universities, women in STEM associations and platforms, gender specialists, women engineers.
- Training and awareness sessions for teachers and students.
- Celebration of important dates, such as International Day of the Girl Child, Girls in ICT Day, International Day of Women and Girls in Science, International Women's Day, among others.

Examples of some of the activities carried out in the 6th edition (2022/2023):

- Engineering Challenges: 68 sessions, 1482 students reached (758 female and 724 male students) from 28 schools, 9 higher education institutions and 2 companies.
- INCoDe.2030 Roadmap Workshops: the "Choose your Career" workshop had the overall goal of helping students (5th to 12th grade) to deconstruct gender stereotypes and map out their future vocational and professional choices.
- SmartBus Huawei: a partnership with Huawei to promote the Huawei SmartBus, a mobile classroom for students aged 10 to 14. This sought to raise students' awareness regarding safe and responsible use of new technologies.
- Girls in ICT Day & STEM Labs: 2 face-to-face events, one in Viana do Castelo and one in Lisbon. Labs put together schools and partner entities with the overall goal of showing students how engineering and technology are present in our daily lives through practical and experimental activities. During the 2 days of activities, 160 professionals carried out 45 activities for 764 students from 17 schools.

Figures 44 to 51 - Photos of students experiencing with STEM-related activities, during STEM Labs

Impact

Women Engineers for a Day has been thoroughly evaluated by the Commission for Citizenship and Gender Equality, through an annual report. Among other things, these reports include:

- An overall assessment of each programme's edition.
- Participating teachers and students' perspectives and inputs.
- Number of participating schools, higher education institutions and partner entities.
- Information about the current state of the "Alliance for Equality in ICT".

Such reports identify the initiative's key outcomes and impacts:

- 1st Edition: 1550 students; 10 schools; 3 partner entities; 1 higher education institution.
- 2nd Edition: 4624 students; 25 schools; 30 partner entities; 11 higher education institutions.
- 3rd Edition: 1801 students (schools closed in March 2020 due to the Covid-19 pandemic); 25 schools; 44 partner entities; 11 higher education institutions; 7 municipalities.
- 4th Edition: 2436 students (100% online edition); 28 schools; 54 partner entities; 13 higher education institutions; 8 municipalities.
- 5th Edition: 2203 students; 52 schools; 75 partner entities; 19 higher education institutions; 11 municipalities.
- 6th Edition: 6140 students; 62 schools; 86 partner entities; 23 higher education institutions; 15 municipalities.

As such, since its launch, Women Engineers for a Day has:

- Reached 18964 students from basic and secondary schools across the country,
- Organised 731 activities.
- Collaborated in the launch, by the government, of the "Alliance for Equality in ICT" in December 2021, as a result of the programme's significant positive impact and a willingness from partner entities to boost women's engagement in STEM fields. This Alliance is backed by 60 entities (e.g. Natixis Portugal, Microsoft Portugal, University of Coimbra, *etc.*) and recognises the commitment of the entities participating in the programme, with 3 key priorities:
    1. To promote women's digital inclusion and participation in engineering and technology.
    2. To develop initiatives contributing to action and reflection on the role of gender equality in emerging technological areas.
    3. To strengthen the commitment and cooperation among partner entities to combating gender segregation in educational and professional choices.

Women Engineers for a Day programme was one of the 5 finalists in the European Digital Skills Awards 2023 (EDSA) in the "Women in ICT" category. In 2023, ESDA, which aims to recognise and promote projects that help improving the European population digital skills, received 330 applications, 36 of which in the "Women in ICT" category.

Figures 52 and 53 - Photos taken during the meetings of the "Alliance for Equality in ICT"

Testimony of Use

Women Engineers for a Day appears to be an effectively good practice (Monteiro & Lopes, 2022) by allowing a big number of girls to choose their future profession based on their interests, free from gender-based stereotypes that limit their career choices.

Figure 54 - Advertising poster from the 3rd "Alliance for Equality in ICT" meeting

It contributes to and works towards a feminist and egalitarian pedagogy in STEM-related teaching and activities. By viewing Engineering and Technology as a gendered area, where the default is masculine, this programme prioritises an inclusive approach to its activities, workshops and laboratories, aiming to create new role-models and new perceptions of those areas and, above all, regarding who belongs and can participate in them. Such endeavours allow for an increased number of "opportunities for expression, entertainment and individual and social fulfilment" (Nogueira *et al.*, 2010) for girls, steering them away from the stereotypical categories that usually push them away from STEM-related sectors.

Below we cite several testimonies from participants.

"I participated in the (Women Engineers for a Day) project in its first edition, when I was enrolled in the 9th grade, and I have to say that it had a very positive impact on me. Throughout the year, I had the opportunity to participate in several activities that allowed me to get to know the world of engineering a little better and to take part in debates on gender equality.

This project was to me a sort of wake-up call. It was from that moment on that I started to seriously consider Engineering as a possibility for me. It also made me realise that I have the capacities to pursue Engineering, and that there is room for me in the Engineering world and that my work deserves recognition regardless of gender.

(If I had to describe it, it is) The project that brings uncomfortable debates on the table and gives girls a chance to feel empowered in a society that is still so full of labels." (Amélia Patacho - programme ambassador for Women Engineers for a Day)

Link: https://www.youtube.com/watch?v=emzIC7pNoTQ

"We are here trying to change mindsets and demonstrate what we have learned in the field of engineering at university, showing that these areas are not just for boys, as is often heard. With the experiences we bring, we are showing students that girls, engineers, can play an important role in the future and in the development of technology. (Female engineering university student who mentored at a secondary school).

Link: https://www.youtube.com/watch?v=82zwkQzDFqw

"We have evolved a bit since the time when it was all men. But actually, I didn't have this idea that there were so many more men than women in engineering. For me, it was important to see that girls can and do succeed." (Secondary school girl from Lisbon who participated in a workshop on engineering challenges).

"I think that projects like these help us girls to choose our future professions. In terms of gaining a better understanding of what we want to do, it broadens our horizons. I had no idea there were so many practical aspects in these fields of study." (Secondary school girl who participated in a workshop on engineering challenges in Lisbon).

"In our biology and geology class, we were given the opportunity to develop a project on the interaction of Earth's subsystems... We noticed an environmental issue because the water in the Lis River was heavily polluted due to the local pig farming industry. The solutions involved directing the water into ponds, where it would then infiltrate into the soil before reaching the river. We employed the technique of vermifiltration and

successfully managed to produce much cleaner water." (Two girls from a secondary school in Leiria, on their experiences in biology classes within the Women Engineer's for a Day programme)

"We took an algae that is in extinction and decided to genetically modify it so that it could survive the rising acidity levels of the ocean. We created these 4 models so that we could have a more practical way of showing it to the public. As this project took several months, we had to do several things, we had to split up and realise what each of us could do and, in the end, we realised that it's not that difficult to work together and we

managed to work in harmony with each other. Whenever we encountered any difficulties, we all tried to solve them and I think that helped a lot, not only in our co-operation, but also in our social skills in dealing with other people." (4 girls from a secondary school in Leiria, on their experiences in biology classes within the Women Engineer's for a Day programme)

Link: https://www.youtube.com/watch?v=NeriCuWmwHg

"- It's quite interesting and, even if it doesn't help us make a decision straight away, it gives us an idea of the options we have in the future.

- Exactly, it shows us various things we weren't even aware of. For example, we have several areas that we didn't even know existed.

- Yes, and various options that supposedly weren't for girls, but we came to realise that they do exist and that they could also be good options for our future." (3 different girls who participated in the 2023 edition of STEM Labs)

Link: https://www.youtube.com/watch?v=_dzAPU87BX0

Other videos on the impact of this programme may be found in:

- https://www.youtube.com/watch?v=TWIKG_8jOyQ (Video about the Engineering Challenges organised by the Women Engineers for a Day programme)
- https://www.youtube.com/watch?v=CdY8Y3hmsYk (Presence of Women Engineers for a Day Programme in Futurália 2023, a national education, training and employability fair)
- https://www.youtube.com/watch?v=82zwkQzDFqw (News report about the programme in a national newscast)

SUMMARISED INFORMATION	
School Involvement	▪ In and out of school.
Time of the activities	▪ During regular class hours. ▪ In extracurricular hours.
Context of the activities	▪ School. ▪ Scientific Context. ▪ Community Context. ▪ Science and technology museums. ▪ Company Context.
Activities format	▪ Mixed (in-person/in-person with streaming, online).
Type of equality approach	▪ Mainstreaming (girls and boys, whole school, companies, and teachers).
Actions to impact on families and parents	▪ Awareness-raising to break stereotypes. ▪ Direct information. ▪ Indirect information through children. ▪ Participation in initiatives.
Disciplines or courses enrolled/integration	▪ Integrative approach (e.g., gender across discipline tasks and integrated as part of the subject).
Pedagogical Materials and resources used	▪ Team of volunteers. ▪ Diverse engineering/science/technology related materials. ▪ Textbooks, brochures, guides. ▪ Educational videos. ▪ Online Platforms.
School Practices & Pedagogical Practices	▪ Inclusion of a gender equality perspective: in programs/curricula; vocational guidance counsellors' activities. ▪ Integration of community, local and/or national projects on gender gap in STEM. ▪ Celebrating symbolic days like International Day of Girls in ICT, Girls in ICT days. ▪ Implement innovative beyond the classroom pedagogical practices to promote a gender perspective in STEM teaching, like mentoring and role modelling programs and sessions with female STEM professionals, teachers, and students; STEM labs; study visits to stem companies, technology centres and universities; and school community links to promote hands-on learning initiatives. ▪ Awareness raising activities targeted to schools, teachers, students, families and parents, companies, and public opinion.

PRACTICE 3 - GENDER AND CITIZENSHIP EDUCATION GUIDES: A STRATEGY FOR GENDER MAINSTREAMING IN THE EDUCATION SYSTEM

Description: The Guides focus on integrating equality between women and men into pedagogical practices and school organisation and culture and aim to integrate a gender perspective into the non-higher education curriculum.

Responsible Entity: Commission for Citizenship and Gender Equality (CIG).

Goals: Integrate gender-sensitive perspectives in curricula and in educational books; Integrate gender sensitive approaches in classes; Teachers training in gender and STEM; Gender stereotypes awareness; Give visibility to women in STEM.

Target Audience: Education professionals from all stages of non-higher education - pre-school, basic and secondary education – all across the country.

School/Teacher's Involvement: The Guides are available online for any teacher to use and have also been distributed to school libraries. They have also been used in the professional training of teachers promoted by several universities and colleges that have established partnerships with the CIG.

Edition: The Guides have been around since 2008/2009**.**

Website:https://www.cig.gov.pt/area-igualdade-entre-mulheres-e-homens/projetos/guioes-de-educacao-genero-e-cidadania/

The Guides were produced within the project "Gender and Citizenship Education Guides: a strategy for gender mainstreaming in the education system", coordinated by CIG, seeking to integrate equality between women and men into pedagogical practice and school organisation and culture.

Five "Gender and Citizenship Education Guides" were produced to effectively, continuously, and sustainably mainstreaming gender equality in the curriculum of non-tertiary education (early childhood, primary, lower, and upper secondary). Their 4 priority objectives are:

1. Integrating a gender equality perspective into the individual and collective pedagogical practices of teachers.

2. Incorporating relations between women and men and the contributions of Women's Studies and Gender Studies into the curricula.

3. Placing equality between women and men at the centre of Citizenship Education.

4. Introducing gender equality issues into decision-making and into the school's organisational and communication dynamics.

Guides aim to embed a gender perspective into teaching practices and schools' organisational culture, while also facilitating teachers pedagogical and scientific decisions to incorporate gender equality themes into various subject areas.

"Gender and Citizenship Education Guides" began to be published in 2008-2009. From 2011 onwards, they became a policy measure in the framework of the Education of the National Plans for Gender Equality and the National Strategy for Equality and Non-Discrimination ENIND 2018-30.

The Guides were built through 3 distinct phases:

1. In an initial stage (2008-12) the main focus was drawing guidelines for the various levels of education, with the inputs f specialists and experts. During this phase 4 Guides were produced: pre-school; 1st Cycle; 2nd Cycle and 3rd Cycle.

2. From 2013 to 2017 the primary emphasis was teachers' training, aiming to generalise the use of the Guides, empowering them to work on gender in the education settings and to integrate a gender equality perspective into teaching practices. The 5th guide, for the secondary school level was also published.

3. In the final phase, starting in 2018, the main concern has been the implementation of the Guides in schools. This stage had the overall goal of integrating a gender equality perspective not only in teaching practices, but also to extend these improvements into the school organisation and culture.

A total of 5 guides have been published, from pre-school up to secondary school, recognizing the relevance of mainstreaming a gender perspective as early as possible but also throughout the entire school trajectory.

The authorship of the Guides involved researchers in Women's and Gender Studies, from different scientific backgrounds, mostly specialising in Education and Teachers' Training. Up until 2018, all the process involved 44 researchers and teachers from 18 higher education institutions. In the last years, the "Gender and Citizenship Education Guides" programme has been able to establish partnerships and networking with several relevant institutions:

- The Directorate-General for Education of the Ministry for Education.
- Some municipalities (as part of their local equality policies).
- Madeira's Regional Directorate for Education.
- Some Schools' Association Training Centres (CFAE).

European Funds have supported 3 higher education institutions, previously involved in the Guides Project, to keep on training teachers focusing the training on the widespread use of the Guides in teaching practice.

Figure 55 - Front Covers of the "Gender and Citizenship Education Guides"

There are currently 5 "Gender and Citizenship Education Guides" freely available, one for each level of education:

- Guide for Pre-School (3 to 5 years old).
- Guide for the 1st cycle (6 to 9 years old).
- Guide for the 2nd cycle (10 to 11 years old).
- Guide for the 3rd Cycle (12 to 14 years old).
- Guide for Secondary School level (15 to 18 years old).

The content of all these Guides shows a similar structure:

A first part presents a theoretical framework about gender and citizenship, gender and curricula and gender and education practices (in basic education guides) and gender and knowledge (in the secondary education guide);

A second part is composed of practical suggestions for educational intervention. The 2nd and 3rd cycles' Guides also include some key themes and propose practical activities. The secondary education Guide includes some curriculum suggestions for 9 different subjects.

The practical suggestions found the pre-school and 1st cycle Guides consist of examples of teaching situations to be created. The chapter on practical suggestions for educational intervention share some common themes:

- Organisation of the educational environment.
- Role of the Educator/Teacher: Examples of Activities.
- Family and community involvement.
- Learning/Content Areas: Examples of Projects.

In the 2nd and 3rd cycle's guides the proposed activities are organised around transversal themes that can

be worked on in any subject. They include explicit references to STEM-related themes such as Leisure Activities; Characters from children's literature; History and Heritage; Body; Health; ICT; Vocational Choices.

In the 3rd Cycle's Guide, for example, there is a chapter exclusively dedicated to Gender and ICT (Chapter 5) whose primary goal is to highlight the gender gap in ICT and to demonstrate how gender affects the relation each one of us has with technology. It also provides suggestions and practical activities to try to deal with this issue. For instance, one of the many activities proposed is called "Technology and Everyday Spaces" and its main objectives are:

- Identify the diversity of contexts in which technologies are used in everyday life.
- Recognise that the use of technology in our daily activities and spaces is often linked to gender roles.
- Reflect on the consequences of gender issues on different ways of using technology.

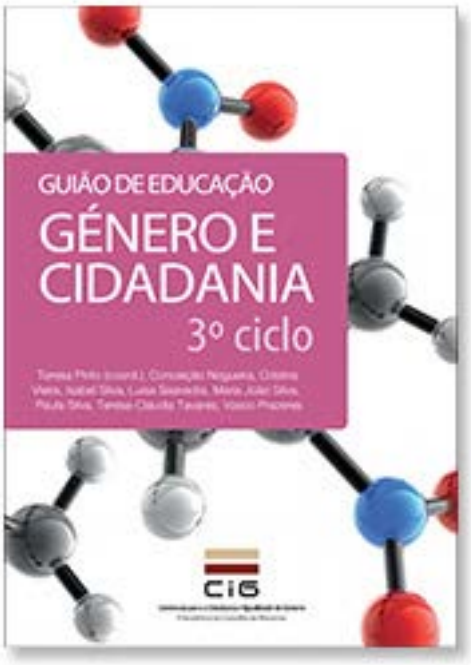


Figure 56 - 3rd Cycle "Gender and Citizenship Education Guide"

This activity is expected to aid teachers getting students to acknowledge the impact gender can have when it comes to the day-to-day use of technology, but also to enable them to identify some of those impacts and differences in the context of the classroom and in their learning experiences and environments.

The Guide dedicated to the secondary school level develops a critical reading, from a gender perspective, of the programmes of some disciplines, introducing some examples of integration of a gender perspective in several disciplines of the curriculum, namely: Portuguese, English, Philosophy, Biology, Physical Education, History, History of Culture and Art, Economics, Integration Area.

Chapter 7 is dedicated specifically to Biology. Called "Biology and Gender: other perspectives", this chapter aims to demonstrate how science, technology and gender are related to each other and how a gender perspective is crucial in such matters. It helps deconstructing hegemonic discourses in these subjects by showing how a gender perspective can be integrated in various topics (e.g. metaphors and language, reproduction and fertility manipulation, female genital mutilation, among others).

Of the various activities proposed in this chapter, we highlight the one called "Women in Science" which can be implemented in any unity or content of either Biology or Geology. It aims reviewing beliefs and ideas that, over the years, have placed women on the margins of those scientific areas, seeking to value the achievements and "forgotten" contributions of women to science and technology and to deconstruct the genealogical path that has fuelled centuries of gender prejudice in science education.

Summing up, the "Gender and Citizenship Education Guides" include a myriad of practical activities that fulfil

some of the main criteria of a gender sensitive STEM pedagogy, namely:

- Integrating a gender perspective in curricula, with specific examples of practical activities.
- Promoting awareness and competencies to detect and combat gender stereotypes.
- Promoting awareness and competencies to detect and combat gender discrimination across education levels.
- Promoting a systemic and non-punctual practice.
- Adopting a whole school approach.
- Supporting and informing teacher's training.
- Being a national policy measure, it has multiplier effects through all country schools and professionals.

Figure 57 - Secondary level "Gender and Citizenship Education Guide"

Impact

Online since 2010, these Guides are easily accessible to basic and secondary school teachers and educators, allowing them to freely use these materials in their professional activity, especially when teaching Education for Citizenship, Health Education and, in particular, Sex Education, which is compulsory in the 2nd and 3rd cycles. Guides were printed and distributed to schools' libraries across the country. Higher education institutions offering initial teachers' training and organisations accredited for in-service teachers' training have also received these materials for their libraries.

The Guides have also gradually begun to be used in the initial training of education professionals at Initial Teacher Training Colleges, Faculties of Psychology and Educational Sciences and Higher Education Schools. Some figures account for their impacts:

- By the end of 2020, 134 accredited training sessions, 5,000 hours of training.
- By the end of 2020, 2,708 teachers trained at all levels of non-tertiary education (preschool to 12th grade), of whom 84% female and 16% male.
- Teachers' training covered around 50 per cent of the school groups in mainland Portugal, covering 60% of the country's municipalities in all districts.

Finally, it should be noted that these "Citizenship and Gender Education Guides" have been internationally recognised as Good Practices by various entities (European Commission, in 2012; Council of Europe, in 2015, 2019; EQUINET, in 2016). Such recognitions demonstrate their important role for mainstreaming a gender equality perspective and empowering teachers to develop gender sensitive pedagogies into all the aforementioned teaching and learning levels.

Testimony of Use

The "Gender and Citizenship Education Guides" appear to be an effectively good practice that allows for the continuous and sustained integration of gender equality between men/boys and women/girls in school education, teachers practices and in the curricula of non-higher education, including some STEM-related areas.

Some testimonies of use can be found in a book chapter entitled "Gender issues and citizenship: brief reflections on the emancipatory power of education" (Vieira *et al.*, 2017), where the authors intended to discuss the role of education in promoting the critical awareness of both students and teachers. The following are opinions of teachers taking part in a training session where they were presented the "Gender and Citizenship Education Guides" Project:

"This training provides us with knowledge and materials that are very useful for our daily performance and that enable us to improve and enrich the teaching/training of young people, making them aware of and sensitising them to these issues."

"[I suggest] greater publicity in schools, because it was only at this training that we learnt about this work, because although the Guides were in the School Library, the community was not aware of this fact."

SUMMARISED INFORMATION	
School Involvement	▪ Out of school (training of teachers).
Time of the activities	▪ In extracurricular hours.
Context of the activities	▪ School (whole and classroom) application of pedagogical proposals. ▪ Community Context (training).
Activities format	▪ Presential.
Type of equality approach	▪ Mainstreaming (girls and boys, whole school, companies, and teachers).
Actions to impact on families and parents	▪ None.
Disciplines or courses enrolled/integration	▪ Integrative approach (e.g., gender across discipline tasks and integrated as part of the subject). ▪ Mainstreaming in all courses and grades.
Pedagogical Materials and Resources used	▪ Team of higher education and gender expert teachers. ▪ Educational Guides. ▪ Training courses at universities and polytechnics.
School Practices & Pedagogical Practices	▪ Inclusion of a gender equality perspective in programs/curricula. ▪ Recommendations about pedagogical practices to promote a gender perspective in teaching.

PRACTICE 4 - EDUCATION PROJECT

Description: The Code Girls is a non-profit organisation focused on promoting digital inclusion and gender equality by teaching programming to women and girls of school age in Portugal. In 2023, the organisation started a pilot project dedicated to educating and raising awareness among elementary and secondary school children, promoting a preventive rather than corrective approach to the Information Technology (IT) sector. This gave rise to the "Education" Project, currently being implemented, which aims to demystify the role of women in technology and encourage more young people to experiment with STEM areas and explore activities and career paths in the IT sector.

Responsible Entity: The Code Girls (As Raparigas do Código).

Goals: Gender stereotypes awareness; Students Awareness; Teachers Awareness; Enhance girls' interest in STEM; Information, vocational orientation; Develop new visions of STEM professionals in schools; Give visibility to women in STEM.

Target Audience: Female students.

Edition: Pilot Project.

Website: https://raparigasdocodigo.pt

Instagram: https://www.instagram.com/asraparigasdocodigo/

Facebook: https://www.facebook.com/AsRaparigasDoCodigo

LinkedIn: https://www.linkedin.com/company/raparigasdocodigo

The "Education" Project is a pilot project dedicated to educating and sensitising elementary and secondary school children, by promoting a preventive rather than corrective approach to the Information Technology (IT) sector. Starting in June 2023, this project is currently being implemented with the aim of demystifying the role of women in technology and encouraging more young people to experiment with STEM areas and explore activities and pursue a career in the IT sector. Fitting within the framework of inclusive education, the "Education" Project is aligned with SDG 4 (Quality education) and 5 (Gender Equality) of the UN's 2030 Sustainable Development Goals.

This pilot project is presently being developed by The Code Girls, a non-profit organisation focused on demystifying the role of women in technology, promoting digital inclusion and encouraging more girls and women to enter the IT sector. The Code Girls organisation works around the pillars of diversity and inclusion, seeking to create a safe environment where Portuguese girls and women can feel empowered in their technological capacities and develop their digital, entrepreneurial and leadership skills. Furthermore, this non-profit organisation aims to foster the creation of more diverse and inclusive school and work environments.

The Code Girls is a reliable organisation in what concerns expertise in teaching and implementing STEM activities, with experience in promoting STEM-related initiatives and projects. The Code Girls seeks to foster

a culture of technology from an early age, challenging new generations to "learn to play" through logic and programming games. It promotes various activities to girls and children (basic, secondary, and higher education levels) in different schools and institutions across the country, including workshops. programming clubs, and summer schools.

The Code Girls Organisation offers free access to education and mentoring, not only to girls of school age or recent graduates, but also to women attending qualification or re-qualification programmes and women wanting to develop personal entrepreneurial projects. This specific programme comprises a wide range of workshops aimed at helping women and girls develop their technological and entrepreneurial skills: Web Technologies (HTML, CSS, JS, React JS), Programming in Python, Data Science, Career Management, LinkedIn, Preparing for Interviews.

Activities promoted

As part of the "Education" pilot project, The Code Girls have been conducting face-to-face activities in the major urban centres and a few in more disadvantaged regions, in partnership with other organisations and local authorities (through protocols with schools, hospitals and institutions in Lisbon, Oporto and Coimbra). The project works not only with girls and children, in general, but also with young people at risk.

So far, the following activities have been carried out:

- 1 activity conducted in the António Luís de Oliveira Foundation (in partnership with CGI Portugal)[9].
- "The Secret Code of Rebel Girls" (Women in Tech Summit).
- "AI in your daily life" (D. Duarte Secondary School in Coimbra).
- "Using AI in a positive way" (Azores participatory budget).
- "Fun Robotics" (Coimbra Paediatric Hospital, in partnership with the Calioasis Association).
- Participation in technology competitions and events, such as:
  - Collaborations with the Zero Association (We4Change + Changemakers).
  - Technovation Girls.

The "Education" Project is free and runs on a voluntary basis by collaborators and staff from The Code Girls organisation. The project functions on a monthly or bi-monthly basis and aims to offer a greater opportunity for girls and children of different ages and with different levels of knowledge to experiment with technology by building small practical projects in robotics, programming, and artificial intelligence.

The team behind this pilot project is dedicated to developing educational games, open to the general public,

9 António Luís de Oliveira Foundation is a foster home that welcomes children and young people who, for various reasons, are unable to remain with their families and for whom an alternative life project must be devised that guarantees the effective realisation of their rights, namely, to receive appropriate care to their age and developmental needs, safety and participation.

CGI is an IT and business consulting services company and is among the biggest in the world.

that can be used by teachers, parents, or educators to develop children's skills. Some examples of those are:

- The **"Professions Game"** (https://jogodasprofissoes.pt/).
- The **"Pull the Neurons"** recognition software.
- The **"Shapes Factory"** (a board game still in development).

The "Professions Game" is the only resource available online. Created in 2021, it comes out of the need to deconstruct prejudices related to stereotypes and gender roles from an early age and to demonstrate there are no professions just for men or just for women. Beyond The Code Girls, it brought together some other organisations, such as:

- Women in Tech.
- Centre for Social Studies of the University of Coimbra.
- Secretary State for Citizenship and Equality of the Portuguese Government.
- IronHack Lisbon.
- .PT.

The "Professions Game" is essentially a memory game that wants to let children know they can be whoever they want to be, by showing them several professions and jobs in various fields. At the same time, as aforementioned, the game tries to deconstruct the prevailing stereotypes and prejudices surrounding each of the professional areas.

Figures 58 and 59 - Examples taken from the "Professions Game". The image on the right shows "Joana, the Engineer". The image on the left shows "Matilde, the Astronaut"

Summing up, the Education Project comprises a myriad of practical activities that fulfil some of the main criteria of a gender sensitive STEM pedagogy, namely:

- Women in STEM visibility and role modelling.
- Awareness raising on gender stereotypes, horizontal sexual segregation.
- Ludic and technological activities.
- Deconstruction of stereotypes about STEM professions, STEM professionals and gender stereotypes.
- Innovative educational tools.
- Project based, hands-on and problem-solving pedagogical methods.
- Focus on real world problems.

Impact

The Education Project is still at an early stage of implementation and development. However, The Code Girls Portugal has some sound impact results to show from its overall activity:

- More than 650 students have signed up to the project.
- A team of 25 mentors and collaborators, both women and men.
- Several initiatives organised, including:
  - 3 editions of Web Technologies.
  - 2 editions of Introduction to Programming in Python.
  - 3 editions of Career Management.
  - 1 edition of Python for Data Science.
  - 1 edition of React JS.
  - 2 OutSystems Certificates.
  - 1 Cybersecurity edition.
  - Multiple LinkedIn, Git and GitHub, UX/UI and Figma workshops.
- Several networking opportunities:
  - 1 Tech Community Get-Together Edition with 4 speakers, 7 communities and approximately 100 participants.
  - 1 RdC Community Brunch with around 50 participants, where the "Education" Project was presented.
  - Women Open Day 42 Lisbon with nearly 40 participants.

The Code Girls has already received some awards:

- "Best Digital Inclusion Project started by a Woman" at the Portuguese Women in Tech Awards 2021.
- "Equality and Inclusion" and "Qualifications" categories, in the Cities and Territories of the Future Award 2023.

Figure 60 - Members of The Code Girls organisation receiving an award in the "Equality and Inclusion" category at the Cities and Territories of the Future 2023 Awards

Testimony of Use

In the future, the team in charge of this pilot project intends to deepen its partnerships and to produce a guide to be used by kindergarten teachers and 1st and 2nd cycle teachers to help them in classroom work.

The teams of the new school project have high expectations about it, since it fills a gap in their activity, by enabling them to a systematic intervention and response to schools' and teachers' demands. They recall the impact of their first game (the "Professions Game") launched with big public and mediatic impact on the 1st of June 2021 (International Children's Day).

Below, a testimony of use in Facebook about the "Professions Game" demonstrates its importance and relevance in educating young girls:

"Looks great! I was actually coming to ask if you are considering making this available for mobile, as I wanted to show it to a girl I've been tutoring 🙂 It might be a bit harder on PC, but not impossible eheh"

and another one:

"If she were alive today, Beatriz Pinheiro (a Portuguese feminist and pedagogue) would applaud exuberantly, reminding us that gender equality must transition from the realm of portals to everyday life."

SUMMARISED INFORMATION	
School Involvement	▪ In and out of school.
Context of the activities	▪ School. ▪ Community context. ▪ Company context. ▪ Scientific Context.
Activities format	▪ Mixed (in-person/in-person with streaming, online)
Type of equality approach	▪ Specific Action (only women involved).
Actions to impact on families and parents	▪ None.
Disciplines or courses enrolled/integration	▪ Representativeness in ICT/STEM.
Pedagogical Materials and Resources used	▪ Team of volunteers. ▪ Educational Games. ▪ Online Platforms.
School Practices & Pedagogical Practices	▪ Integration in community, local and/or national projects on gender gap in STEM. ▪ Partnership with feminist academics, networks, and NGOs. ▪ Implementation of innovative beyond the classroom pedagogical practices to promote a gender perspective in STEM teaching, like school community links to promote hands-on learning initiatives.

2.2. Inspiring Italian practices

- PARI lo imPARI a SCUOLA (5)
- "Girls & Science": female inclusion in STEM subjects (6)
- Robotics laboratory for scientific exploration (7)
- Stem Paths on Gender Difference in Science and Beyond (8)
- Stem Pathways on Gender Equality: Women to Know (9)
- "StemDays-il camp delle ragazze" (StemDays-the girls' camp) (10)

PRACTICE 5: PARI LO IMPARI A SCUOLA

Description: The project was carried out by the Equality Department Opportunity as a path to raise awareness on the topic of cultural and educational gender differences in a preventive way, in three comprehensive schools of the city of Seregno: "A. Stoppani", "A. Moro", "G. Rodari", and in the "CFP S. Pertini" and "G. Terragni" of Monza Brianza.

Responsible Entity: The project was carried out by the Equality Department Opportunity of the municipality of Seregno, in collaboration with Afol metropolitan of Milan.

Goals: Gender stereotypes awareness; Students awareness; Parents awareness; Teacher's awareness; Information, vocational orientation; Enhance girls and all students interest in STEM; Integrate gender sensitive materials in curricula; Integrate gender sensitive approaches in classes; Give visibility to women in STEM.

Target Audience: Male and female students; Parents; School Directors; Teachers from all disciplines; Vocational Guidance Counsellors; Companies and institutions in the community; Municipalities.

Edition: The project has been carried out on an annual basis since the 2012-2013 school year.

YouTube: https://www.youtube.com/watch?v=F6wmZvqH02o

Websites:

https://www.impariascuola.it/media/io-sono-la-scuola-secondaria-di-primo-grado

www.impariascuola.it

The "PARI lo imPARIaSCUOLA" project is carried out by the Equal Opportunities Department of the Municipality of Seregno, in collaboration with Afol Metropolitana of Milan, as a path to raise awareness on the topic of gender differences in a preventive, cultural and educational way in the schools of Seregno and Monza Brianza.

It is an important educational initiative for the students at the schools involved. With the active collaboration of parents and teachers, the girls and the kids are supported to recognise and value gender differences, to get closer to their authentic desires and to capitalise on the opportunities this project contains.

Activities promoted

The educational activities carried out during the project were described through training intervention sheets developed by the schools.

The interventions, transversal and integrated with the curricular subjects, were co-designed and modulated together with the teachers on the basis of the teaching programme of the individual class, the teaching subject and the topics addressed during the training and awareness meetings.

Each school has chosen different ways to tell and communicate its journey: videos, presentations and questionnaires are the result of group work that made the students active protagonists of the experimentation and stimulate cooperative work.

The activities were carried out in 4 macro thematic categories which, with different methods and levels of complexity, were addressed by the schools of different levels involved in the project, from nursery to secondary school.

The themes used for the macro categories are:

I AM – Reflection on oneself, on one's gender identity and on one's aspirations: how we are and how we would like to be.

ROLES IN THE FAMILY - Reflections on the division of care and domestic tasks in the family.

THE PROFESSIONS – Reflections on professions considered by women and professions considered by men, the conditions that can influence the choice of a job, gender discrimination in career paths.

SOCIETY - The stereotypes present in media, literature, fairy tales; the role of women in history and society, violence against women.

All the works created share the use of active methodological practices in which it is possible to learn starting from one's own experiences. Cooperation games, group research, interviews, theatrical performances are activities which, with the direct participation of students, make it possible to give greater concreteness to the proposals through experiential learning bringing into play the cognitive component, but also feelings and emotions.

The purpose of gender education courses is not a simple expansion of knowledge but rather a path of awareness of one's own desires and aspirations, starting from one's own experiences which are intrinsically linked to our gender affiliations.

In this perspective, the school's task, in a precious alliance with families, is not to offer solutions but tools,

keys to enable the citizens of tomorrow to act and plan their own existence in the awareness that being born a woman or man is not a destiny but an open and dynamic exploratory path.

Thus, this project comprises a myriad of practical activities that fulfil some of the main criteria of a gender sensitive STEM pedagogy, namely:

- Awareness raising on gender stereotypes.
- Putting student at the centre (expectations, capabilities, needs, obstacles).
- Deconstruction of stereotypes about STEM professions, STEM professionals and gender stereotypes targeted not only to students, but also to families.
- Innovative educational tools.
- Focus on real world problems.
- Project based, hands-on and problem-solving pedagogical methods.
- Encouraging students to share their experiences (expectations and obstacles) as a pedagogical strategy.
- Inclusion of a gender equality perspective in the curricula, textbooks, educational materials.

Impact

The project is characterised by a transversal communication action which translates into awareness-raising activities and dissemination of the results.

The main source of documentation and dissemination of results is the website www.impariascuola.it, conceived as a dynamic place in continuous evolution to which everyone can make their own contribution.

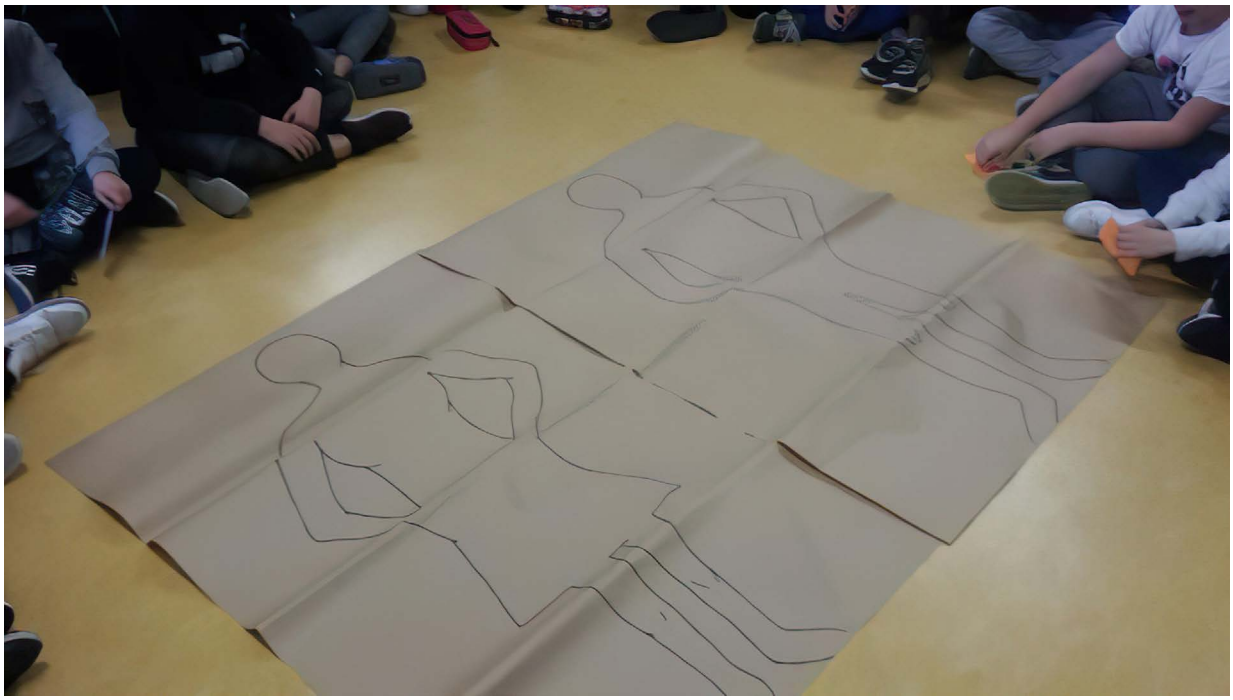
The web channel is a useful, constantly updated tool, available to teachers and anyone who wants to explore and reflect on the topic of gender education, for finding and sharing experiences and information.

In order to guarantee a comparison on the topic at different levels (scholastic, institutional and territorial) the project's path also includes moments of presentation and sharing of the activities and results, such as seminars, publications and exhibitions set up with the works carried out by the schools.

The project was well received by both the teachers and the boys and girls involved. In all classes there was active participation and constant interest in the topics, activities and games proposed.

Students were the protagonists of the discussions and reflections, sharing their ideas, often citing their personal experiences as examples. The opportunities for discussion were therefore made the most of. Even when different points of view emerged, the climate of the discussions was always respectful and open to listening to opinions different from one's own. The relationship with the teachers was also very positive. In all schools there was strong interest both in the topics addressed and in the methods of conducting the workshops. Teachers, present in the classroom during the workshops, were an added element, enhancing the discussion and bringing relevant reflections to the topics addressed, further stimulating the students.

Figure 61 - Photo taken during an activity on gender stereotypes



Testimony of Use

For the majority of teachers, the project was experienced as an opportunity to get to know their students better and to establish a more collaborative climate of mutual understanding and respect. Furthermore, the experience contributed to enriching the professional profile of teachers, both from the point of view of theoretical development and experimentation of new methodological practices.

The contents of the project also touched aspects of personal emotional life, stimulating reflections and rereading on one's past experiences and experiences.

For the students, protagonists of the discussions and reflections, the activities allowed them to share their personal experiences. The opportunities for discussion were therefore made the most of; the climate of the discussions has always been positive and open to listening to different opinions; interest, curiosities and continuous in-depth questions have never been lacking; indeed, they have been the central elements of the entire journey.

SUMMARISED INFORMATION	
School Involvement	▪ In and out of school.
Time of the activities	▪ During regular classes and in extracurricular hours.
Context of the activities	▪ School. ▪ Community Context.
Activities format	▪ In-person.
Type of equality approach	▪ Mainstreaming (girls and boys, whole school, and teachers).
Actions to impact on families and parents	▪ Direct Information. ▪ Participation in initiatives.
Disciplines or courses enrolled/integration	▪ Integrative approach (e.g., gender across discipline tasks and integrated as part of the subject).
Pedagogical Materials and Resources used	▪ Didactic worksheets. ▪ Educational videos. ▪ Laboratory activities
School Practices & Pedagogical Practices	▪ Inclusion of a gender equality perspective in programs/curricula; textbooks and educational materials; training requirements, teaching, educational and guidance staff; vocational guidance counsellors' activities. ▪ Implementing anti-violence, antisexist, and anti-harassment tools and services in school, and information about these issues, to promote school as a safe space. ▪ Implement innovative beyond the classroom pedagogical practices to promote a gender perspective in STEM teaching such as exhibitions of women's contributions in STEM and promoting a multidisciplinary approach and hands-on learning initiatives. ▪ Giving visibility to women's roles in STEM: examples of women protagonists and voices. ▪ Teaching in an interdisciplinary way, doing articulation with non-STEM disciplines (specifically, exploring the intersections of science, mathematics, history, civic education, technology, art). ▪ Developing classroom activities to deconstruct stereotypes about STEM professions, STEM professionals and gender stereotypes.

PRACTICE 6 - GIRLS&SCIENCE: FEMALE INCLUSION IN STEM SUBJECTS

Responsible Entity: Conceived by Apindustria Confimi Vicenza, in partnership with IIT (Italian Institute of Technology), Associazione Eurocultura and the research institutes and research laboratories of the University of Padua and involving 8 schools.

Goals: Teachers training in gender and STEM; Gender stereotypes awareness; Students awareness; Teacher's awareness; Enhance girls and all students interest in STEM; Develop new visions of STEM professionals; Integrate gender sensitive materials in curricula; Integrate gender sensitive approaches in classes; Give visibility to women in STEM.

Target Audience: Male and female students; School Directors; STEM teachers; Companies and institutions in the community; Women in STEM networks; Universities.

Edition: 2nd Edition.

Website: https://www.girlsandscience.it

Facebook: https://www.facebook.com/girlsandscience/

The project "Girls&Science: female inclusion in STEM subjects" was conceived by Apindustria Confimi Vicenza, in partnership with IIT (Italian Institute of Technology), Associazione Eurocultura and the research institutes and research laboratories of the University of Padua. It was born from the passion and the desire to do something concrete to bring children, girls and young people closer to STEM, by directly connecting them with companies, universities, institutions and associations in the Veneto area.

The objectives are to encourage "exchanges of knowledge", increase skills, support innovative ideas, prepare young people for future choices, favouring technical/scientific paths. In short, increasing young people's awareness of the opportunities that science and technology offer, for them to get ready for the future job market.

The project includes educational-experiential courses suitable for different school age levels: from practical laboratories to visits to research centres, from contests to STEM camps. Older students also can attend entrepreneurship courses and get in touch with comparisons with European institutes and internships, and innovative technological solutions applicable to business processes, supported by partners and companies interested in training them with immediately usable skills.

The intent is to create a bridge allowing to meet supply and demand of jobs in Veneto, thanks to concrete interventions, planned over the long term and involving the educational and business system, with a focus on overcoming gender prejudices and on truly employable skills in a labour market undergoing a profound digital and technological transformation.

Activities promoted

An intense programme of activities and initiatives involves companies, universities, institutions and associations in the organisation of open innovation laboratories, contests, STEM camps, visits to research centres, internships in companies, mentoring, support of innovative ideas. The programme also comprises training of teachers, bringing young people closer to work, stimulation of creativity and innovation in ideas, conception of vertical curricula.

Specifically, the following activities are planned:

- 58 workshops, of which 20 are specific for girls.
- 8 science camps.
- 14 contests.
- 45 internships.
- 16 scientific meetings and with innovative companies.
- 8 workshops for teachers.

The approaches to STEM and gender equality start from primary school, showing the playful aspects of science and technology and making children, girls and their families aware that science and technology are within everyone's reach, without prejudices and stereotypes.

Middle school boys and girls are involved through experience, practice and knowledge of the potential and professional opportunities that science offers, for a conscious choice of their own training path.

High schools and high school students come into direct contact with companies. Ad hoc training workshops, STEM courses are planned - some of which are specific for girls and post-diplomas - in collaboration with Mech4.0tronics LAB of the ITS Academy Meccatronico Veneto Foundation, and internships with the support of Apindustria Confimi Vicenza with the development of research projects and work experiences.

Impact

“Girls&Science” aims to promote a general increase in interest in STEM disciplines, regardless of gender, and aims to offer students the opportunity to carry out conscious choices for your future, making them the protagonists of their own change, drivers of their own future and of the development and innovation of the territory,. The project stimulates the discovery of the potential of companies and of the training proposals in the scientific and technological fields offered by the territory, directing young people towards wider employment opportunities.

There are 8 schools that have embraced the Girls&Science project.

The project involved more than 8000 students, both male and female, with a greater percentage of female students, whose participation was a priority.

Through cooperation and connections within the territory, companies, scientific/technological entities and young people engage in a continuous meeting and exchange which encourages:

- greater knowledge and awareness for choosing the next study path, creating open-mindedness and easiness in facing challenges deemed "tough".
- the synchronisation of training proposals with the production reality and future needs of the market.
- a change in corporate mentality: co-planning and co-participating in project activities, relating to the ideas, aspirations and needs of the students, understanding their needs, aligning the needs of the students and the company and helping to create opportunities for collaboration and new spaces in which to welcome and support the innovative ideas of students.
- a renewed connection with universities which can promptly come into contact with potential future students, contributing to more informed choices.
- new processes to make science and technology more used in companies closer and more interesting for students.
- the creation of STEM paths for girls and post-diploma students, regardless of their educational path.

Testimony of Use

The initiatives, defined by Apindustria Confimi Vicenza in partnership with the ITS Academy Meccatronico Veneto, aim to make science and technology accessible to all, against any prejudice or gender stereotype, guiding the new generations in orientation and job placement paths.

Thanks to the construction of positive relationships between the world of school and the economic-productive fabric of the territory, the project also responds to the need for theoretical-practical skills expressed with ever greater insistence by companies.

“Girls & Science” in fact involves companies, universities, institutions and bodies in the organisation of laboratories, contests, internships, summer camps, meetings, etc. for students.

SUMMARISED INFORMATION	
School Involvement	▪ In and out of school.
Time of the activities	▪ During regular classes and in extracurricular hours
Context of the activities	▪ Schools. ▪ Laboratories. ▪ Companies. ▪ University.
Activities format	▪ Mixed (In-person/in-person with streaming, online).
Type of equality approach	▪ Mainstreaming (girls and boys, whole school, and teachers).
Actions to impact on families and parents	▪ Indirect information through students. ▪ Awareness-raising to break stereotypes.
Disciplines or courses enrolled/integration	▪ Integrative approach (e.g., gender across discipline tasks and integrated as part of the subject). ▪ Cross-discipline approach (e.g., inclusion of a gender module for several courses).
Pedagogical Materials and Resources used	▪ Case simulation activities. ▪ Design thinking activities. ▪ Open innovation, programming, and coding workshop paths. ▪ Laboratory Activities.
School Practices & Pedagogical Practices	▪ Inclusion of a gender equality perspective in programs/curricula. ▪ Implementing innovative beyond the classroom pedagogical practices to promote a gender perspective in STEM teaching, such as exhibitions of women's contributions in STEM and promoting a multidisciplinary approach and hands-on learning initiatives. ▪ Giving visibility to women's roles in STEM: examples of women protagonists and voices. ▪ Encouraging girls to participate in STEM projects/workshops. ▪ Introducing specific positive reinforcements for girls, like mentorship and peer support to girls. ▪ Using project based, hands-on and problem-solving pedagogical methods. ▪ Integrating technology and innovative educational tools to motivate students, like educational platforms.

PRACTICE 7: ROBOTICS LABORATORY FOR SCIENTIFIC EXPLORATION

Description: The project intends to promote among students the use of educational robotics and programming languages as tools for writing, telling, and staging three-dimensional stories of life or fantasy, using digital scripts and robotics.

Responsible Entity: Liceo Teresa Ciceri (Como)

Goals: Through the articulation of the path into various phases - "explore", "compose", "decompose", "reinvent", "communicate" "reflect" - the students experiment manual laboratory activity with the creation of real scenography (objects, costumes, wigs, faces of the protagonists and antagonists of the scripts) and the use of smart toys and programs, block programming software to tell stories.

Target Audience: Male and female students (With priority given to female students)

Edition: 1st Edition.

The project **"**Robotics laboratory for scientific exploration", developed by two mathematics and computer science female teachers from the "Teresa Ciceri" Human Sciences High School in Como, intends to promote the use of educational robotics and programming languages as tools for writing, telling, and staging three-dimensional stories of life or imaginative, using digital scripts and robotics. Educational robotics also fuels the curiosity and passion of students towards science, contributing to the strengthening of the teaching-learning processes of scientific and IT subjects.

This orientation for STEM careers is carried out with specific attention to the issue of equal opportunities, fully aware of the importance of involving and motivating female students as well as male students, providing them with tools and opportunities to deal with these subjects and possibly choose technical-scientific careers in those areas.

The in-depth topics are:

- laboratory and skills-based teaching;
- methodologies and practices based on IBSE;
- programming of the Arduino system and use of environmental sensors for data collection;
- creation and programming of a robotic system through the use of the Scratch Platform;
- construction and testing of an educational path on the use of robots in exploration activities.

Activities promoted

The project "Robotics laboratory for scientific exploration" activities take place in person, during extracurricular hours, and involve a maximum of 30 participants (priority was given to female students) in a total of 30 hours comprising:

- use of materials on a dedicated platform.
- 5 in-person meetings.

The activities are aimed at developing a final project work, a robot model programmed using the programming tools Scratch Platform for Arduino.

The layout of the classroom includes a number of workstations corresponding to the number of participants, so that each one accommodates one student, and each workstation must be set up on a table-desk in the following way:

- 1 PC with internet connection.
- 1 Arduino Starter Kit.
- 1 pressure sensor.
- 1 soil moisture sensor.

Impact

The project **"**Robotics laboratory for scientific exploration", currently ongoing, aims to familiarise 25 students (especially female) of the Teresa Ciceri High School of Human Sciences of Como with the use of programming tools aiming to:

- Increase interest and involve students in STEM disciplines.
- Plan teaching consistently with the pedagogical references on teaching methodologies and National Indications, integrating knowledge and cognitive skills with personal, social, and relational skills.
- Develop curricular activities related to what has been studied by researchers in the field of robotics and automation, from unmanned cars to the use of drones in the field of security, to applications in space exploration.
- Use and programming.
- Acquisition of specific terminology through the demonstration and development of a mini robot model.

The project was born with the aim of offering schools innovative educational contents and paths, suited to the profound transformations taking place in society and in line with the new skills and abilities required for 21st century education.

Testimony of Use

The project “Robotics laboratory for scientific exploration” aims to combine science and technology, theory and laboratory, individual and cooperative study, in a way that only the use of educational robotics can achieve in schools.

The powerfully constructivist approach to knowledge, where the student can “learn by doing", promotes inclusion on the one hand and the valorisation of excellence on the other.

In particular, the multidisciplinary nature of robotics brings students (especially female) closer to computer science, physics, electrical and electronic circuits, and mechatronics. Furthermore, robotics becomes the ideal terrain for computational thinking, strengthening analysis skills and "problem solving".

SUMMARISED INFORMATION	
School Involvement	▪ In school.
Time of the activities	▪ Extracurricular hours
Context of the activities	▪ School
Activities format	▪ In person
Type of equality approach	▪ Mainstreaming (girls and boys, whole school, and teachers).
Actions to impact on families and parents	▪ Indirect information through students.
Disciplines or courses enrolled/integration	▪ Cross-discipline approach (scientific topics treated with a gender perspective, also linking them to other subjects, including non-scientific ones)
Pedagogical Materials and Resources used	▪ Scratch platform for Arduino. ▪ Educational videos. ▪ Laboratory activities
School Practices & Pedagogical Practices	▪ Partnership with feminist academics, networks, and NGOs. ▪ Encouraging students to work in mixed-gender groups (creating learning environments that foster gender collaboration). ▪ Using project based, hands-on and problem-solving pedagogical methods. ▪ Putting student at the centre (expectations, capabilities, needs, obstacles). ▪ Integrating technology and innovative educational tools to motivate students, like educational platforms. ▪ Bring real world problems to the classroom. ▪ Encouraging girls to participate in STEM projects/workshops. ▪ Developing classroom activities to deconstruct stereotypes about STEM professions, STEM professionals and gender stereotypes.

PRACTICE 8. STEM PATHS ON GENDER DIFFERENCE IN SCIENCE AND BEYOND

Description: It is a practice carried out by two classes of a school in Rome that implemented two interdisciplinary STEM courses on gender difference/parity. This practice aimed to give visibility to two important women of science, Marie Curie and Henrietta Lacks, describing their lives, their backgrounds, and above all their scientific discoveries, through a multidisciplinary approach and connections (from Science, Civic Education, History, etc.).

Responsible Entity: Istituto Comprensivo "Maria Montessori" of Rome (as part of the Erasmus project "Boosting Science at School").

Goals: Give visibility to important women in STEM; Students awareness; Enhance girls and all students interest in STEM; Develop new visions of STEM professionals; Integrate gender sensitive approaches in classes.

Target Audience: Male and female students.

Edition: It only happened once, but the school and the teachers involved continue to use the materials produced with other classes.

Video on Marie Curie: https://www.youtube.com/watch?v=cYL0cQ30588&ab_channel=Boosting-GreenEducationatSchool

Video on Henrietta Lacks: https://www.youtube.com/watch?v=eL0Wqw4j73c&ab_channel=-BoostingGreenEducationatSchool

"Stem Paths On Gender Difference in Science And Beyond" is a practice carried out by two classes of a low secondary school, in Rome, that implemented two interdisciplinary STEM courses on gender difference/parity.

The work was carried out in 2018-2019 by the Istituto Comprensivo "Maria Montessori" of Rome (Italy), as part of the Erasmus project "Boosting Science at School".

The main objectives were to give visibility to two important women of science, Marie Curie and Henrietta Lacks, describing their lives, their backgrounds, and above all their scientific discoveries, through a multidisciplinary approach: all topics were developed by connecting different subjects, from science to civic education, history, etc., directly involving all students in practical classroom activities.

Activities promoted

The practice aimed to raise awareness of Marie Curie and Henrietta Lacks and their scientific discoveries, addressing the topic through multiple interdisciplinary connections (from science, civic education, history, technology, etc.). It was implemented in classes, 2 hours per week for 6 weeks, involving all the students, and using different teaching materials, didactic worksheets, educational videos.

One class worked on Henrietta Lacks, an African-American woman suffering from cervical cancer. Unbeknownst to the patient, cells were taken from her tumour that enabled all subsequent studies in biology and medicine, opening hitherto unimaginable fields of research.

The students' work was divided into 4 sections, covering the following different subjects:

1. Biography of Henrietta Lacks (Italian) with reference to the life of black Americans in the 1950s (Civic Education), characteristics of HeLa cells isolated from tumour (Science). Parallelism between the discrimination of Henrietta because she was black and the discrimination of women in the field of science in relation, for example, to the achievement of the Nobel Prize and examples of women who should have won the Nobel Prize but did not receive it (Italian, History, Science).
2. Characteristics of cancer cells and non-cancer cells (Science) and database search for information (Technology).
3. Insights into what is a tumour (Science).
4. Study of vaccines and bacterial and viral diseases (Science and History).

Another class worked on Marie Curie, the first woman to teach at Sorbonne University in Paris. The students' work was divided into 4 sections, covering different subjects:

1. Biography of Marie Curie (Italian).
2. Study of the structure of the atom (Science) and construction of two atomic models of two isotopes of the carbon atom (Technology).
3. Insights into what is radioactivity and its technological applications (Science, Technology and History).
4. Research section dedicated to Nobel Prizes to highlight the fact that only a very small number of women have won the Nobel Prize and, above all, the fact that Nobel Prizes have often been denied to women (Science, History, Arithmetic).

As a final result of this work, the students worked together and produced drawings, research and two videos.

Impact

The practice had a positive impact not only on the classes involved, but on the entire school and on teachers who continued to use the materials produced in their classes. Thanks to this practice, it was possible to develop a multidisciplinary approach combining STEM subjects with other subjects, including the humanities. STEM teaching was approached in an interdisciplinary way, making articulations with non-STEM subjects, and exploring the intersections between history, art, science, mathematics, technology, civic education, *etc*.

The interdisciplinary approach meant that skills from different disciplines (in this case, science, technology, mathematics, history and civic education) contaminated each other, developing new skills in the students, including creative skills, as they were involved in video production.

Testimony of Use

During the work with the students – conducted in an interdisciplinary manner, combining different topics from different subjects – no obstacles or difficulties were encountered. Girls and boys all participated actively and proactively and above all critically concerning the information gathered.

For example, the students were very impressed by the numerical data on the low number of Nobel Prizes awarded to women and their types, and on how many female scientists, who made important discoveries, were bypassed in their careers simply because they were women.

The work on Henrietta Lacks was an opportunity to discuss racism and its relevance in broader terms, beyond gender inequality. Also interesting were the observations on the testing of new drugs on humans and/or animals and the importance of awareness of what is being done to humans in the medical field.

Both activity pathways are broadly transferable to other contexts besides those in which they were implemented, applying them to both lower (primary school) and higher (secondary school) school levels. Both paths could be integrated with science and art labs.

SUMMARISED INFORMATION	
School Involvement	▪ In school.
Time of the activities	▪ During regular class hours.
Context of the activities	▪ School.
Activities format	▪ In-person.
Type of equality approach	▪ Mainstreaming (girls and boys, whole school, and teachers).
Actions to impact on families and parents	▪ None.
Disciplines or courses enrolled/integration	▪ Cross-discipline approach (scientific topics treated with a gender perspective, also linking them to other subjects, including artistic ones).
Pedagogical Materials and Resources used	▪ Didactic worksheets. ▪ Educational videos.
School Practices & Pedagogical Practices	▪ Inclusion of a gender equality perspective in programs/curricula. ▪ Implementing innovative beyond the classroom pedagogical practices to promote a gender perspective in STEM teaching, like exhibitions of women's contributions in STEM, and promoting a multidisciplinary approach and hands-on learning initiatives. ▪ Giving visibility to women's roles in STEM: examples of scientific and technological discoveries made by women. ▪ Giving visibility to women's roles in STEM: examples of women protagonists and voices. ▪ Visibilising women in STEM fields. ▪ Teaching in an interdisciplinary way, through articulation with non-STEM disciplines (specifically, exploring the intersections of science, mathematics, history, civic education, technology, art).

PRACTICE 9 - STEM PATHWAYS ON GENDER EQUALITY: WOMEN TO KNOW

Description: A project carried out by a class of Istituto Comprensivo Foscolo Oberdan, a low secondary school in Naples (Italy). The main aim of the project was to give visibility to important women to get to know, such as Ann Makosinshi, Katherine Johnson, Lynn Margulis, Rita Levi Montalcini, Alice Hamilton, etc., learning about their lives, backgrounds and discoveries or inventions. Together with the classroom activities within the framework of this project, the school also organised a public event on 24 March 2024 to raise awareness of gender equality and violence against women.

Responsible Entity: Istituto Comprensivo Foscolo Oberdan of Naples (Italy).

Goals: Give visibility to important women in STEM; Gender stereotypes awareness; Students awareness; Parents Awareness; Information, vocational orientation; Enhance girls and all students interest in STEM; Integrate gender sensitive approaches in classes.

Target Audience: Male and female students.

Edition: 1st Edition.

Social Media: https://messaggisottobanco.wordpress.com/2024/03/17/donne-parte-i/

https://messaggisottobanco.wordpress.com/2024/03/24/donne-parte-2/

"Stem Pathways on Gender Equality: Women to Know" is a project carried out by a class of Istituto Comprensivo Foscolo Oberdan, a low secondary school in Naples (Italy).

The project aims to raise awareness of some important women to get to know, such as Ann Makosinshi, Katherine Johnson, Lynn Margulis, Rita Levi Montalcini, Alice Hamilton, etc., learning more about their lives, backgrounds, discoveries and inventions, addressing the topics through in-depth research and artistic work.

The activity carried out with the students resulted in research and drawings for the creation of 40 bookmarks, each dedicated to a woman to be known. The project was carried out during science lessons, but students also worked independently at home.

Moreover, together with the classroom activities within the framework of this project, the school organised a public event held in the town square to raise awareness of gender equality and violence against women, during which the bookmarks made by the students were distributed to the local community.

Activities promoted

The project started with the reflection that for gender equality and the fight against gender-based violence, culture is important, and that culture also means reading. This is why the project is about making bookmarks, meaningful symbols to convey a twofold message: the importance of reading and therefore culture, and the importance of knowing the history of important women, represented on these bookmarks.

Each bookmark thus becomes a vehicle for multiple symbols and messages, all related to the same theme. As many bookmarks as possible were produced, with the photo of the chosen woman on one side and a significant phrase from them, and their biography on the other side.

The choice of women was as wide as possible: women writers, scientists, activists, young or not, from all continents, Nobel Prize winners or not. Women who, starting from the most diverse social conditions, have achieved important goals, fighting against various types of discrimination.

Together with the students, 40 women were chosen. Through research and in-depth study, their photographs were downloaded from the web and their biographies and characterising phrases were researched.

Students were then involved in creative and artistic hands-on activities: the photos of the women, their phrases and short biographies were printed and cut out, and 40 strips of drawing paper measuring 6 cm x 22 cm were prepared to make bookmarks.

The photos of the women and their phrases were glued on one side of the bookmarks, and their biographies on the other. The students decorated the bookmarks with themed drawings inspired by these women. Each bookmark was then plasticised.

This activity was then linked to another activity conducted by the entire school: the organisation of a public event held in the town square to raise awareness of gender equality, reflecting on the deconstruction of gender language, spreading the culture of equal opportunities, analysing gender stereotypes to overcome them and combating all forms of violence to build a fairer world. During the event the bookmarks made by the students were distributed to the local community.

Impact

The practice had a positive impact not only on the participating classes, but on the entire school and the local community, which was involved during the school public event organised in the town square to raise awareness of gender equality, spread the culture of equal opportunities, and combat all forms of violence, particularly violence against women.

By highlighting the achievements and contributions of women, especially those who might not receive widespread recognition, the activity challenged stereotypes and encouraged critical thinking about gender roles.

Moreover, organising a public event in the town square amplified the message of gender equality, reaching a broader audience and sparking conversations that may not have taken place otherwise. It provided a platform for students to engage with the community, fostering a sense of civic responsibility and activism.

Through this hands-on approach, students not only learned about the importance of gender equality but also experienced firsthand the power of collective action in promoting social change. By recognising and celebrating the achievements of women, the activity not only honoured their contributions but also inspired others to advocate for gender equality in their own spheres of influence.

Testimony of Use

During the work with the students – conducted by combining different activities, from research to artistic and hands-on activities, no obstacles or difficulties were encountered.

The project involved a class in which there are no major problems of gender inequality, but in which the female group often has a subdued voice. For this reason, and because of the continuing phenomenon of violence against women, with many media episodes having a wide resonance, the need was felt for a comprehensive STEM project on gender equality.

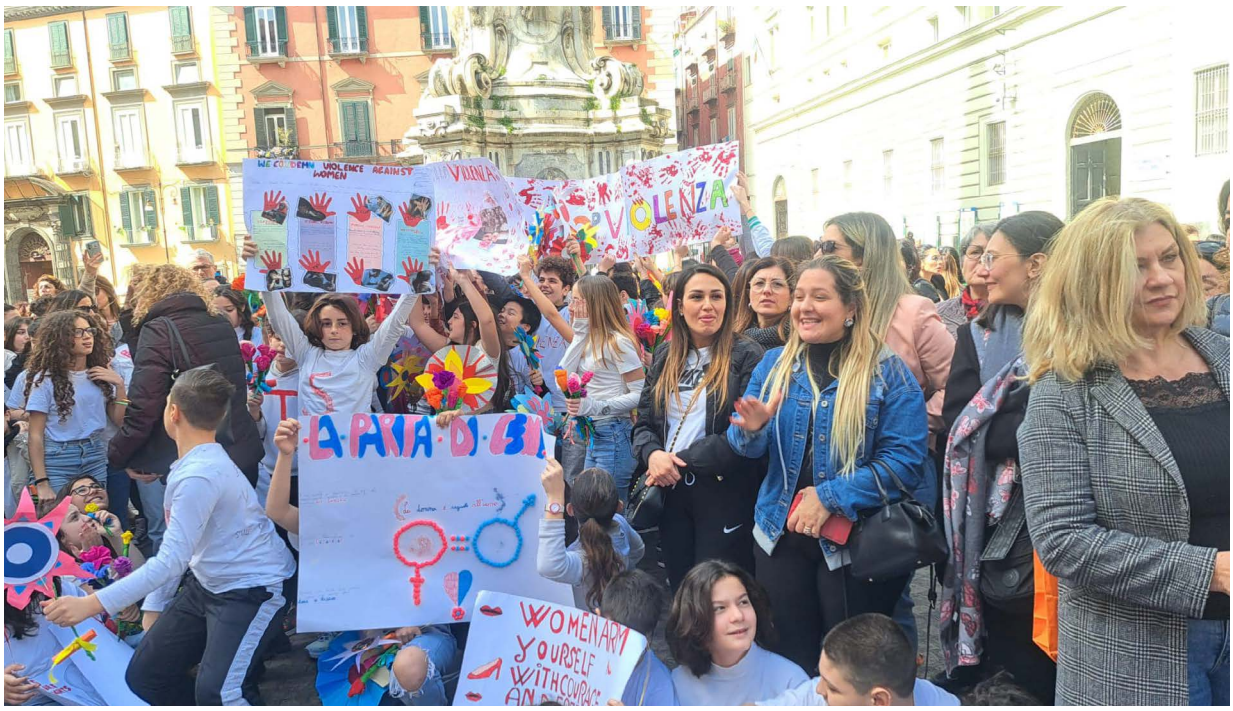
The work carried out was very important for awareness-raising on issues related to gender equality and gender-based violence, involving not only the students but also their parents and the local community.

The project is highly transferable and adaptable for elementary or high secondary schools. For example, in upper school grades, the creation of similar bookmarks can be accompanied by the reading of some related books such as:

- Good Night Stories for Rebel Girls, by Elena Favilli, Penguin, 2018 (Italian Version: Storie della buona notte per bambine ribelli, Elena Favilli *et al.*, Mondadori, 2017).
- Ragazze con i numeri. Storie, passioni e sogni di 15 scienziate, Vichi De Marchi e Roberta Fulci, Editoriale Scienza, 2018.

Students can be invited to explore, write and illustrate in their own way the stories of many women, not necessarily famous ones, that can be interesting and stimulating for them.

Figure 62 to 65 - Photos taken from the official Facebook page of IC Foscolo Oberdan of Naples https://www.facebook.com/ic.foscolooberdan




Le Chiavi
Del Cuore
stop alla violenza contro le donne

SUMMARISED INFORMATION	
School Involvement	▪ In school.
Time of the activities	▪ Regular class hours. ▪ Extracurricular hours.
Context of the activities	▪ School. ▪ Community context.
Activities format	▪ In-person.
Type of equality approach	▪ Mainstreaming (girls and boys, whole school, and teachers).
Actions to impact on families and parents	▪ Awareness-raising to break stereotypes. ▪ Indirect information through children.
Disciplines or courses enrolled/integration	▪ Integrative approach (e.g., gender across discipline tasks and integrated as part of the subject). ▪ Cross-discipline approach (e.g., inclusion of a gender module for several courses).
Pedagogical Materials and Resources used	▪ Didactic worksheets and materials. ▪ Insights and research. ▪ Educational videos.
School Practices & Pedagogical Practices	▪ Implement innovative beyond the classroom pedagogical practices to promote a gender perspective in STEM teaching like exhibitions of women's contributions in STEM. ▪ Giving visibility to women's roles in STEM: examples of scientific and technological discoveries made by women and to STEM examples of women protagonists and voices. ▪ Encouraging students to work in mixed-gender groups (creating learning environments that foster gender collaboration). ▪ Giving equal voice and opportunity to speak to boys and girls. ▪ Putting students at the center (expectations, capabilities, needs, obstacles). ▪ Teaching in an interdisciplinary way, through articulation with non-STEM disciplines (exploring the intersections of design, arts, science, and mathematics, engineering). ▪ Developing classroom activities and materials targeted to student's and student's parents to deconstruct stereotypes about STEM professions, STEM professionals and gender stereotypes. ▪ Integration of community, local and/or national projects.

PRACTICE 10 – STEMDAYS - IL CAMP DELLE RAGAZZE ("STEMDAYS-THE GIRLS' CAMP")

Description: A project for mobilising and educating girls (aged 15 to 18) to pursue studies in STEM disciplines. The project is developed by Fondazione Human+ and organised as a 9-day summer camp: a large 7-stage lab workshop, during which the participants work in groups on specific project work. StemDays is proposed as an experiential training course that aims at fostering empowerment and self-awareness as women, strengthening technological preparation through applied workshops, bringing young women closer to the work experience in a practical way, and developing a conscious orientation in their future choices.

Responsible Entity: Fondazione Human+, with the support by Intesa Sanpaolo through the Formula Programme in cooperation with the CESVI Foundation.

Goals: Gender Stereotypes Awareness; Students Awareness; Enhance girls' interest in STEM; Develop new visions of STEM professionals; Give visibility to important women in STEM.

Target Audience: Female students.

Edition: 4th Edition.

Website: https://www.stemdays.it/

Instagram: https://www.instagram.com/stemdays_torino/?hl=it

Facebook: https://www.facebook.com/StemDaysTorino

"StemDays-il camp delle ragazze" ("StemDays-the girls' camp") is a project for mobilising and educating girls (aged 15 to 18) to pursue studies in STEM disciplines.

The project is developed by Fondazione Human+ and supported by Intesa Sanpaolo, through the Formula Programme in cooperation with the CESVI Foundation.

The project first began in 2020, being currently on its fourth edition. It is organised as a 9-day summer camp: a large 7-stage lab workshop, during which the participants work in groups on specific project work. It is free, but attendance is mandatory (for a total of 65 hours).

StemDays is proposed as an experiential training course that aims at fostering empowerment and self-awareness as women, strengthening technological preparation through applied workshops, bringing young women closer to the work experience in a practical way, and developing a conscious orientation in their future choices.

Every day of the camp participants carry out practical activities, working in groups, supported by experts in computer science, engineering, technology/STEM, psychology, and coaching.

Activities promoted

The StemDays camp is organised in summer (around mid-June) and lasts 9 days, totalling 65 hours.

The training course is divided into 7 didactic steps, for a total of 9 full-time days. Participants go through a progressive learning path, which can be traced back to three main moments:

1. Gender Bias and Team Building.
2. Project Work and Speech Design.
3. Project Presentation and Designing the Future.

In the workshops, participants learn by doing, trying and failing first-hand and working in groups of 8-10 female students, using various digital tools and programmes, such as the Python programme, the 3D printer, the Arduino platform.

The centrepiece of the campus is the project work, in which the participants have the opportunity to practice programming languages, artificial intelligence, sensor technology and robotics.

The STEM disciplines are not the subject of theoretical study, rather being developed in the objects and artifacts performed: group projects are aimed at the production of a functioning technological output that is then presented to the public.

More specifically, there are 4 project works:

- *Webby*, to design a website for innovatively analysing music, programming in Python.
- *Miss Robot*, to build a robotic arm with 3D printing and put it into action.
- *AstroGame*, to create and explore virtual worlds to make a real video game.
- *Doctor Green*, to build an automated mini-greenhouse with an Arduino board and sensors to monitor plant growth.

Impact

Throughout the years, the "StemDays-il camp delle ragazze" ("StemDays-the girls' camp") has collected many positive testimonies from young participants and teachers: they all expressed enthusiasm for the concrete activities carried out and the results developed, for the stimulating environment and the possibility the camp offers to work concretely in groups on STEM.

The project is open to all schools in the Turin area, comprising a high variety of study paths (technical institutes, high schools, and vocational schools), and offers a valuable opportunity to girls who wish to get involved, with a genuine motivation to participate in this experience, without entry barriers.

About 40 girls are directly involved each year, for a total of almost 120 girls so far.

Testimony of Use

StemDays is three things in one: a STEM/technology lab, an online community and an observatory on gender equality practices among young people.

The initiative, conceived by the Human+ Foundation, offers a free training course together with a team of empowerment and technology experts. The camp is also an opportunity to forge friendships to be cultivated over time within a valuable community.

There are many positive testimonies from some of the students who participated in the camp and from some of the teachers. All of them expressed enthusiasm for the concrete activities carried out and the results developed, for the stimulating environment and the possibility the camp offers to work concretely in groups on STEM.

Among the barriers that prevent girls from learning and participating in these STEM-related activities is the fact that the camp is limited to a specific number of girls (maximum 40) from the metropolitan city of Turin.

Figure 66 to 68 - Photos taken from the official Facebook page of StemDays, https://www.facebook.com/StemDaysTorino

SUMMARISED INFORMATION	
School Involvement	▪ Out of school, with multiple schools.
Time of the activities	▪ In extracurricular hours.
Context of the activities	▪ Scientific context. ▪ Community context.
Activities format	▪ In-person.
Type of equality approach	▪ Specific action (only women involved).
Actions to impact on families and parents	▪ None.
Disciplines or courses enrolled/integration	▪ Integrative Approach (e.g. Gender across discipline tasks and integrated as part of the subject).
Pedagogical Materials and Resources used	▪ Team of experts in computer science, engineering, technology/ STEM, psychology, and coaching. ▪ Didactic worksheets. ▪ Various tools and programmes, such as the Python programme, the 3D printer, the Arduino platform.
School Practices & Pedagogical Practices	▪ Integration in community, local and/or national projects on gender gap in STEM. ▪ Implement innovative beyond the classroom pedagogical practices to promote a gender perspective in STEM teaching, such as STEM labs and mentoring programs and sessions with female STEM professionals, teachers, and students. ▪ Using project based, hands-on and problem-solving pedagogical methods. ▪ Putting students at the center (expectations, capabilities, needs, obstacles). ▪ Encouraging girls to participate in STEM projects/workshops.

2.3 Inspiring Belgian practices

- Girls Day, Boys Day (11)
- Filles-garçons : brisons les stéréotypes de genre à l'école (12)
- Physics Project Days programme (13)
- STEM4Her (14)

PRACTICE 11 - *GIRLS DAY, BOYS DAY*

Description: This project invites girls and boys to explore the world of work by presenting them with traditionally 'feminine' professions performed by men and 'masculine' professions performed by women, and to make their academic and professional choices based on their personal interests and skills.

Responsible Entity: Direction de l'Egalité des Chances du Ministère de la Fédération Wallonie-Bruxelles

Goals: Gender stereotypes awareness; Students' awareness; Teachers' awareness; Parent's Awareness; Information, vocational orientation; Enhance girls and all students interest in STEM;

Develop new visions of STEM professionals.

Target Audience: Male and Female Students**.**

Edition: Girls Day, Boys Day was organised every year in Belgium between 2010 and 2019.

Website: www.gdbd.be

Girls Day, Boys Day is the Belgian French speaking version of an initiative which is present in several countries (USA, Germany, Luxembourg, France, etc.). *Girls Day, Boys Day* invites girls and boys to explore the world of work by presenting them with traditionally 'feminine' professions performed by men and 'masculine' professions performed by women, and to make their academic and professional choices based on their personal interests and skills.

Specifically, Girls Day, Boys Day aims to:

- Deconstruct gender stereotypes.
- Enable young people to discover different professions.
- Motivate young people in their career choices.
- Facilitate connections between the world of work and young people.

- Reflect on the concept of gender in academic paths.
- Combat preconceived ideas about certain professions.
- Foster debate among teenagers.

In Belgium, this programme is funded by the Fédération Wallonie Bruxelles and the Fonds Social Européen. It is organised in partnership with more than 30 organisations (public and private) to perform the animations in the schools.

Activities promoted

The Girls Day, Boys Day programme was initially proposed to 11–15-year-old students (lower secondary school). During the last two editions (since 2018), the programme was proposed to all the students from secondary school. It occurs during regular class hours. Firstly, a 2-hour animation takes place in the classroom. During this animation, a facilitator initiates a discussion about traditional male or female-dominated professions and the stereotypes associated with each. The animation also allows anyone to prepare questions to ask to the professionals that will be met in the framework of the programme. Then several meetings are organised with professionals, in the classroom or on the working site of the professional. These meetings occur during the whole school year.

All the sessions are supervised by a teacher. The professionals share their experiences, and students can ask questions about the nature of their jobs, the required skills, working conditions, etc.

An animation guide for this practice has been developed and is available here http://www.gdbd.be/index.php?eID=tx_nawsecuredl&u=0&g=0&hash=5c77f7379d0c6aa0ad615671bccfa15f228bf163&file=fileadmin/sites/bdgd/upload/bdgd_super_editor/bdgd_editor/documents/GDBD_Final_24.pdf.

Girls Day, Boys Day operated in Belgium every year from 2010 to 2019. In the first two editions of this programme, only the Province du Luxembourg and the Province du Brabant Wallon were involved. Since 2012, the whole Wallonia was involved and since 2013, Girls Day, Boys Days also operated in Brussels.

To guarantee a smooth collaboration with teachers and partners, one charter for teachers and one charter for partners was used since the 2013-2014 edition.

Figures 69 and 70 - Animation in school. [Source: EGALITEcfwb. Animations en classe. Youtube. 2013/10/22. Available on https://www.youtube.com/watch?v=eL2-2d6ouoc]

Figures 71 and 72 - Meetings with professionals. [Source: EGALITEcfwb. Visites aux témoins. Youtube. 2013/10/23. Available on https://www.youtube.com/watch?v=_hiKsqAtAwM]

Impact

In the 2018-19 edition, the project took place in 47 schools in Wallonia and in Brussels. During that same edition, in the Provinces of Liège[10], Namur[11], Luxembourg and in Brussels, 878 female students and 876 male students participated to this programme. Regarding the teachers, there were 88 women and 30 men.

At the end of the programme, teachers, students and parents were asked to fill in an assessment form. In the 2018-19 edition, 17% of the student assessed the animation. 93% of them found the presentation satisfactory to very good, and 89% found the facilitator "cool" to "very cool". 7% of the student assessed the meetings with the professionals. 92% of them found the meeting satisfactory to very good, and 79% of the students who participated in the meeting had never been in contact with someone practicing an unusual, atypical profession for their gender.

10 Data are incomplete for the Province of Liège.

11 Data are incomplete for the Province of Namur.

This programme allowed 37% of the students who participated in the assessment to realise that women and men could have different jobs from what they usually imagined, to become aware of this reality, and to reconsider their position. For 27% of the students, this project allowed them to question without necessarily changing their opinion. 25% of the students found the project amusing but nothing more.

However, 77% of the students still expressed the possibility of one day pursuing an uncommon profession for their gender.

In the 2018-2019 edition, the assessment form has been filled in by 4 parents (all females). These parents expressed that it is very important to renew this programme as it succeeded in changing their children's perceptions regarding their future orientations and allowed them to initiate a discussion with their children about gender stereotypes and biases in academic and professional paths.

11,7% of the teachers filled the assessment form in. The interviewed teachers found the project to be well-organised (100%) and suited to the target audience (100%). They observed that the students were interested and enthusiastic about the project (100%) and believe that the experience should be renewed (100%). Moreover, many of them stated that they will promote the project among their peers (88%).

Testimony of Use

Despite the overall positive feedback about this programme, several difficulties were encountered. For instance, it was difficult to find and keep professional witnesses and partners. The programme sometimes suffered from the lack of coordination and motivation among the teaching staff as well as cancellation by schools. Some classrooms encountered difficulties with the transports.

Some improvement suggestions were proposed by the partners:

- Seek greater teacher involvement during presentations and meetings.
- Make a connection with the citizenship class or another subject.
- Introduce the witnesses at the end of the animation and never before.
- Target 2nd year of secondary school classes.
- Start from students' evaluations and adapt certain aspects for the classroom presentation.
- Change the animations each time.
- Deepen the debate on gender equality with students.
- Prepare the project more thoroughly, have meetings with teachers, and ensure that students are well prepared for the animation.
- Organise meetings with witnesses in a different way.
- Highlight the project to young people and involve teachers and the school administration in the project.

SUMMARISED INFORMATION	
School involvement	▪ In and out of school.
Time of the activities	▪ During regular class hours.
Context of the activities	▪ School. ▪ Scientific context. ▪ Company context.
Activities format	▪ In-person.
Type of equality approach	▪ Mainstreaming (girls and boys, whole school, and teachers).
Actions to impact on families and parents	▪ Awareness-raising to break stereotypes.
Disciplines or courses enrolled/integration	▪ Cross-discipline approach (e.g., inclusion of a gender module for several courses).
Pedagogical Materials and Resources used	▪ Animation Guide. ▪ Video. ▪ Visits to schools.
School Practices & Pedagogical Practices	▪ Developing classroom activities to deconstruct stereotypes about STEM professions, STEM professionals and gender stereotypes. ▪ Developing activities and materials targeted to students' parents to deconstruct stereotypes about STEM professions, STEM professionals and gender stereotypes ▪ Integrating technology and innovative educational tools to motivate students. ▪ Giving equal voice and opportunity to speak to boys and girls. ▪ Visibilising woman in STEM fields. ▪ Encouraging students to work in mixed-gender groups (creating learning environments that foster gender collaboration).

PRACTICE 12 - FILLES-GARÇONS: BRISONS LES STÉRÉOTYPES DE GENRE À L'ÉCOLE

Description: A training proposed to any people involved in kids' education (childcare professionals, teachers, educators, vocational guidance counsellors, directors, psycho-medical school teams, youth, and community center workers, etc.). The Ceméa training team encourage the participation of a mix of people working with kids/teenagers in the same training session. They think that it is important to share different points of view related to their field of work (teaching, educating, advising, *etc.*).

Responsible Entity: Ceméa (Centres d'Entraînement aux Méthodes d'Éducation Active) in Belgium.

Goals: Teachers training in gender and STEM; Gender stereotypes awareness; Teacher's awareness; Integrate gender sensitive materials in curricula; Integrate gender sensitive approaches in classes and in educational books.

Target Audience: School directors; Teachers from all disciplines; Vocational guidance counsellors; Companies and institutions in the community.

Edition: The training is proposed several times each year since 2013.

Website: https://www.cemea.be/Brisons-les-stereotypes-de-genre-a-l-ecole

The training "Filles-garçons: brisons les stéréotypes de genre à l'école" was developed by Ceméa (Centres d'Entraînement aux Méthodes d'Éducation Active) in Belgium. Gender education has been a flagship issue for Ceméa since the 1990s. Therefore, the Ceméa has developed a strong expertise about gender equality and how to train people on these issues.

This training is proposed to any people involved in kids' education (childcare professionals, teachers, educators, vocational guidance counsellors, directors, psycho-medical school teams, youth and community centre workers, etc.). The Ceméa training team encourage the participation of a mix of people working with kids/teenagers in the same training session. They think that it is important to share different points of view related to their field of work (teaching, educating, advising, etc.). The training invites participants to:

- Think about the implicit or explicit messages sent to children about social and gender roles.
- Question the influence of school in the transmission of social and gender identity.
- Consider building and initiating reflection and action within one's educational practices.

"Filles-garçons: brisons les stéréotypes de genre à l'école" is organised in partnership with the IFPC (Institut Interréseaux de la Formation Professionnelle Continue), the CECP (Conseil de l'Enseignement des Communs et des Provinces), the CEPEONS (Conseil des Pouvoirs Organisateurs de l'Enseignement Officiel Neutre Subventionné), the FWB (Fédération Wallonie Bruxelles) and the ISPB (Institut Supérieur de Pédagogie de la Région de Bruxelles-Capitale).

This training was initiated in 2013 and has been proposed several times a year since its creation. It has been continuously improved, considering societal evolution and changes in awareness of the participants over time.

The training is accessible through different ways. People can attend the programme thanks to training agencies. In that case, the trainings are essentially funded by the Fédération Wallonie Bruxelles. The Ceméa organises itself training sessions twice a year where participants must pay a part of their training themselves (the remaining cost is granted thanks to subsidies). Schools can also ask the Ceméa to provide the training to their staff. In that configuration, schools fund the training themselves.

Activities promoted

Training sessions are different from each other, as the Ceméa team adapts the content of the training to the participants background regarding gender issues. Participants are active during the training. The experience of the participants is always the starting point of the training.

Participants work together to uncover gender stereotypes and deconstruct them to analyse and change their practical experiences. Through various concrete activities (role-playing, document analysis, etc.), reflections, exchanges, and an analysis of experiences, participants collectively think about the means that will enable children to make their own choices.

The training is often provided over 2 days (sometimes over 4 days) as follows:

- 1st day - participants are invited to discuss about questions such as: What is gender? What do you know about gender issues? Everybody has gender stereotypes, what are yours? Tools such as the "Perso-genre" (see below) are sometimes used.
- 2nd day - Starting from the discussions of the 1st day, participants are invited to think about changes they can bring in their practice (e.g.: classroom arrangement, tasks assignation, etc.). A situation analysis by level is carried out (e.g., What can you do at your level? With your class? With your colleagues? With the school direction?).

Aside of the training "Filles-garçons: brisons les stéréotypes de genre à l'école", Ceméa has developed several tools that tackle gender issues and that are available for free:

- **Perso-genre tool**
  https://www.cemea.be/Le-PERSO-GENRE#:~:text=Un%20outil%20pour%20clarifier%20certains,en%20Éducation%20permanente%20des%20CEMÉA
- **Guide de survie en milieu sexiste**
  https://www.cemea.be/Guide-de-survie-en-milieu-sexiste https://www.cemea.be/Guide-de-survie-en-milieu-sexiste-4812
- **Mix-outils**
  https://www.cemea.be/Mix-Outils-edition-2024

Trainings like "Filles-garçons: brisons les stéréotypes de genre à l'école" are also proposed to audiences other than schools, such as the public transport company or the regional school of public administration of the Brussels-Capital region – ERAP. With these audiences, there are more difficulties associated to homophobia and sexism. The trainers therefore draw the attention of the participants to the legal framework (sexism and homophobia are forbidden and punishable by law) and explain them that as public workers they must ensure the law is respected, regardless of their personal opinions on these issues.

Impact

In most schools the training is given over 2 days (4 days are too long). At the beginning, the training team thought that the training brought too little results and it was discouraging. But, in the end, they noticed that even 2 days training triggered little changes in the practices (e.g., teachers stopped using gendered nickname for kids, they stopped writing girls' names in pink and boys names in blue, etc.), which is already something good.

The training has been given for 10 years. At the beginning (in 2013), the participants did not realise that there were issues related to gender. Now, 10 years later, participants are more aware about these issues.

Testimony of Use

The training team pay attention to prevent participants from demoralisation ("everything I do is bad and I can't do anything") but draw their attention on what they can change.

In Belgium, the teacher's initial formation does not include psychology courses. Therefore, teachers are often lost when they have to face psychology issues, especially with teenagers. According to Ceméa, teachers lack an in-depth knowledge of the children's development and psychology from 0 to 18 years old as well as an in-depth knowledge of themselves (their limits, how they feel about gender issues, etc.). This lack of knowledge about these important societal issues can make teachers feel insecure, especially because teenagers are often better informed than teachers about such issues. "Brisons les stéréotypes de genre à l'école" is therefore particularly useful for teachers.

The training is provided according to active pedagogy principles. During the training, participants are active, and they are invited to think together about the solutions they can implement. However, teachers are often not used to think collectively and to be creative.

The training focuses on the school staff. Teachers are not encouraged to include the parents in the practices they implement at school. Partnership with the parents is often difficult as they usually do what they want at home. It is better to ask to people having the right formation (e.g.: psychology team) to tackle issues related to the parents. Teachers are rather encouraged to act during the school hours when they are with the kids/teenagers.

SUMMARISED INFORMATION	
School involvement	▪ In and out of school.
Time of the activities	▪ During regular class hours. ▪ In extracurricular hours.
Context of the activities	▪ School. ▪ Company context. ▪ Community context.
Activities format	▪ In-person.
Type of equality approach	▪ Mainstreaming (girls and boys, whole school, and teachers).
Actions to impact on families and parents	▪ None.
Disciplines or courses enrolled/integration	▪ The training is proposed to all the members of the school staff, from all disciplines.
Pedagogical Materials used	▪ Perso-genre tool developed by the Ceméa (https://www.cemea.be/Le-PERSO-GENRE#:~:text=Un%20outil%20pour%20clarifier%20certains,en%20Éducation%20permanente%20des%20CEMÉA.) ▪ Guide de survie en milieu sexiste (tome 1 https://www.cemea.be/Guide-de-survie-en-milieu-sexiste et 2 https://www.cemea.be/Guide-de-survie-en-milieu-sexiste-4812) ▪ Mix-outils (https://www.cemea.be/Mix-Outils-edition-2024)
School Practices & Pedagogical Practices	▪ Inclusion of a gender equality perspective in training requirements for teaching, educational and guidance staff; vocational guidance counsellors' activities; programs/curricula; educational books.

PRACTICE 13 - PHYSICS PROJECT DAYS PROGRAMME

Description: This programme is a 4-day immersive workshop dedicated to Physics for secondary school female students.

Responsible: Université Catholique de Louvain (UCLouvain), Belgium

Goals: Gender Stereotypes Awareness; Students' awareness; Parents awareness; Teacher's awareness; Enhance girls' interest in STEM; Develop new visions of STEM professionals.

Target Audience: Female students from STEM courses; Parents; STEM teachers.

Website: https://uclouvain.be/fr/facultes/sc/physics-project-days.html

The Physics Project Days programme is an immersive workshop dedicated to physics, organised by the School of Physics of the Université Catholique de Louvain (UCLouvain), in Belgium. For four days, 50 secondary school female students have the opportunity to grasp this subject, earn confidence, work in groups, and create a support network, while also gaining insight into the daily lives of physicists at UCLouvain. Participation is completely free, and accommodation and meals are provided by the UCLouvain School of Physics. This programme is currently completely funded by different entities of the UCLouvain.

The Physics Project Days are aimed at high school young women interested in scientific studies, particularly in physics, and who are eager to delve into an experimental or theoretical project while meeting people with similar interests. Students have the opportunity to explore beyond the confines of school science courses and carry out their own projects using the equipment of the university research groups.

The concept originates from Germany. It was developed to combat gender biases in enrolment in scientific fields of study. Each year, more than 100 female students participate in similar programmes in Germany, at the universities of Hamburg and Kiel.

Activities promoted

This programme takes place at the UCLouvain, at the beginning of September.

The students work in groups on several projects related to different fields of Physics (e.g., Particle Physics, Cosmology, Molecular Physics, Climate System Physics, etc.). The full description of the proposed projects is available in French.

Each project is independent. Some are performed in the lab, while other are done on computers. Some reuse didactic material (CERN CMS master classes) while original material was developed for others. In the 2023 edition, more than 20 researchers participated as tutors, in addition to the 5-people organising committee.

The colloquium on the last day consists of a ceremony, drink and poster session where participants present

the results of their work accomplished during the 4-day workshop to their family, friends and schoolteachers. Showing parents what their daughters are capable of is one of the most important aspects of the project.

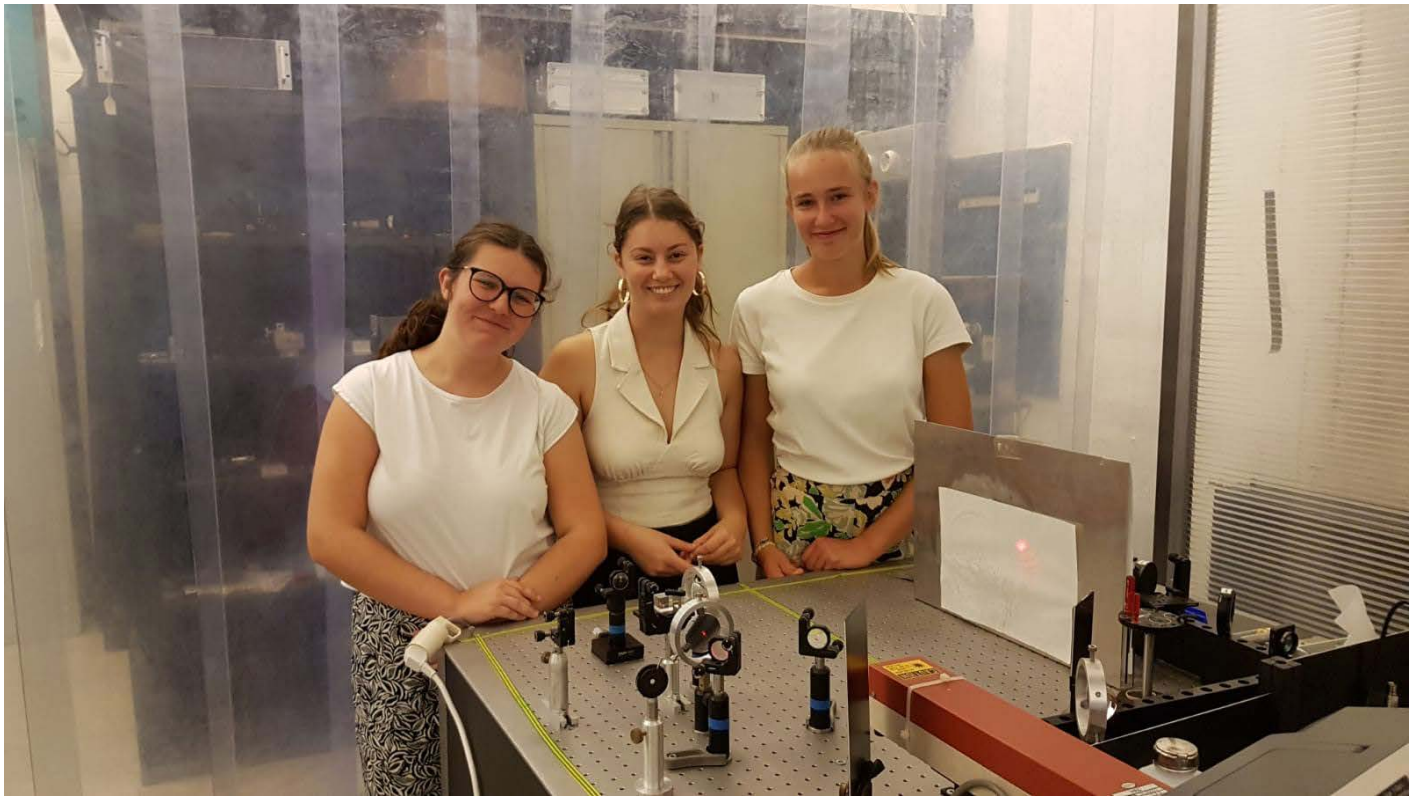
Impact

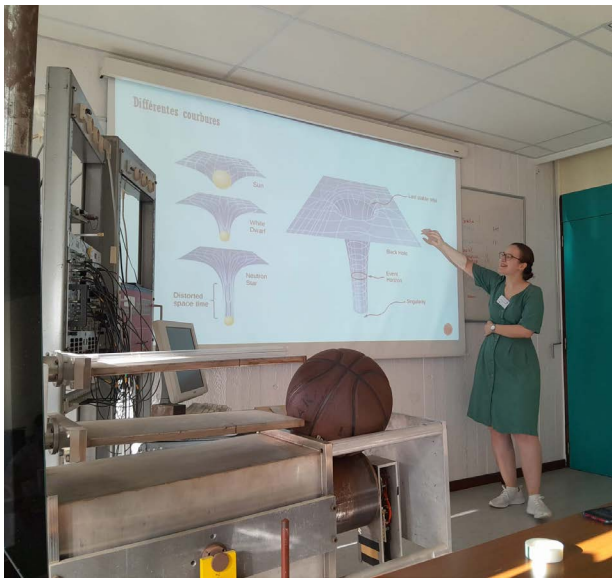
At Université Catholique de Louvain, 50 students took part to the programme in the 2023 edition. In addition, approximately 100 invited people participated in the colloquium on the last day (parents, teachers, friends).

The students enrolled in the programme filled out a survey before and after the event, to assess their opinion on Physics, university, and inclusion topics. They will be surveyed again 3 years later to measure the effect in terms of study choices.

The German editions show that 2/3 of participants study in STEM afterwards. As a general rule, twice as many girls consider studying physics after the workshop compared to before (typically 25% before and 50% after the workshop).

Figures 73 to 76 - Physics Project Days, Université Catholique de Louvain, Belgium – 6-9 September 2023 [source: pictures provided by the Physics Project Days organisers]





Testimony of Use

Finding enough money is a challenge (the cost of the programme is approximately 350€/student). According to the organisers, some people expectedly have a hard time seeing the benefit of such initiatives. However, the Physics Project Days experience in 2023 at Université Catholique de Louvain was overall very positive:

- The support by local academics was mostly enthusiastic.
- The support by fellow researchers was tremendous. Even people not participating in the projects helped with logistics.
- It allowed to discover a network of interested people in the university.
- The participants were all positive about the experience, and their concerns with equity increased a lot.

SUMMARISED INFORMATION	
School involvement	▪ Out of school with multiple schools.
Time of the activities	▪ During regular class hours.
Context of the activities	▪ Scientific context.
Activities format	▪ In-person.
Type of equality approach	▪ Specific action (only women involved).
Actions to impact on families and parents	▪ Awareness-raising to break stereotypes. ▪ Participation in initiatives.
Disciplines or courses enrolled/integration	▪ Physics.
Pedagogical Materials and Resources used	▪ Team of volunteers. ▪ Didactic material developed for the projects. ▪ Scientific devices of UCLouvain.
School Practices & Pedagogical Practices	▪ Encouraging girls to participate in STEM projects/workshops. ▪ Using project based, hands-on and problem-solving pedagogical methods. ▪ Introducing specific positive reinforcements for girls, like mentorship and peer support to girls. ▪ Developing classroom activities to deconstruct stereotypes about STEM professions, STEM professionals and gender stereotypes. ▪ Integrating technology and innovative educational tools to motivate students. ▪ Visibilising woman in STEM fields. ▪ Partnership with feminist academics, networks, and NGOs. ▪ Implementing innovative beyond the classroom pedagogical practices to promote a gender perspective in STEM teaching, such as mentoring and role modelling programs and sessions with female stem professionals, teachers, and students.

PRACTICE 14 – STEM4HER

Description: A mentoring programme that aims to support young women in their choice and success in STEM fields of study.

Responsible Entity: B12 Consulting

Goals: Gender stereotypes awareness; Students' awareness; Teachers' awareness; Develop new visions of STEM professionals; Enhance girls' interest in STEM; Give visibility to women in STEM.

Target Audience: Female students from STEM courses.

Edition: Only happened once.

Website: https://stem4her.be

Instagram: https://www.instagram.com/stem4her.be/?hl=fr

STEM4Her is a mentoring programme for young women in their last year in secondary school and in their first year in higher education. This programme was proposed by B12 Consulting, a private company specialised in Artificial Intelligence, with the financial support from the Service Public Fédéral Economie through the project call "Women in Digital".

During their last year in secondary school, girls are accompanied in their choice of orientation. Then, during their first year in higher education, mentorship and workshops about work methodologies are proposed to them.

Young women participating in the programme are selected and their participation is free of charge for them. The programme also offers a computer to each enrolled girl.

Activities promoted

All the schools of the Fédération Wallonie Bruxelles have been informed about this programme. 9 schools invited the responsible organisation (B12 Consulting) for a presentation of the programme to their female students. Other schools simply spread the information among their students.

The programme starts with a kick-off event. Then, throughout the year, participants take part in a hackathon and 5 collective activities - including workshops about working/study methodologies, immersion in companies, conferences, and team building. Individual mentoring sessions - were organised on demand.

Each female student had a buddy and a mentor at B12 Consulting. Furthermore, a network of active women in STEM in various sectors, including the academic sector, has been developed. These professional women

have been active as role models in the first two organised events of the STEM4Her programme (kick-off party and hackathon).

Figures 77 to 80- STEM4Her – edition 2023 [source: https://stem4her.be/#presse]

Impact

About 70 students took part to the kick-off party and to the hackathon event. Among these participants, 13 students were selected to enrol to the 1-year programme. 2 students out of the 13 gave up before the end of the programme.

STEM4Her has been assessed thanks to a questionnaire survey (quantitative assessment) and individual meetings (qualitative assessment) at the end of the programme.

The programme achieved several important objectives, notably by bringing together several dozen female students interested in STEM during the first two major events. It also contributed to building a new image of STEM for young women, sparking their interest in these fields of study and careers. By addressing schools on the issue of gender in the STEM area and presenting inspiring female role models, the programme inspired students and fostered meaningful exchanges to stimulate their curiosity and enthusiasm. It raised awareness of STEM study opportunities, established connections between selected students, and prevented students to give up by offering moral support and reinforcing their self-confidence. Additionally, the programme highlighted the diversity of professional opportunities in STEM fields and developed an extensive support network including tutors, mentors, organising team members, and industry professionals. Eventually, it enhanced the academic experience by identifying participants' specific needs and providing targeted support, such as custom-made company sessions and laptops. Focusing on the figures, out of the 11 selected participants, 8 have successfully passed their first examinations session (in full or with 1 failure). Furthermore, nearly 75% of participants say that STEM4Her has helped them achieve their first semester goals in higher education.

Testimony of Use

This first edition brought several key learnings. Firstly, positive feedback and clear enthusiasm were observed from the beginning. Out of the 13 selected girls, 11 completed the programme.

However, the limited availability of participants, due to busy schedules during the summer break and even more so after the academic semester began, constituted challenges, requiring adjustments to the schedule. Collective initiatives were well received during the events, demonstrating the effectiveness of collaborative approaches. Qualitative interviews revealed that, for many of the participants, these events provided significant moral support to counterbalance the stress of the first semester, thus contributing to their academic success.

However, personalised technical support encountered a more moderate enthusiasm, highlighting the importance of evaluating and adjusting tutoring methods. For the selected candidates, the added value of the programme lay less in technical instruction, which they already got from teachers or classmates, but rather in other aspects such as the moral support and supportive community provided by the programme.

In its first edition, the STEM4Her program did not include any action for the families and parents of the students. In future editions, organisers would like to include such actions to the programme.

SUMMARISED INFORMATION	
School involvement	▪ Out of school with multiple schools.
Time of the activities	▪ In extracurricular hours.
Context of the activities	▪ School. ▪ Scientific context. ▪ Company context.
Activities format	▪ In-person.
Type of equality approach	▪ Specific action (only women involved).
Actions to impact on families and parents	▪ None.
Disciplines or courses enrolled/integration	▪ Other.
Pedagogical Materials and Resources used	▪ Team of volunteers. ▪ Mentors. ▪ Network of active women in STEM (including academic sector).
School Practices & Pedagogical Practices	▪ Partnership with feminist academics, networks, and NGOs. ▪ Implement innovative beyond the classroom pedagogical practices to promote a gender perspective in STEM teaching, such as mentoring and role modelling programs and sessions with female STEM professionals, teachers, and students. ▪ Giving visibility to women's roles in STEM examples of women protagonists and voices. ▪ Introducing specific positive reinforcements for girls, like mentorship and peer support to girls. ▪ Encouraging girls to participate in STEM projects/workshops.

2.4. Inspiring Romanian practices

- GE-STEAM: she chooses STEM for the future (15)
- WiSTEM 2D (16)
- Female Legends of Science (17)
- "IT is for me" (18)

PRACTICE 15 - GE-STEAM: SHE CHOOSES STEM FOR THE FUTURE

Description: The mission is to encourage young women to choose studies in science, technology, engineering, and mathematics to reduce the gender gap in tomorrow's world.

Responsible Entity in Romania: University of Pitesti Romania.

Responsible Entity Internationally: Primăria din Narni (Italy- Principal Coordinator), Istitutul Gandhi in Narni (Italy), EPRALIMA - Escola Profissional do Alto Lima in Arcos de Valdevez (Portugal), IES La Zafra din Motril (Spain), Simeon Radev Institute din Pernik (Bulgaria), UCAM - Fundacion Universitaria San Antonio in Murcia (Spain), Asociația Bulgaria Training in Sofia (Bulgaria) The Environment Department of CRN in Roma, (Italy), The European Platform of Women Scientists in Bruxelles (Belgium).

Goals: Teachers training in gender and STEM; Gender stereotypes awareness; Students awareness; Parents awareness; Teacher's awareness; Information, vocational orientation; Enhance girls' interest in STEM; Integrate gender sensitive approaches in classes; Give visibility to women in STEM.

Edition: Erasmus+ project - 2 years.

Website: https://www.stemforthefuture.eu

Facebook: https://www.facebook.com/stemforthefuture

She Chooses STEM for the Future is an Erasmus Plus project coordinated by the Municipality of Narni, UMBRIA, that aims to promote and disseminate gender equality and the inclusion of women in science, to reduce the gender gap in tomorrow's world.

The mission is to encourage young women to choose studies in science, technology, engineering, and mathematics to reduce the gender gap in STEM.

The project She Chooses STEM for the Future stems from the need to develop an inclusive approach, to increase the knowledge and awareness of female students to make them free to make unconditional choices.

The objectives of the project are: developing common and transferable STEM strategies, promoting and disseminating gender equality, including women in science through interactive dialogue, identifying and combating social bias through dialogue and dissemination, promoting an interdisciplinary STEAM approach that also intends to stimulate artistic creativity and personal expression.

The project, coordinated by the Municipality of Narni, includes the cooperation of high schools and universities from different European countries, such as IIS Gandhi (Italy), IES La Zafra (Spain), GPCHE "Simeon Radev" (Bulgaria) and UCAM University (Spain).

This team is complemented by the strategic and functional introduction of EPRALIMA, a higher education school from Portugal, the University of Pitesti from Romania, Bulgaria Training, a non-profit organisation working in the field of education, training and others.

Two associated partners are also members of the project: the European Platform of Women Scientists (EPWS), a network of women scientists and organisations for gender equality in scientific research; and the Air Pollution Institute of the CNR-IIA, which carries out research and provides high-level consultancy services on this topic.

Each partner contributes to the achievement of the objectives through meetings, workshops for teachers, development and production of methodological teaching models, creation of digital toolkits for students, production of digital storytelling videos, and dissemination and sharing of models and stories.

The partners participating in the project are active in the fields of education, vocational training, and scientific and technological research.

The project is expected to have a strong impact in the field of education, especially in the final years of high school: thanks to the planned activities, in the long term a change is expected in higher education, which will be more oriented towards STEM subjects.

Activities promoted

LAB work group

First Lab Work Group for definition of the experimental methodological-didactical model for orientation to STEM disciplines (Methodological Guidelines "She Chooses STEM"). The leader of the Work Group is Bulgaria Training. The work team consists of 11 persons: 1 technician from Bulgaria Training, 2 trainers/researchers, 2 expert participants in Education Sciences and Psychology for the Partner University of Pitesti, 1 participant for each of the other Partners.

Second Lab Work Group for development of digital and multimedia tools to support the implementation of the new inclusive STEM orientation pathway (Methodological Guidelines "She Chooses STEM"). The leader of the Work Group is University of Pitesti. The work team consists of 10 persons: 2 teachers, 1 technician from the University of Pitestii, 1 participant for the other Partners.

Third Lab Work Group for development of a Multimedia Digital Story-Telling Tool for STEM orientation. The work team consists of 10 persons: 2 lecturers, 1 technician from UCAM University and 1 participant per each partner.

Meetings and conferences

Training

The first Training Workshop establishes the strategic collaboration lines and methodological co-programming processes. Elements of experimental co-assessment and story-telling as a teaching tool for orientation and transferability of results.

Pilot test

4 Pilot Tests for Career Orientation Programme "Open Space for STEM". The project runs for two years (2022-2024) during which the following products will be produced: a methodology on teaching STEM subjects in middle and high schools, a report on the analysis of the current situation on teaching STEM subjects, open educational resources (oer) _ Guidance ethics, two digital tools for students, namely: a digital teaching toolkit and a digital book on STEM subjects.

Impact

- 450 students.
- 30 teachers.
- 50 families.
- 10 vocational counsellors.
- More than 20 entities who promote the project.

SUMMARISED INFORMATION	
School Involvement	▪ In school.
Time of the activities	▪ During regular class hours. ▪ In extracurricular hours.
Context of the activities	▪ School. ▪ Scientific Context.
Activities format	▪ Mixed (In-person/in-person with streaming, online).
Type of equality approach	▪ Specific Action (Only women involved).
Actions to impact on families and parents	▪ Direct information. ▪ Participation in initiatives.
Disciplines or courses enrolled/integration	▪ Integrative Approach (e.g. Gender across discipline tasks and integrated as part of the subject).
Pedagogical Materials and Resources used	▪ Educational platform. ▪ Didactic worksheets. ▪ Lab materials. ▪ PowerPoint presentations.
School Practices & Pedagogical Practices	▪ Inclusion of a gender equality perspective in programs/curricula; in training requirements for teaching, educational and guidance staff; in vocational guidance counsellors' activities. ▪ Giving visibility to women's roles in STEM examples of scientific and technological discoveries made by women; and to STEM examples of women protagonists and voices. ▪ Implement innovative beyond the classroom pedagogical practices to promote a gender perspective in STEM teaching, like mentoring and role modelling programs and sessions with female stem professionals, teachers, and students.

PRACTICE 16 - WISTEM2D

Description: In 2015, Johnson & Johnson launched WiSTEM2D (Women in Science, Technology, Engineering, Mathematics, Manufacturing, and Design), an educational initiative that includes various programmes. The initiative has been taken up by JA Europe in 5 European countries to bring it into schools. In Romania, starting with the 2018-2019 school year, the WiSTEM2D project is being run with the financial support and volunteer consultants from Johnson & Johnson.

Responsible Entity in Romania: Junior Achievement Romania.

Responsible Entity Internationally: Junior Achievement Europe.

Goals: Gender stereotypes awareness; Students awareness; Parents awareness; Teacher's awareness; Information, vocational orientation; Enhance girls and all students interest in STEM;

Develop new visions of STEM professionals; Integrate gender sensitive materials in curricula; Integrate gender sensitive approaches in classes and in educational books.

Target Audience: Female students from STEM courses; Parents; School Directors; STEM Teachers; Teachers from all disciplines; Companies and institutions in the community.

Edition: Since 2018 in Romania (6 editions).

Social media:

https://www.jaromania.org/programe-proiecte/orientare%20profesionala/wistem2d/

https://jar.ro/stem2d.

STEM2D is an acronym for science, technology, engineering, mathematics, manufacturing, and design.

The project is developed through a partnership between: JA Worldwide, that is one of the world's largest youth-serving NGOs, to prepare young people for employment and entrepreneurship; FHI 360, that is a non-profit human development organisation dedicated to improving lives in lasting ways by advancing integrated, locally driven solutions; the Smithsonian Science Education Centre who is transforming K-12 Education through Science™ in collaboration with communities across the globe; Girl Scouts of the USA; World Association of Girl Guides and Girl Scouts (WAGGGS).

The WiSTEM2D project includes 12 Hybrid Learning (blended learning) activities in the STEM2D fields and a career guidance activity. Through learning by doing activities, students will practice and develop skills such as:

- Teamwork.
- Problem Solving.
- Creative Thinking.

- Logical Thinking.
- Analysis and Synthesis Skills.
- Negotiation and Organisational Skills.

Working alongside volunteer business consultants give students the opportunity to explore different career opportunities so that they can more easily find their way into future jobs and careers.

Activities promoted

STEM2D at home:

STEM^{2}D skills can be learned in people´s kitchen, basement, or patio, through quick-and-easy activities called "Ignite" activities, typically taking 5 to 15 minutes to complete, using everyday materials. Each activity and video are available in Chinese, English, French, German, Indonesian, Italian, Portuguese, and Spanish. There's also a tip sheet for each activity, for adults to join in!

Classroom activities (12):

- Building with Wonderful Waste - students, grouped in teams, plan, and build different objects using waste materials.
- Green batteries - students discover how chemical energy is converted into electricity.
- Biomimicry in design and engineering - students discover how nature and living organisms can be a source of inspiration for solving human problems.
- What's the code? Students use the materials at their disposal to create and execute code that controls the movement of robots.
- Pressed strawberries - students experiment with how DNA is extracted from strawberries and learn about the role of genes and DNA in development.
- Research and development - students take on the role of biomedical researchers and conduct laboratory experiments to determine the effectiveness of pharmaceutical formulas.
- Create, test, produce - students discover the importance of hands-on activities in choosing future careers and learn about opportunities for people with STEM skills in manufacturing.
- Light Bending 101 - students study the path of light through different optical media.
- The Physics of Floating - students discover the physical principles that cause certain objects to float or sink.
- Innovation in Support of Patients - students learn about the discovery and creation of innovative medicines that can improve or save people's lives.
- Preventing and combating pollution - students discover how pollution affects the environment and propose solutions to prevent and combat it.
- Transform, create, find solutions, design! - Students discover that new technologies and innovations

emerge when engineers apply scientific and mathematical principles to design and develop products that can improve people's lives.

Meet women scientists:

Every year on February 11 (United Nations International Day of Women & Girls in Science).

Manufacturing Magic from STEM2D.

Navigating Nursing.

Impact

The project produced Videos, eBooks, pedagogical sheets, students books.

In Romania, the impact is:

- 2018-2019: 2178 students, 51 teachers, 30 schools.
- 2019-2020: 5500 students, 240 teachers, 160 schools.
- 2020-2021: 8800 students (4674 girls), 395 teachers, 288 schools.
- 2021-2022: 11370 students (6370 girls), 470 teachers, 370 schools.
- 2022-2023: 15730 students (8810 girls), 650 teachers, 450 schools.

SUMMARISED INFORMATION	
School Involvement	▪ In and out of school.
Time of the activities	▪ During regular class hours. ▪ In extracurricular hours.
Context of the activities	▪ School. ▪ Company Context. ▪ Community Context. ▪ Scientific Context.
Activities format	▪ Mixed (In-person/in-person with streaming, online).
Type of equality approach	▪ Mainstreaming (girls and boys, whole school, and teachers).
Actions to impact on families and parents	▪ Indirect information through children. ▪ Awareness-raising to break stereotypes. ▪ Participation in initiatives.
Disciplines or courses enrolled/integration	▪ Integrative approach (e.g. gender across discipline tasks and integrated as part of the subject).
Pedagogical Materials and Resources used	▪ Lab experiments. ▪ Didactic worksheets. ▪ eBooks. ▪ Student's book. ▪ Videos.
School Practices & Pedagogical Practices	▪ Implement innovative beyond the classroom pedagogical practices to promote a gender perspective in STEM teaching, like mentoring and role modelling programs and sessions with female stem professionals, teachers, and students; study visits to stem companies, technology centres and universities; and school community links to promote hands-on learning initiatives. ▪ Introducing specific positive reinforcements for girls, like mentorship and peer support to girls. ▪ Encouraging boys and girls to share their experiences in STEM learning (expectations and obstacles) in the classroom as a pedagogical strategy.

PRACTICE 17 – FEMALE LEGENDS OF SCIENCE

Description: The project is based on gender equality and non-discrimination between women and men in STEM subjects (Science, Technology, Engineering and Mathematics). It is also intended to enhance the innovative spirit and creativity.

Responsible Entity: BAHCESEHIR Foundation of the University of Istanbul (Turkey) and has the participation of EUPHORIA NET SRL (Italy), the CHALLEDU centre (Greece), the SUKRAN ULGEZEN MESLEKI institute (Turkey) and the CORPULUI house educational centre (Romania), in addition to AIJU.

Goals: Gender stereotypes awareness; Enhance girls and all students interest in STEM; Give visibility to women in STEM; Develop new visions of STEM professionals; Information, vocational orientation; Students awareness; Teacher's awareness; Teachers training in gender and STEM.

Target Audience: Female and Male students; STEM teachers; Vocational guidance counsellors; STEM science professionals, such as trainers, career advisors, science communicators, researchers, academics.

Edition: Erasmus Project 2019-2022.

Website: https://femalesproject.eu/#

The project Female Legends of Science is based on the values of gender equality and non-discrimination between women and men in the fields of science, technology, engineering, mathematics, and also intends to promote innovation and innovative entrepreneurship among its participants.

It aims to:

- Highlight the significant role of women in STEM.
- Combat stereotypes among students and teachers.
- Inspire young girls through education as role models to pursue careers in STEM.
- Improve the acquisition by all students (boys and girls) of key skills and competences for careers in STEM fields.
- Strengthen teachers' skills in addressing inclusion in STEM disciplines.
- Raise awareness of the importance and possibilities of role-model, play and girl-based education in STEM disciplines.

The project is targeted to:

- Young girls aged between 13 and 18 years old, by empowering them through game-based education with role models in STEM, and through the discovery of inspiring personalities and career planning, regardless of social stereotypes.
- Young men between the ages of 13 and 18, by giving them the ability to respect their classmates and, later on, their work colleagues, without stereotypes, as they learn about the importance of women's contributions to STEM.
- STEM teachers (in secondary education), by enhancing their skills and professional development through innovative educational methods that make the role of women in science visible in the classroom, to overcome their own stereotypes and encourage young girls to take up this field.
- STEM professionals such as trainers, career advisors, science communicators, researchers, academics.

Impact

It is anticipated that, in the long term, 300 professionals (teachers and STEM educator-communicators) and 1500 students with the above profile were empowered during the project.

Organisations of various kinds were also involved. These organisations were experienced and made up of a team of well-trained professionals from public bodies and educational authorities, researchers and university professors, NGOs and associations with extensive activity in the field of STEM gaming and digital learning tools.

- Over the course of the project, 3 outputs were produced:
- Output 1 was a methodological guide was devised for educating girls and women about the role-model education.
- Output 2 were role-model, game-based educational tools and game-based activities.
- Output 3 was an e-learning platform with Moocs and courses on role-models and game-based education.

SUMMARISED INFORMATION:	
School Involvement	▪ In-school.
Time of the activities	▪ During regular class hours.
Context of the activities	▪ School. ▪ Scientific context.
Activities format	▪ Mixed (In-person/in-person with streaming, online).
Type of equality approach	▪ Mainstreaming (girls and boys, whole school, and teachers).
Actions to impact on families and parents	▪ None.
Disciplines or courses enrolled/integration	▪ Integrative approach (e.g., gender across discipline tasks and integrated as part of the subject)
Pedagogical Materials used & Resources	▪ Didactic worksheets. ▪ eBooks. ▪ Educational games/activities.
School Practices & Pedagogical Practices	▪ Eliminating the use of gender stereotypes in documents and communication initiatives. ▪ Inclusion of a gender equality perspective in training requirements teaching, educational and guidance staff. ▪ Implement innovative beyond the classroom pedagogical practices to promote a gender perspective in stem teaching, like mentoring and role modelling programs and sessions with female stem professionals, teachers, and students. ▪ Giving visibility to women's roles in stem examples of scientific and technological discoveries made by women; in STEM examples of women protagonists and voices; in STEM examples of scientific and technological discoveries mostly benefitting women. ▪ Using project-based hands-on and problem solving pedagogical methods. ▪ Integrating technology and innovative educational tools to motivate students, like educational platforms. ▪ Encouraging girls to participate in STEM projects. ▪ Developing classroom activities to deconstruct stereotypes about STEM professionals, professions and gender stereotypes.

PRACTICE 18 – "IT IS FOR ME"

Description: The project aims to motivate children to opt for STEM studies, to reduce gender stereotypes in choosing the educational path, and to contribute to raising awareness of climate change through a series of workshops that combine science with information technology in order to create solutions to protect the environment.

Responsible Entity: VERTIK Association for the Future in partnership with Women in Tech Romania and with the support of Orange Foundation.

Goals: Enhance girls and all students interest in STEM; Gender stereotypes awareness; Information, vocational orientation; Student's awareness.

Target groups: Female and male students.

Edition: 1 edition (2023).

Website: https://www.womenintech.ro/post/it-is-for-me-educational-programe

The educational project "IT is for me" aims to motivate children to opt for STEM studies, aiming to also reduce gender stereotypes in choosing the educational path, and to contribute to raising awareness of climate change through a series of workshops that combine science with information technology in order to create solutions to protect the environment.

The project started in 5 schools in Romania in September 2023 and has had the help of over 25 volunteer mentors.

Activities promoted

Over the course of 4 months, students were introduced to the basic concepts of computer science, programming languages and the hardware and software components that make up electronic devices. Hands-on demonstrations with rain sensors and motion sensors helped students understand more about the Internet of Things (IoT) and the possibility of interacting with the physical world through technology.

MicroPython, a programming language specifically designed for microcontrollers, also played a central role in the programme. Students gained hands-on experience writing instructions for a Raspberry Pi Pico microcontroller, allowing them to control electronic devices and create interactive projects.

Over the course of the programme, the focus was also on problem-solving skills, teamwork skills and creative thinking.

Impact

125 students, of which 50% are girls, are expected to benefit from a very interactive and practical introduction to the world of IoT (Internet of Things) to discover the digital world.

Testimony of use

""IT is for me" is about balance, confidence, and dedication: balancing gender diversity in a predominantly male area, confidence that each of us individually and through communities can influence the future of the planet, and the dedication to take clear, coordinated actions for these values to come to life, to become concrete. I can't wait to be a volunteer myself, to tell stories about the project and the beautiful experiences we will have." (Ioana Grigore, Head of HR at Orange Services and program manager)

Figure 81 - Promotional poster for the project

SUMMARISED INFORMATION	
School Involvement	▪ In-school.
Time of the activities	▪ During regular class hours.
Context of the activities	▪ School.
Activities format	▪ In-person.
Type of equality approach	▪ Mainstreaming (girls and boys, whole school, and teachers)
Actions to impact on families and parents	▪ None.
Disciplines or courses enrolled/integration	▪ Representativeness in ICT/STEM.
Pedagogical Materials and Resources used	▪ Different programming software. ▪ Educational tools. ▪ Team of volunteers.
School Practices & Pedagogical Practices	▪ Integrated STEM education includes exploring real-world problems, putting students in the context of applied use of critical and self-critical thinking, and increasing students' motivation to learn. ▪ Using project-based hands-on and problem solving pedagogical methods. ▪ Integrating technology and innovative educational tools to motivate students, like educational platforms. ▪ Encouraging girls to participate in STEM projects.

2.5. Other inspiring practices:

- Hypatia Project (19)
- Girls Go Circular Project (20)

PRACTICE 19 - HYPATIA PROJECT

Description: The project engaged with 13-18-year-old girls both in and out of the school environment. To do this, Hypatia brought together science centres and museums, schools, research institutions and industry with gender experts and teenagers themselves. Toolkits were developed for each of them, ensuring that everyone can be empowered to organise and create gender inclusive activities, programmes, and events.

Responsible/Coordinating Entity: NEMO Science Centre (Netherlands).

Goals: Enhance girls' and all students interest in STEM; Information, vocational orientation; Gender stereotypes awareness; Students awareness; Parents Awareness; Teachers Awareness; Integrate gender sensitive approaches in STEM-related activities and communication; Teachers training in gender and STEM; Integrate gender sensitive approaches in classes and in educational books; Integrate gender sensitive materials in curricula; Give visibility to women in STEM.

Target Audience: Female Students; Secondary school teachers and head teachers; Researchers; Science communicators and policymakers; Industry partners.

Edition: 1 edition (3-year duration).

Website: https://www.ecsite.eu/activities-and-services/projects/hypatia

Funding: Horizon 2020

The Hypatia Project is a project that seeks to change the way schools, science museums, research institutions and industry engage adolescent girls in STEM across Europe. Beginning in 2015 and ending in 2018, this project sought mostly to interact with girls aged 13-18, both inside and outside the school environment, not only with the aim of exposing these young women to STEM-related careers, but also to contribute to a European society where science is communicated to young people in a gender-inclusive way so that they can fulfil their potential in these areas.

Main objectives:

- To foster partnerships among schools, museums and science centres and industries and offer gender inclusive STEM education to young people.
- To actively expose young people and especially girls to the variety of STEM related careers.
- To encourage young people to open up their horizons and expect everything from the field of STEM.

With these objectives in mind, Hypatia sought to bring together the aforementioned stakeholders with gender experts and adolescents themselves, in the hope of developing and disseminating a unique modular toolkit of activities and guidelines, like:

- Guidelines for schools, museums, and industries on gender inclusion.
- Ready to use activities for schools, museums and industries that incorporate gender inclusion (Toolkit).
- Dialogue among policy makers, industry, and school decision makers on the issue of gender inclusion (Hypatia Hubs).
- Pan European campaign for and with young people focusing on gender inclusion and career paths in STEM (Expect Everything Campaign and Youth Editorial Boards).

The Hypatia Project was coordinated by the NEMO Science Centre in the Netherlands, whose mission is to bring science and technology closer to the public in an interactive and accessible way: - in its museum; in schools, where Nemo offers a wide range of educational programmes for different levels and ages; at national events, such as the "Weekend of Science"; or even online, through activities aimed at children under the age of 14. NEMO museum receives around 650,000 visitors a year.

In addition to the NEMO Science Centre, the Hypatia project also involved 10 partners and 9 third parties, more specifically:

Partners:	Third Parties:
▪ NEMO Science Centre (The Netherlands). ▪ Fondazione Museo Nazionale Della Scienza E Della Tecnologia "Leonardo Da Vinci" (Italy). ▪ Bloomfield Science Museum Jerusalem (Israel). ▪ Association Européenne Des Expositions Scientifiques Techniques Et Industrielles (Belgium). ▪ Centre For Formidling Af Naturvidenskab Og Moderne Teknologi Fond (Denmark). ▪ Etablissement Public Du Palais De La Découverte Et De La Cite Des Sciences Et De L'industrie (France). ▪ Kobenhavns Universitet (Denmark). ▪ BureauQ (The Netherlands). ▪ PPG (The Netherlands). ▪ L'Oréal Sa (France).	▪ Centrum Nauki Experyment W Gdyni (Poland). ▪ Science Gallery Dublin (Ireland). ▪ Centar Za Promociju Nauke (Serbia). ▪ Fundacion Bancaria Caixa D'estalvis I Pensions De Barcelona La Caixa (Spain). ▪ Science Centre Netzwerk (Austria). ▪ AHHAA Science Centre Foundation (Estonia). ▪ Stiftelsen Teknikens Hus (Sweden). ▪ The Association For Science And Discovery Centres (United Kingdom). ▪ Kentro Diadosis Epistimon Kai Mouseio Technologias Idryma (Greece).

Together, these partners have set up 14 Hubs throughout Europe, with the mission of reaching out to diverse audiences and fulfilling the project's objectives of getting girls interested in STEM areas.

Finally, it's worth mentioning that this project received funding from the European Union's Horizon 2020 research and innovation programme under the "Promote gender equality in particular by supporting structural change in the organisation of research institutions and in the content and design of research activities" topic.

Resources and useful output produced

1. Hubs (14) across Europe, made up of panels of schools and other institutions including adolescents. Researchers worked to provide schools, museums, and industries not only with guidelines capable of improving gender inclusion in teaching, but also to introduce new concepts and approaches to gender in science education.

These efforts have resulted in a wide range of tools developed to help science organisations implement more gender-inclusive practices throughout its National Hubs.

2. Hypatia Toolkit: ready-to-use digital collection of innovative activities for teenagers. The collection contains workshops, speed dating, card games, discussion scenarios and theatre plays drawn from good practices across Europe. Each activity, called a module, focuses on gender-inclusive ways of communicating STEM in schools, science centres and museums, and industry and research institutions. Below you can find the list of modules that compose the Toolkit:

<table>
<tr><th>Schools:</th><th>Science Centres & Museums:</th></tr>
<tr><td>Find Gender Stereotypes in STEM Representations.
Gender Inclusiveness in your Science Teaching.
Inquire: Shape and Action.
Play Decide Game & Debate.
Science Ambassadors and Ambassadresses.
STEM Women Cooperative Card Game.
Test Yourself.
What's your Opinion?</td><td>Find gender stereotypes in STEM Representations.
Science Café or Café Scientifique.
STEM Women Cooperative Card Game.
Test Yourself.
Wearable Technology.
Your Role in Research: Inquiry into Chemical Reactions.</td></tr>
<tr><th colspan="2">Industry & Research Institutions:</th></tr>
<tr><td colspan="2">Gender optimising software programming.
Science Ambassadors and Ambassadresses.
Skill Game.
Speed Dating.
Your Role in Research: Inquiry into Chemical Reactions.</td></tr>
</table>

3. Hypatia Theoretical Framework that critically discusses the reasons why current science education does not attract the necessary diversity of young people to STEM study programmes. The framework gives rise to a set of criteria for analysing gender inclusion in existing STEM education activities, or for designing new gender-inclusive activities.

4. Hypatia Institutional Guidelines: concrete suggestions for building institutional capacity for gender inclusion, aimed at staff, educators and managers of schools, science centres and museums, industry and research institutions involved in STEM education, as well as decision-makers and stakeholders in STEM education at local, regional, national, or international level. More specifically, this Guideline offers beginning, intermediate and advanced suggestions for:

- Transforming gender inclusion capacity at the institutional level, such as:
  - Setting up a team to coordinate gender inclusion initiatives (Beginning).
  - Providing opportunities for staff professional development on gender inclusion (Intermediate).
  - Actively seeking out partnerships with members of local communities to bring new expertise and knowledge into institution (Advanced).
- Transforming gender inclusion capacity at the interactional level, like:
  - Reading and distributing literature about gender inclusion (Beginning).
  - Formulating gender inclusion guidelines and including them in all new projects and initiatives (Intermediate).
  - Leading innovative gender inclusion projects (Advanced).
- Transforming gender inclusion capacity at the individual level, including:
  - Providing staff members with gender inclusion resources (reports, web sites, journals, and activities) (Beginning).
  - Providing individuals with training opportunities about gender inclusion in science education (Intermediate).
  - Developing a professional development programme for individual staff members, connected to the vision and policy of the institution (Advanced).
- **Supporting the transformation of gender inclusion capacity from the 'outside'**, like:
  - Providing access to target audience (girls and boys) and gives them a voice (Beginning).
  - Supporting initiatives that address identified gender inclusion issues (Intermediate).
  - Contributing to holding institutions accountable for changing gender exclusion practices (Advanced).

5. A Good Practices on Gender Inclusion in Stem Communication Report which presents several gender-inclusive science education activities designed by European science centres, museums, research institutions, industrial institutions, and other science education institutions. The 49 collected science education activities were reported by institutions from 14 European countries, all Partners, or Third Parties in the project Hypatia.

Impact

One of the main impacts is the production of important and useful materials:

- 19 modules with ready-to-use activities designed to promote gender inclusion.
- Available in14 different languages in culturally adapted versions.
- Guidelines on facilitation and gender adapted to different contexts and expertise.

During the three years of Hypatia, both teenagers and adults actively engaged in the activities, debates, events, and seminars:

- More than 5500 teachers directly using the Hypatia Toolkit.
- Almost 500 000 students being engaged in school activities.
- More than 1200 head teachers and education decision makers participating in the Hypatia Seminars.
- More than 65 000 teenagers engaging in the toolkit activities in the after school activities involving museums and other informal learning organisations.
- Hypatia modules being implemented by or in industry and research contexts, ultimately involving more than 40 000 teenagers.

Furthermore, Hypatia advocated for a new approach towards gender in science education and argued for the importance of organisations first looking at their own stereotypes and acknowledging the fact that science is a gender issue.

Figures 82 and 83 - Photos of female students experiencing with STEM-related activities, during the project

Testimony of Use

The Hypatia Project seemed to be a good practice working and producing tools for STEM gender inclusive professionals and decision makers with responsibilities in the teaching, funding, communication, and dissemination of STEM. The activities also allowed girls and young women to interact more closely with STEM-related areas and, moreover, to communicate science to its potential target audiences in a more gender-inclusive way.

Below news items taken from the Ecsite website that testify not only to the importance of the National Hubs in making this project a reality, but also to the importance of involving adolescents in their communication activities:

"Austrian Youth Hub Takes the helm of the Expect Everything Campaign:

Expect Everything is Hypatia online campaign for and by teenagers. The campaign communicates directly with teenagers to spread the word on how great and varied STEM careers can be, how teenagers have an impact in science, how they can get involved, and other key messages.

Every month a group of teenagers from Hypatia's hubs, called Expect Everything Editorial boards, contribute to the campaign with blog and social media posts. The contents are diverse as their voices and express their perception on STEM and gender inclusiveness (...).

Since the campaign was launch in April 2017, teenagers from the Netherlands, Denmark, Italy, France, Israel, UK, Estonia, Ireland, and Serbia have contributed to Expect Everything (...)"

"Hypatia Inspires new Exhibit and Tech Lab:

(...) Hypatia's Hub in Denmark, Experimentarium, has been quite active and is now able to offer a new experience to its visitors. They have inaugurated a new Hypatia-inspired, gender-inclusive tech lab. The designers referred to Hypatia gender criteria and consulted teenage girls in order to understand how they could create a space that would simply be fun for teens and not only for boys.

Still in Copenhagen, the Tycho Brahe Planetarium has just unveiled their new exhibition called "Made in Space", about our origins from the depths of space. As partners in the Hypatia project, the people behind the exhibition wanted to make it as inclusive as possible.

The other Hypatia hubs have been quite active as well. The Museo Della Scienza in Milan hosted a lively nighttime remembrance event for mathematician Maria Gaetana Agnesi, a collaborative inquiry about gender balance in STEM and a Science Ambassador event. Our partners from Serbia have organised multiple Hypatia events featuring Hypatia toolkit activities. Universcience, in Paris, have also drawn from the Hypatia toolkit for the International Women's Day and organised a day for school classes to come and learn about STEM. And finally, our Estonian partners, AHHAA, have hosted a screening of the movie 'Hidden Figure' and will be organising a chemistry camp from the 26th to the 28th of February. The Expect Everything campaigning machine is running in full swing, with its 73.000 followers on Facebook."

SUMMARISED INFORMATION	
School Involvement	▪ In and out of school.
Context of the activities	▪ School. ▪ Scientific Context. ▪ Community Context. ▪ Communication of science activities. ▪ Company Context.
Activities format	▪ In person.
Type of equality approach	▪ Specific Action (only women involved).
Action to impact on families and parents	▪ Awareness-raising to break stereotypes.
Disciplines or courses enrolled/integration	▪ Integrative approach (e.g., gender across discipline tasks and integrated as part of the subject). ▪ Cross-discipline approach (e.g., inclusion of a gender module for several courses).
Pedagogical Materials Used	▪ Hypatia Toolkit ▪ Hypatia Theoretical Framework ▪ Hypatia Institutional Guidelines
School Practices & Pedagogical Practices	▪ Integration of community, local and/or national projects on gender gap in STEM. ▪ Implementing innovative beyond the classroom, like study visits to stem companies, technology centres and universities; and school community links to promote hands-on learning initiatives. ▪ Eliminating the use of gender stereotypes in documents and communication initiatives (written, visual...) ▪ Inclusion of a gender equality perspective in training requirements teaching, educational and guidance staff and vocational guidance counsellors' activities.

PRACTICE 20 - GIRLS GO CIRCULAR PROJECT

Description: The project supports schoolgirls, and more broadly, any student, to develop their digital and leadership skills while learning about the circular economy and finding solutions for a sustainable future. The Girls Go Circular Project seeks to address various societal challenges through a learning-by-doing approach which engages students in different activities such as online research, entrepreneurial role-plays or challenge-based exercises.

Responsible/Coordinating Entity: European Institute of Innovation & Technology (EIT).

Goals: Teachers training in gender and STEM; Gender Stereotypes Awareness; Students Awareness; Teachers Awareness; Enhance girls' and all students interest in STEM; Integrate gender sensitive approaches in classes and in educational books; Integrate gender sensitive materials in curricula; Give visibility to women in STEM; Develop new visions of STEM professionals.

Target Audience: Female Students.

Edition: 4th edition.

Website: https://eit-girlsgocircular.eu/

Facebook: https://www.facebook.com/people/Girls-Go-Circular/100088423186997/

Instagram: https://www.instagram.com/girlsgocircular/

X: https://twitter.com/GirlsGoCircular

Girls Go Circular is an EU-funded project that aims to equip at least 50,000 schoolgirls, aged between 14 and 19, with digital and entrepreneurial skills by 2027, through an online learning programme on the circular economy. In addition, the project contributes to closing the gender gap in the number of women active in the digital and entrepreneurial sectors in Europe, dismantling gender stereotypes and raising awareness of the opportunities that STEM subjects offer.

Girls Go Circular project seeks to support school-age girls and, more generally, any student, to develop their digital and leadership skills while learning about the circular economy and finding solutions for a sustainable future. Boys are also invited to take part in the learning programme, especially in collaborative environments with girls.

The Girls Go Circular Project also aligns with the EU Digital Competences Framework 2.2 (DigComp), the European Entrepreneurship Competence Framework (EntreComp), and the European Sustainability Competence Framework (GreenComp) and contributes to the gender equality objectives of the DEAP 2021-2027 and closely supports the European Institute of Innovation and Technology's (EIT) flagship Deep Tech Talent Initiative, introducing deep tech topics into school curricula across Europe. It also supports Action 13 – Encourage women's participation in STEM (science, technology, engineering and mathematics) of the European Commission's Digital Education Action Plan.

Girls Go Circular project is currently coordinated by the European Institute of Innovation & Technology (EIT) and it started in 2020 with a pilot phase in 6 countries: Bulgaria, Greece, Italy, Portugal, Romania, Serbia.

In 2021, the project expanded to Hungary and Poland, and in 2022, Lithuania and Slovenia also joined the project. North Macedonia, Montenegro, Cyprus, and Armenia participated in the project as guest countries.

Beyond these countries and the EIT, 9 other partners are involved in the Girls Go Circular project:

- Sostenilibidad Ética (Spain).
- European Union Intellectual Property Office (Spain).
- Ellen Macarthur Foundation (United Kingdom).
- Junior Achievement Europe (Belgium).
- Brainshuttle GMBH (Germany).
- Universita Degli Studi Di Torino (Italy).
- European Digital Learning Network (Italy).
- PPIS Pannon Pro Innovations (Hungary).
- Asociatia Young Initiative (Romania).

The European Institute of Innovation and Technology (EIT) is Europe's largest innovation network, created by the European Parliament and the Council in 2008, operating as an independent institute.

Resources produced

The Girls Go Circular project methodology is based on a learning-by-doing approach which engages students in different activities such as online research, entrepreneurial role-plays, or challenge-based exercises.

1. Circular Learning Space (CLS) (online learning platform)

- Offers students the opportunity to deepen their knowledge of the circular economy while acquiring digital competencies.
- As an open-source online learning management system designed for teachers, includes 18 learning modules they can use in their classroom and that impart digital skills while exploring the circular economy.
- The learning modules are also divided into beginning, intermediate and advanced levels. Some of the available Learning Modules include:
  - Rethinking Plastics.
  - Fashion and the Circular Economy.
  - E-Waste and the Circular Economy.

- Robotics and the Circular Economy.
- Artificial Intelligence and the Circular Economy.
- Semiconductors: Powering Digital and Green Transformation.
- Deep Tech Innovation from Farm to Fork.
- A Circular Economy for Smartphones and Electronic Devices.
- Tackling Climate Change Through Circular Consumption

- Supports schools in Europe in building digital skills with their students and empowering them to reflect on important societal challenges by offering them the opportunity to:
  - Acquire knowledge on the circular economy.
  - Gain insights into the steps taken by businesses toward the circular economy.
  - Improve their digital and entrepreneurial skills.
  - Come up with their own solution to societal and environmental challenges.

Beyond this, it is important to note that this learning programme has been designed primarily as a tool for virtual or face-to-face classroom environments. It involves group challenges and activities as well as individual learning. For this reason, it can also be partly conducted by individual users. Therefore, interested students can also complete it on their own.The minimum requirement of the learning programme is to complete 3 modules: the 2 introductory modules "Online Safety and Etiquette" and "Circular Economy" and 1 thematic module of the student's choice.

After a successful completion of the learning programme, students receive a micro-certification that endorses the skills and competences acquired. Teachers will also be granted a certificate recognising their contribution to implementing the Girls Go Circular project in their country.

Figure 84 - Front cover of the English version of the Teacher's Guidebook

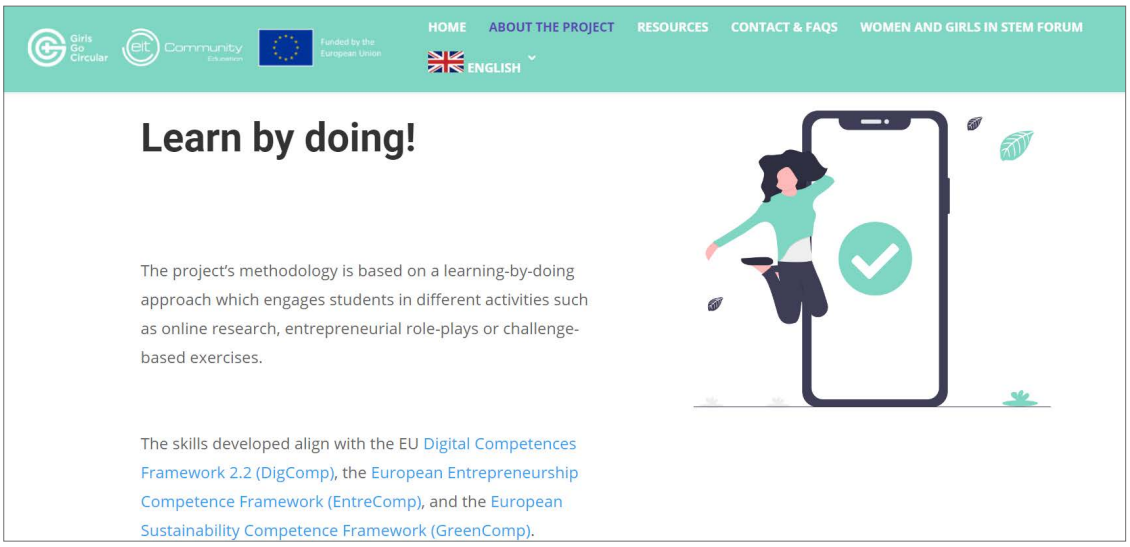
2. Teacher's Guidebook: Teachers play a fundamental role as facilitators guiding students through the learning programme by helping them understand and reflect on key contents and navigate the challenges presented in the different modules. Due to this, the Girls Go Circular project team offers teacher training and provides a Teacher Guidebook designed to support teachers' work with students in the classroom. This Guidebooks include thorough guidelines, tips and tricks, and alternative activities on implementing each module in the classroom.

It is available in 16 different languages. The online platform (CLS), on the other hand, is currently available in 9 languages.

Thus, we can argue that the activities promoted by the project fulfil some of the main criteria of a gender sensitive STEM pedagogy, namely:

- Awareness raising on gender stereotypes.
- Putting student at the centre (expectations, capabilities, needs, obstacles).
- Innovative educational tools.
- Focus on real world problems.
- Project based, learn by doing, problem-solving pedagogical methods.
- Encouraging students to share their experiences (expectations and obstacles) as a pedagogical strategy.
- Inclusion of a gender equality perspective in the curricula, textbooks, educational materials and teaching's training requirement.
- Use of technologies in the classroom.
- Giving equal voice and opportunity to speak to boys and girls.
- Teaching in an interdisciplinary way, doing articulation with non-STEM disciplines (exploring the intersections of design, arts, science, and mathematics, engineering).

Figure 85 - Website of the Project where you can find all the available resources



Impact

Since its creation the Girls Go Circular project has:

- Empowered over 38 000 girls.
- Supported over 1000 schools.
- Had over 60 000 registered users in its learning programme.

Furthermore, the Girls Go Circular Project hopes to expand to all EU Member States in the coming years, reaching 22 countries in 2023.

Testimony of Use

Girls Go Circular Project seems to be a good practice that allows for schoolgirls, and more broadly, any student, to develop their digital and leadership skills while learning about the circular economy and finding solutions for a sustainable future.

To prove it, below you'll find some testimonies, first, from a girl who took part in the Girls Go Circular project and, second, from a teacher also involved in the project. These testimonies have been taken from the project's Facebook and YouTube page:

"This programme should be compulsory in schools everywhere. It should also be made compulsory for organisations, local authorities, businesses, and politicians."

"Hi, I'm Carolina Versi, I teach English, and I am a support teacher for special needs students at the Polo Liceale "Illuminati" in Atri. I joined Girls Go Circular with a class of 4H of the Liceo Scienze Umane and we went through the whole programme of the Circular Learning Space platform. So, we did both the two introductory modules and the four elected courses. What my pupils said they liked best about the programme was the learning by doing approach its challenge based structure. Students can be really competitive, you know? So, they tried themselves really hard in completing the interactive tasks and in winning the challenges. Of course they had different attitudes towards the topics of the modules. For example, the girls were particular fascinated with the concept of circular fashion. Otherwise, the boys loved the module about electronic devices and smartphones. As a teacher, I really appreciated the fact that the programme joined together two main aspects of modern life. Tools young people are kind of addicted to like Twitter, YouTube, Instagram and Facebook that they usually use for entertainment, and something that they had just learnt about and that they were not fully aware of. That is the issues about environmental impact, recycling, environmental activism and so on. So, social media and digital skills on one side, sustainability and circular economy on the other. Moreover, the programme has been a precious help during these pandemic times since it represented a challenging tool able to provide that social interaction students were deprived of during lockdowns and distance learning. Online peer tutoring and group working offered a viable option to develop our student's awareness about both the future of the planet and the possibility of using social media and digital skills as working opportunities. Last but not least, the programme is fully flexible and can be easily adapted to your student's needs and learning abilities. So, I strongly recommend it."

SUMMARISED INFORMATION	
School Involvement	▪ In school.
Time of the Activities	▪ During regular class hours.
Context of the activities	▪ School.
Activities format	▪ Mixed (in-person/in-person and online).
Type of equality approach	▪ Specific Action (only women involved).
Actions to impact on families and parents	▪ None.
Disciplines or courses enrolled/integration	▪ Cross-discipline approach (e.g., inclusion of a gender module for several courses). ▪ Integrative Approach (e.g. Gender across discipline tasks and integrated as part of the subject).
Pedagogical Materials used	▪ Girls Go Circular Learning Platform: Circular Learning Space.
School Practices & Pedagogical Practices	▪ Change learning environment in classrooms and schools. ▪ Integrating technology and innovative educational tools to motivate students. ▪ Teacher's platforms and training tools. ▪ Student centered; respecting girl's and boy's interests. ▪ Revamping STEM courses curricula to offer a more inclusive and socially relevant curriculum. ▪ Developing classroom activities to deconstruct stereotypes about STEM professions, STEM professionals and gender stereotypes.

CHAPTER 6

Tools

1. Scientific literature

In this chapter, we present 31 European and international bibliographical references that offer a variety of information, statistical data, explanatory models, theoretical reflections, analytical models, national public policies, recommendations, resources, projects and practices aimed at understanding the gender gap phenomenon of the gap between boys/men and girls/women in STEM areas.

According to the main contributions of each reference, the aim was to align all the works around three main thematic axes:

1) **Diagnosis**: studies that seek to characterise the problem through quantitative and/or qualitative data, survey hypotheses and possible factors that keep girls/women away from STEM areas (focused on education), elaboration of explanatory models and analyses based on pre-existing indicators.

2) **Recommendations for National, European and International public policies**: based on a broad knowledge of the problem and the various challenges faced by teachers and schools, suggest practical measures to foster profound pedagogical changes.

3) **Resources, projects, and pedagogical practices**: aligned with the aim of presenting a set of tools to support teachers in their educational practice.

1) Diagnosis

Merayo, N., & Ayuso, A. (2023). **Analysis of barriers, supports and gender gap in the choice of STEM studies in secondary education**. *International Journal of Technology and Design Education, 33*(4), 1471-1498.

https://doi.org/10.1007/s10798-022-09776-9

Abstract: "A quantitative descriptive, correlational and explanatory descriptive design was used to identify barriers, supports and gender gaps in STEM in Secondary Education, by analysing the interest and perception of 1562 students and 432 teachers. ... The results show that fewer female students want to pursue STEM studies, with girls preferring health and education professions and boys preferring engineering and computer science. Indeed, their motivation is different since the study found correlations between being a girl and choosing STEM for helping people and society, while earning money is important for boys. Girls believe it is more necessary than boys to have qualities to study STEM and less often perceive themselves as intelligent and courageous. The study revealed that families and teachers encourage more boys than girls towards STEM activities. Teachers believe that girls are influenced by preconceived ideas, lack of STEM knowledge and lower self-esteem. Regarding gender equality, almost half state that no objectives are included in the curricula, 43.85% do not include it in subjects and only 30% received training. Female vocations need to be promoted by teaching how STEM solves real-life problems, fostering creativity, increasing self-confidence, promoting STEM activities and making female role models visible. Teachers should receive more gender training and promote gender-sensitive STEM education."

Main conclusions: Identification of barriers: The study identifies various barriers that hinder students, especially girls, from choosing STEM studies, such as societal stereotypes, lack of role models, and limited exposure to STEM fields. Importance of support: The research highlights the significance of supportive environments, encouragement from teachers, and access to resources in fostering students' interest and confidence in pursuing STEM subjects. Teachers' perceptions and actions: The paper discusses the role of teachers in shaping students' attitudes towards STEM, emphasising the importance of teacher training, awareness of gender biases, and proactive guidance to encourage more female students to engage in STEM studies.

Contributions: A comprehensive examination of the barriers supports and gender gap in the selection of STEM studies in secondary education. By delving into students' beliefs, attitudes, motivations, and extracurricular interests, especially those of girls, the study provides valuable insights into the factors influencing students' decisions to pursue STEM subjects. Furthermore, the exploration of teachers' beliefs, training, and efforts in guiding students, particularly female students, towards STEM fields offers a holistic perspective on the challenges and opportunities in promoting diversity and inclusivity in STEM education.

Microsoft Corporation. (2017). **Why Europe's Girls Aren't Studying STEM**. Microsoft Philanthropies.

https://news.microsoft.com/uploads/2017/03/ms_stem_whitepaper.pdf

Abstract: "Across 35 European countries, fewer than 1 in 5 computer science graduates are women. Interest in science, technology, engineering and math (STEM subjects) drops off far too early. Data from OECD's Programme for International Student Assessment (PISA) reveals that boys are far more likely than girls to imagine themselves as ICT professionals, scientists or engineers. This is a major issue for both the current and future jobs market. If we don't help more young women to embrace STEM, we'll never close this widening skills gap. Nor will we ensure students are set up for success in a world where STEM skills are increasingly important. One of the key issues is the fact that male and female students continue to make different career choices. Conformity to social expectations, gender stereotypes, gender roles and lack of role models continue to channel girls' career choices away from STEM fields. This report answers the questions of exactly when girls' interest in STEM subjects begins to decline, and why. It also makes recommendations for policymakers, educators and private sector executives on how to get more young women interested in these fields."

Main conclusions: Most young European women become attracted to science, technology, engineering and math between the ages of 11 and 12. But that interest then drops off significantly between 15 and 16, with limited recovery. This means that governments, teachers and parents only have four or five years to nurture girls' passion before they turn their backs on these areas, potentially for good. The country where young women live have a major impact on their attitudes to STEM. Results varied wildly from country to country. In some places, confidence is a major barrier, while in others, peer approval or lack of role models is holding them back most. There are five major drivers impacting girls' interest in STEM subjects. In order of importance, those are: female role models; gaining practical experience and hands-on exercises (including creativity in the classroom); mentoring by teachers; real life applications; and confidence in equality - Girls believe anything is possible, but only if they are treated the same as boys.

Recommendations are made for public and private bodies. Policy Key actions: Integrate digital literacy into the broader Curriculum; create more opportunities for computer science teaching in and out of the class-

room; place a greater focus on STEM education as part of the Digital Skills strategy. Education key actions: Use new technologies to spark girls' interest; Future-proof teacher training programs and make teaching more collaborative, immersive and social; more creative and hands-on experiences in classes; gender neutral classes. Private sector key actions: Partner with governments and the non-profit sector to support digital literacy initiatives; More visible role models**.**

Contributions: Comprehensive analysis of the factors influencing the low participation of young European women in science, technology, engineering, and math fields. The study sheds light on the challenges faced by girls in pursuing STEM education and careers. It provides valuable insights into the gender gap at various stages, from early education to workforce retention, and offers recommendations for policymakers, educators, and private sector executives to encourage more young women to enter STEM fields. This publication serves as a sound resource for understanding and addressing the barriers that hinder girls' interest and participation in STEM subjects.

Viarengo, M. (2021). ***Gender gaps in education: evidence and policy implications***. EENEE Analytical Report, 46. Publications Office of the European Union. doi: 10.2766/40099

https://op.europa.eu/et/publication-detail/-/publication/719f1434-1ce2-11ec-b4fe-01aa75ed71a1/language-en

Abstract: "This report was prepared for the European Commission and focus on gender gaps in educational attainment and educational trajectories. It provides a review of recent research and state-of-the-art empirical evidence by examining the economic literature. It documents trends and how gender gaps vary by level of educational attainment and field of study. Existing research has documented the presence of limited gender gaps at the early stages of education. Gender gaps seem to be related to educational choices that start in high school, and then widen along the educational trajectory. This report shows that gender differences in educational choices are significant and persist over time. It also highlights the heterogeneity in gender gaps in STEM and across related sub-fields. Women are not equally under-represented in all sub-fields of STEM, but they are especially under-represented in the maths-intensive STEM fields. The available evidence suggests that the cross-country variation in gender differences in each STEM sub-field is as important as the cross-country variation in the overall STEM field."

Main conclusions: Gender differences in educational choices emerge early in secondary schooling, and then widen along the educational trajectory. Existing research provides evidence of a complex set of determinants, though the magnitude of the effects varies across countries and over time. Among other explanatory factors, the educational context, the structure of the labour market and the environment of the workplace, as well as broader gender equality in cultural values and social norms in society, appear to play important roles.

Contributions: This publication makes an in-depth analysis of gender disparities in educational attainment and trajectories. It highlights the importance of understanding how gender differences emerge early in secondary schooling and widen along the educational trajectory, particularly in fields such as STEM. Moreover, the report emphasises the need for tailored policies and interventions at different stages of education to address these gender disparities effectively.

Blumberg, S., Krawina, M., Mäkelä, E., & Soller, H. (2023). ***Women in Tech: The Best Bet to Solve Europe's Talent Shortage.*** McKinsey Publ..

https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/women-in-tech-the-best-bet-to-solve-europes-talent-shortage

Abstract: "McKinsey analysis shows a tech talent gap of 1.4 million to 3.9 million people by 2027 for EU-27 countries. If Europe could double the share of women in the tech workforce to about 45 percent, or an estimated 3.9 million additional women by 2027, it could close this talent gap and benefit from a GDP increase of as much as €260 billion to €600 billion. To better understand why Europe struggles to find and retain tech-talented women, and to determine how best to address the issue, this paper undertook a detailed analysis of the entire development funnel in Europe, from primary school all the way to entering the workforce."

Main conclusions: Analysis on schooling (primary, secondary, and tertiary education) based on publicly available data from Eurostat, the Program for International Student Assessment (PISA), and the Trends in International Mathematics and Science Study (TIMSS) focused on the EU-27 member countries, concluded that women occupy only 22 percent of all tech roles across European companies. There is a drastic drop in women's participation in ICT disciplines, a core element of STEM, during tertiary education, which contributes to the underrepresentation of women in tech roles. The percentage of women in tech roles in Europe is projected to decline to 21 percent by 2027 if current trends persist, indicating a worsening gender imbalance in the tech sector. Redressing bias in the workforce, improving retention rates, reskilling women into tech roles, and promoting girls in STEM classes are key interventions that can help address the gender gap in tech roles. Increasing the representation of women in tech roles can have a positive impact on Europe's GDP and competitiveness in the global tech industry.

A significant drop in the percentage of women in STEM (science, technology, engineering, and math) classes happens at two points: during the transition from primary and secondary education to university, when it drops 18 percentage points, and during the transition from university to the workforce, when it drops another 15. While the rate of women working within tech companies (such as social networks) is closer to parity, the rate of women working within tech roles (such as developers and data engineers) is much lower. Women's graduation rate in STEM disciplines during higher education is declining. Furthermore, the share of women in the workforce is lowest in the tech roles that are growing fastest. At current rates, the share of women in tech roles in Europe is heading toward a decline to 21 percent by 2027.

Contributions: The highlight of the text is its emphasis on the significant drop-off of women in STEM fields at two critical points: during the transition from primary and secondary education to university, and during the transition from university to the workforce. This analysis sheds light on the specific stages where women are disproportionately leaving STEM fields, providing valuable insights for addressing the gender gap in tech roles.

Monteiro, R., & Lopes, M. (2022). **Closing the digital gender gap in Portugal: feminist challenges and achievements**. In: *Algoritmos, teletrabajo y otros grandes temas del feminismo digital (173-193).* Dykinson.

https://www.researchgate.net/publication/367364796_Closing_the_gender_digital_gap_in_Portugal_feminist_challenges_and_achievements

Abstract: In this paper, the authors explore the evolution of the situation of women in ICT in Portugal, map the main actors (state, civil society, companies and representative associations, existing women movements and networks) and analyse the initiatives mobilised to combat the underrepresentation of girls and women in ICT. They present a preliminary analysis of conditions for the success of some selected initiatives promoted by different actors, using the typology of success factors developed by Lagesen *et al* (2022). The analysis focus on the three case studies: the public program Engenheiras por um Dia (Engineers for one Day); a private program of scholarship with a parity threshold - Seeds for the Future 2.0 (Huawei and Incode2030); and on a public university pioneering mentoring program aimed at supporting women's careers in informatics.

Main conclusions: The main conclusions of this paper include: Strong political initiative in Portugal since 2017 to address the gender gap in ICT, driven by the Ministry of Equality and supported by national and international pressures; Implementation of specific programs and initiatives such as "Engenheiras por um Dia" to promote gender mainstreaming in STEM fields; Integration of gender equality goals in important national programs to increase women's participation in the digital transition; Engagement of various actors beyond the Ministry of Equality, including the digital transition secretary of state, the ministry of economy, technological companies, women in ICT networks, universities, and public administration, to promote gender diversity in the digital sector; Pioneering initiatives like the INSPIRA Female Talent Retention Program at the University of Coimbra, aligned with national and international efforts to close the gender gap in ICT; Recognition of the importance of gender equality in the digital transition for a more inclusive and diverse technological landscape. These conclusions highlight the progress made in Portugal towards closing the digital gender gap and the ongoing efforts to promote gender equality in the digital sector.

Contributions: This paper provides a comprehensive understanding of Portuguese initiatives that challenge the current situation. A critical appraisal of those initiatives is presented, underlining core conditions for succeeding in this domain. The contributions of this paper are useful for informing future research, policies and initiatives aimed at promoting gender equality and inclusion in STEM fields. The study concludes that especially in the last 6 years a diverse and systematic approach to the underrepresentation of girls and women in ICT has emerged at the national policy level. This approach is built on some differential and potentially successful strategies: the robust baseline gender assessment grounding the initiatives; the partnership and alliance with women in ICT networks, the dual approach of specific and positive action combined with institutional change initiatives and gender mainstreaming policies, the multilevel and multi-actor approach, and the strong communication strategy. One of the main challenges to the sustainability of those efforts is the continuity of an integrated action including women and feminist networks grounded in strong political will and action to maintain the theme on political and public agenda and to continue to coordinate network programs like Engenheiras por um dia and Alliance for Equality in TIC.

Vossen, T. E., Henze, I., Rippe, R. C. A., Van Driel, J. H., & De Vries, M. J. (2021). **Attitudes of secondary school STEM teachers towards supervising research and design activities**. *Research in Science Education*, *51*, 891-911.

https://doi.org/10.1007/s11165-019-9840-1

Abstract: "Not much is known about the attitudes teachers hold towards supervising research projects or design projects. In this study, a questionnaire to measure teacher attitudes towards supervising research activities and design activities in secondary school was completed by 130 Dutch teachers who taught the relatively new Dutch STEM subjects O&O (research and design) and NLT (nature, life, and technology). These integrated STEM subjects are project and context based and are taught in a limited number of schools. (…) The results showed that on average, both O&O and NLT teachers had high self-efficacy scores on supervising research and design projects even when they had received no special education in doing so. Furthermore, the teachers in general viewed supervising research projects as a more relevant activity than supervising design. Since research and design activities are becoming more important in (inter)national curriculum standards, STEM teacher education and subsequent professional development should not only familiarise teachers with supervising research projects, but with design projects as well."

Main conclusions: STEM teachers generally hold positive attitudes towards supervising research projects and design projects, indicating a willingness to engage in these activities; There are differences in teachers' attitudes towards supervising research activities compared to design activities, with varying levels of enjoyment, self-efficacy, anxiety, and difficulty; Science teachers view supervising research projects as more relevant but also more challenging compared to design projects, while non-science teachers find research projects more difficult but do not significantly differ in their views on relevance; (…) Conclusions highlight the importance of understanding teachers' attitudes and self-efficacy in guiding students through research and design activities in integrated STEM education, as well as the necessity for tailored professional development to support teachers in these roles.

(…) The results of this study indicate that there is a need for additional STEM teachers for professional learning development, especially for non-science teachers who are beginning to teach STEM subjects as well. Since STEM teachers have different backgrounds, it is important that ample time, support, and professional development courses are provided to them. (…) Instead of already existing courses for single subjects, courses specifically aimed at integrated STEM could attract more STEM teachers and could enhance their willingness to attend such professional development opportunities.

Contributions: This study investigated teachers' attitudes towards supervising research and design projects in secondary STEM education. An important contribution of the paper is the presentation of a questionnaire for surveying the Attitudes towards Supervising Research and Design Activities (ASRADA), based on the Dimensions of Attitude towards Science (DAS) questionnaire, which had been used in the context of elementary school teachers teaching science.

By examining the self-efficacy, relevance, enjoyment, anxiety, and difficulty levels experienced by STEM teachers in guiding students through these activities, the study sheds light on the importance of teacher professional development.

Miralles-Cardona, C., Kitta, I., & Cardona-Moltó, M. C. (2023). **Exploring Pre-Service STEM Teachers' Capacity to Teach Using a Gender-Responsive Approach**. *Sustainability*, *15*(14), 11127.

https://doi.org/10.3390/su151411127

Abstract: "Teachers' perceived efficacy of their ability to teach using a gender approach is key for future generations to become more gender-sensitive and respectful towards gender inequities. However, little is known about graduate training for gender-responsive STEM (science, technology, engineering, and mathematics) teaching. In this study, after exploring the measurement invariance across countries (Greece and Spain) and sexes (male and female) of the TEGEP (Teacher Self-Efficacy for Gender Equality Practice) scale, a total of 222 prospective secondary school STEM teachers (136 Greek, 86 Spanish) from seven public universities were surveyed. The study calls for reflection and considering that gender mainstreaming in STEM is anecdotal and not aligned with existing curricula, seeks to raise awareness and institutional compromise in implementing a gender-responsive approach in STEM."

Main conclusions: This investigation yielded two important findings: (1) the TEGEP demonstrated acceptable measurement invariance by country and sex; therefore, it is a valid measure to assess self-efficacy for gender-sensitive teaching across Greek and Spanish samples of pre-service secondary STEM teachers and among sexes; and (2) Greek and Spanish pre-service secondary STEM teachers complete their master level studies without adequate preparation and enough confidence to teach using a gender-responsive approach to instruction. The fact that participants from both countries only reported a 'moderately low' level of self-efficacy deserves consideration, but it is not surprising, given that gender mainstreaming in STEM education, despite being mandatory in both countries, is extremely limited and misaligned with the existing curriculum. This can be attributed to low institutional compromise and low gender awareness, besides lack of training and indifference on the part of the teaching staff.

Contributions: The greatest contribution of this paper lies in its emphasis on the importance of gender competence development in STEM teacher education. It presents an important tool for teachers self-efficacy measurement, the Teacher Efficacy for Gender-Sensitive Teaching (TEGEP).

Sellami, A., Ammar, M., & Ahmad, Z. (2022). **Exploring Teachers' Perceptions of the Barriers to Teaching STEM in High Schools in Qatar**. *Sustainability*, *14*(22), 15192.

https://doi.org/10.3390/su142215192

Abstract: "Understanding teachers' attitudes and perceptions of STEM teaching is a key pathway to enhance effective STEM teaching. Inarguably, teachers are the cornerstone of educational quality and play a central role in students' academic performance. Specifically, the pedagogical strategies teachers employ and their effective use in the classroom are strong determinants of students' enrolment or retention in STEM fields of study and eventual careers. This study sought to explore the experiences of high school STEM teachers in Qatar, focusing on the pedagogical approaches they utilise and the challenges they encounter, with the aim of delving into how these approaches and barriers affect the teaching of STEM in the country's high schools. The study's design is observational, with data collected using a survey of 299 secondary high school STEM

teachers (11th and 12th grades). The study's findings pointed to the influence of student- and school-related factors in shaping STEM teaching. Significant differences were detected based on teachers' gender, grade level of teaching, age group, and university education. Logistic regressions revealed that teachers' demographic attributes, including age group and university education, affect their likelihood to use STEM pedagogies in class. This likelihood was significantly affected by student-related barriers and the learning resources/materials employed in classrooms."

Main conclusions: Student-related barriers included high school students' lack of skills, knowledge, and sleep which are perceived by teachers to affect STEM instruction. Moreover, gender-based differences existed regarding teachers facing school-related barriers, with female teachers facing more barriers compared to their male counterparts. Teachers' perceptions of the decline in student interest in STEM subjects seems ascribed to the lack of parental and family involvement. The pedagogical approaches teachers adopted in STEM teaching appear to be affected by age, university education, and student-related factors. Teachers who employed more activities in their teaching process were more likely to use STEM pedagogies

Contributions: comprehensive analysis of teachers' perspectives on STEM education, providing valuable insights that can inform strategies to enhance STEM teaching practices and address the challenges faced by educators. By focusing on the experiences of high school STEM teachers, the study sheds light on the challenges they face in implementing effective STEM teaching practices. One of the most important contributions is the survey instrument. The survey constructs included student-related teaching barriers, school-related teaching barriers, teacher pedagogy, teacher activity, and factors affecting the decline of student interest in STEM. By utilising logistic regressions, the research highlights how teachers' demographic attributes can affect their likelihood to use STEM pedagogies in the classroom, emphasising the importance of understanding these factors in promoting effective STEM education.

Comber, O., Motschnig, R., Göbl, B., Mayer, H., & Ceylan, E. (2021). **Exploring students' stereotypes regarding computer science and stimulating reflection on roles of women in IT**. *In 2021 IEEE Frontiers in Education Conference* (FIE) (pp. 1-9). IEEE.

https://ieeexplore.ieee.org/document/9637327

Abstract: "The under-representation of women in IT has multiple possible causes, ranging from sociocultural aspects to individual dispositions and social attribution. This full research paper explores secondary school students' (age 12–15) stereotypical perspectives of computer scientists and possible ways to challenge them. The major goal is to let young students form a more accurate concept of computer science professionals by alleviating distorted images, often transmitted through media and the environment. Students who might not think of themselves as fitting in with the prevalent stereotype of a computer scientist may even lose interest in the field. Consequently, our approach challenges stereotypes in order to make any effort to raise young students' interest in computer science and in pursuing careers in this field. As part of this endeavour, we analysed the drawings and descriptions of IT professionals made by 87 students aged 12–15 to determine what sets of preconceived perspectives and misconceptions are present in the learners' minds regarding persons in the IT profession. Our results have shown that stereotypical views on IT actually exist in students' mindsets but are subject to change when systematically challenged in a friendly and safe atmosphere. Aside of the scientific contribution, the paper aims to inspire and support educators in their efforts

to help women and underrepresented groups in computing outgrow inaccurate stereotypes and to uncover young students' potential interest in the field. With this we aim to contribute to overcoming the gender imbalance and foster more equality in the occupational field of information technologies."

Main conclusions: The most important conclusions of the paper include: young learners still predominantly perceive IT as a field for young to middle-aged males, reflecting stereotypes related to intelligence, lack of personal skills, and certain physical features; educational interventions can help challenge existing stereotypes regarding computer scientists and redirect students towards more accurate images and job profiles of IT professionals; frequent interactions and experiences with practitioners of IT, especially female role models, can significantly influence students' perceptions and bias building, inspiring more accurate depictions and descriptions of computer science professionals; the research findings informed the development of educational materials, including a game-based tool and videos showcasing diverse role models in IT, aimed at challenging stereotypes and fostering more equality in the occupational field of computer science.

Contributions: The creation of educational resources, such as game-based tools and videos showcasing a variety of role models, represents a practical and inventive method for combatting stereotypes and advancing gender equality within the IT sector. The research described in the paper is part of the project Dig-Equality FF that aims at designing an inclusive, gender-sensitive educational offering for the subject "digital basic education" (DBE) at secondary level 1 (10 - 14-year-old students). In Dig-Equality FF, digital media and tools are directly experienced, reflected upon and used in a playful way. The paper analysed the drawings and descriptions of IT professionals made by 87 students aged 12-15 to determine what sets of preconceived perspectives and misconceptions are present in the learners' minds regarding persons in the IT profession.

Ayuso, N., Fillola, E., Masiá, B., Murillo, A. C., Trillo-Lado, R., Baldassarri, S., & Villarroya-Gaudó, M. (2020). **Gender gap in STEM: A cross-sectional study of primary school students' self-perception and test anxiety in mathematics**. In *IEEE Transactions on Education*, 64(1), 40-49. doi: 10.1109/TE.2020.3004075.

https://ieeexplore.ieee.org/document/9142452

Abstract: "Significant gender differences are observed in primary school students' perception of self-efficacy and test anxiety in mathematics. Girls perceive themselves to be significantly worse than boys in mathematics and report higher test anxiety toward mathematics exams. Gender differences in 6 self-efficacies become more pronounced as students grow up, and test anxiety increases for all students. However, the present study shows that teachers do not perceive differences in self-efficacy in mathematics between boys and girls. Background: The low presence of women in science, technology, engineering, and mathematics (STEM) might be explained by the attitude of young students toward mathematics. Different studies show that girls are less interested in STEM areas than boys during secondary school. A study on the reasons for this fact pointed out that the early years of education can provide a relevant insight to reverse the situation. Research Questions: Is there any age-dependent gender difference in primary school students in aspects related to mathematics? Are teachers aware of students' perceptions? Methodology: This work presents a study of over 2000 primary school students (6–12 years old) and 200 teachers in Aragón (Spain). The study consists of a survey on aspects that influence the experience of female and male students with mathematics and Spanish language for comparison purposes and teacher's awareness of students' perception.

Findings: The present study shows that during primary school, girls are more likely to experience a negative attitude toward mathematics than boys as they grow up, and teachers may not perceive girls' situation."

Main conclusions: The study shows that during primary school, girls are more likely to experience a negative attitude toward mathematics than boys as they grow up, and teachers may not perceive girls' situation. Results show remarkable differences between genders, with girls presenting a lower perceived self-perceived efficacy in math than boys and significantly higher test anxiety. Consequently, it is more likely for them to avoid studies with mathematical requirements, such as STEM degrees. Primary-school teachers are not aware of this situation or of their implicit bias, so it cannot be expected that they will accomplish actions to reverse the situation. Potential unawareness of the teachers can lead to difficulties in reversing this issue. Teachers' perceptions of students' self-efficacy in mathematics may be influenced by the negative emotions associated with mathematics, such as test anxiety, rather than the positive aspects of the subject. This study highlights the importance of addressing gender differences in self-perception and test anxiety in mathematics at an early age to encourage more girls to pursue STEM studies.

Contributions: Identification of significant gender differences in self-perceived efficacy and test anxiety in mathematics at a primary school age. By shedding light on these disparities and the potential impact on students' attitudes towards STEM fields, the study emphasises the importance of early interventions to address these issues. The findings underscore the need for increased awareness among teachers, the promotion of positive emotions towards mathematics, and the provision of real-world context to enhance girls' interest and confidence in STEM subjects.

Vennix, J., den Brok, P., & Taconis, R. (2018). **Do outreach activities in secondary STEM education motivate students and improve their attitudes towards STEM?** *International Journal of Science Education, 40*(11), 1263-1283.

https://doi.org/10.1080/09500693.2018.1473659

Abstract: "The present study investigated outreach activities, developed by STEM-based companies or universities in co-creation with secondary education with the aim to inform students about and motivate them for a career in STEM by connecting the work-context with school-science. Although many such activities are being offered, little is known about their effects. We investigated students' perceptions of the outreach learning environment, perceived need-fulfilment, self-reported motivation and attitudes towards STEM. Data were gathered from 729 high-school students engaged in 12 activities in the USA and the Netherlands. The students completed a questionnaire, which contained questions about four elements of the theoretical frame based on the Self-Determination-Theory (SDT). Perceived needs-fulfilment and motivation were measured using the basic-psychological-needs-scale and the self-regulation-questionnaire. Attitudes were measured using the test-of-science-related-attitudes. Learning environment perceptions were measured in a previous study using subscales of what-is-happing-in-this-classroom (WIHIC), constructivist-learning-environments-scale (CLES) and classroom-environment-scale (CES) and typified by activity characteristics. (...) Activity characteristics explained almost all variance in these variables between activities. Specific characteristics of outreach activities that statistically significantly related to autonomous motivation and positive general attitudes towards STEM were: workshop-format, understanding science, an out-of-school component. The attitude towards a possible STEM-career was positively associated with autonomous-mo-

tivation and negatively associated with controlled-motivation. Thus, outreach learning environments indeed created opportunities to increase students' motivation in STEM and attitude towards STEM, but the impact varied according to particular characteristics of the activities."

Main conclusions: The findings shed light on some interesting insights that might be of general value to increase the number of students choosing STEM and keep them motivated to pursue a possible career in STEM. The results showed very positive results for students perceived autonomous motivation. In addition, students'-controlled motivation was rated below average as an indication that this type of motivation was relatively absent. Students' attitude towards the social implication of STEM was very positive as well, as an indication of a successful real-life connection and embedding of STEM in society applications. Second, there was quite some variance in students' reported motivation and attitudes. Third, the most important factor of the outreach learning environment related to both the autonomous and controlled motivation was students' perception of the personal relevance of the activity. Real-life examples and longer projects positively impact autonomous motivation, while shorter projects show larger effect sizes.

Contributions: The study emphasises the importance of outreach activities in secondary STEM education for motivating students and improving their attitudes towards STEM, highlighting the need for tailored approaches to maximise the positive impact on students' engagement and interest in STEM fields. The paper makes a significant contribution to understanding the factors influencing students' motivation and attitudes towards STEM, particularly concerning the gender gap in STEM fields. By pinpointing the essential characteristics of outreach activities that boost autonomous motivation and foster positive attitudes towards STEM, the study offers practical guidance for educators and policymakers in developing effective outreach initiatives that can attract and retain students, particularly girls, in STEM fields.

European Commission. (2021). ***Girls' career aspirations in STEM.*** Publications Office.

https://data.europa.eu/doi/10.2766/52684

Abstract: "This study investigates the determinants and drivers of girls' career aspirations in science, technology engineering and mathematics (STEM). It comprises a literature review and an in-depth descriptive and econometric analysis of OECD PISA 2018 microdata. Increasing the proportion of women in STEM is important to expanding the labour force in science and technology (ICT), increasing women's access to well-paid jobs, and promoting the development of technology that is not gender biased. As Commissioner Mariya Gabriel said in her speech at the ICT/STEM event *The work for the future or how to attract young people for careers in ICT and STEM?* "Only one in three STEM graduates is a woman. On average, women make up only 17% of tech-sector jobs." Career aspirations during adolescence have been shown to be good predictors of actual career choices in adulthood though career preferences can be formed earlier. Hence, by providing insights on the drivers of girls' aspirations when they may be making choices about upper secondary and tertiary education, this study helps understand the reasons for lower participation of women in the STEM sector and what policy initiatives can drive up girl's aspirations in STEM and ICT occupations."

Main Conclusions: The study found that girls across EU27 Member States are less likely than boys to aspire to STEM or ICT professions, while showing more interest in healthcare professions. The study identified various drivers and deterrents influencing girls' career aspirations in STEM fields: learning experiences, in-

dividual background, contextual influences (including parental and peer support, role models, societal and cultural factors), and policies.

Contributions: The greatest contribution of this book lies in its comprehensive analysis of the factors influencing girls' career aspirations in STEM fields. The document presents a mixed-methods approach combining insights from relevant literature with an analysis of OECD PISA 2018 microdata. It presents a literature review to establish a conceptual framework based on the Social Cognitive Career Theory (SCCT). This framework guided the organisation of findings, formulation of study questions, and interpretation of statistical analysis results. The study analysed OECD PISA 2018 microdata to explore girls' career aspirations in STEM and related factors. The study aimed to answer three main study questions: Q1: Are there differences among countries regarding girls' STEM career aspirations? Q2: What are the main determinants and deterrents of girls' STEM career aspirations? Q3: What is the role of policies in fostering girls' STEM career aspirations?

The analysis identifies several factors that influence girls' career aspirations in STEM, including PISA science competences, motivation levels, and parental influence. Notably, girls aspiring to STEM careers tend to be better performers in science, suggesting that gender gaps in aspirations cannot be solely attributed to differences in science performance. Overall, the book's significant contribution lies in its nuanced examination of the gender gap in STEM fields, highlighting the complex interplay of individual, societal, and policy-related factors that shape girls' aspirations in these critical areas of study and employment.

Mizala, A., Canals, C., & Ortega, L. (2023). ***Promoting Gender Equity in and through Education***. Educational Practices Series.

https://unesdoc.unesco.org/ark:/48223/pf0000388037.locale=em

Abstract: "Despite progress made in educational attainment of women, gender inequalities persist in and through education, modelling unequal life trajectories for students and impacting the sustainable development of nations. This contribution to the Educational Practices Series synthesises the international evidence on gender disparities in educational processes and outcomes, discusses the main implications for educators, and identifies educational practices that have the potential to promote gender equity. The booklet focuses on three bodies of literature, deriving nine principles for educators. First, this paper delves into the relevance of teachers' expectations, practices, and interactions, highlighting how teachers can challenge gender bias and stereotypes in the classroom. Second, summarise the evidence on gender gaps in educational achievement in competitive and non-competitive standardised tests, informing how stereotype threat and other gender disparities (i.e., in risk-aversion, self-confidence, response in time-constrained environments, and willingness to compete) affect the performance of boys and girls. The authors also identify school and teaching practices that can contribute to reducing these gaps. Third, the paper focus on gender segregation across fields of study by reviewing evidence on gendered patterns of upper-secondary school specialisation and university-major choices, and on the social mechanisms that drive them. Here, the paper address the role of educators in weakening gender stereotypes and promoting the inclusion of men and women across all fields of study. Finally, conclude by connecting these nine principles and highlighting their relevance in promoting gender equity in education and beyond."

Main conclusions: Gender stereotypes and socialization significantly influence students' educational choices and outcomes, leading to gender disparities in fields of study. Teachers play a crucial role in challenging gender bias and stereotypes in the classroom, which can help reduce gender gaps in educational achievement. Encouraging girls from an early age to develop STEM skills and providing a supportive learning environment can help build their confidence to pursue STEM careers. Increasing the participation of women in traditionally male-dominated fields and promoting the inclusion of men in traditionally female-dominated fields can expand students' opportunities and create more diverse learning environments. Addressing gender segregation across study fields requires early preparation in science and engineering, as well as promoting gender diversity in extracurricular activities and school curricula.

Contributions: The highlight of this paper lies in its emphasis on the role of educators in addressing and reducing the gender gap in STEM fields. The document provides valuable insights into how teachers can challenge gender bias and stereotypes in the classroom, promote gender equity in educational practices, and encourage students to pursue diverse career paths regardless of societal expectations. It underscores the importance of inclusive teaching practices, diverse role models, and supportive learning environments in empowering girls to pursue STEM careers and closing the gender gap in traditionally male-dominated fields.

Voicu, C. D., & Matei, F. L. (2021). **STEAM approach in primary school and preschool education**. *Journal of Education, Society and Multiculturalism, 2*(1), 14-39.

https://doaj.org/article/e73157e753b348a983e71784be9a0c4f

Abstract: "The paper presents the current situation regarding the STEAM approach in Romania. The activity was carried out in the context of the NGSS Erasmus+ project, for the completion of IO1 (Concept Paper). For this, we resorted to the analysis of the curriculum for primary and preschool education and of the studies carried out in our country regarding the approach of STEM and STEAM in Romanian schools. Last but not least, we conducted focus group research with teachers, science and arts specialists and parents. The research objectives were: 1. Identifying teachers, education stakeholders, parents and STEAM professional opinions related to STEAM implementation (good practices, difficulties, strengths, effects) and to the value of STEM+Arts education in increasing the motivation and participation of young girls in science education and careers; 2. Identifying parent`s perceptions of gender differences in their children's play and/or school activities; 3. Identifying teachers' training needs; and 4.Identifying criteria for good practices from the teacher`s perspective. The results showed that STEAM approach is little used in primary and preschool education, mostly due to teachers lack knowledge about this approach, but all the educational actors - teachers, parents, STEM and ARTS professionals, management representatives - agreed on the STEAM approach value for child development and as a best practice for science teaching. Also, from teachers and parents' point of view there are no gender differences regarding science teaching in early education, but there are some older persons (teachers and parents) that might have gendered biased perception on what to consider proper hobby activity for boys and for girls."

Main conclusions: There is a perceived need among teachers for solid knowledge about the STEM/STEAM approach in educational activities. Schools need to be properly equipped to allow the development of skills specific to the STEM/STEAM approach. The majority of teachers believe that STEM/STEAM skills and activities should be included in the curriculum for primary and preschool education. Implementing STEM/STEAM

approaches in primary education is perceived as challenging due to workload and resource requirements. The STEAM approach is valued for child development and is seen as a best practice for science teaching. There is agreement among educational stakeholders on the value of STEM+Arts education in increasing motivation and participation of young girls in science education and careers. Gender differences in science teaching in early education are not perceived by teachers and parents, but some older individuals may have gender-biased perceptions regarding suitable activities for boys and girls.

Contributions: The greatest contribution of the text to the study of the gender gap in STEM fields lies in its emphasis on the value of STEM+Arts education in increasing motivation and participation of young girls in science education and careers. The study underscores the importance of the STEAM approach in promoting gender equality in STEM fields by providing equal learning opportunities for both boys and girls, considering their emotional and social abilities.

Miroiu, M. (2000). ***The gender dimension of education in Romania***. SOCO Project Paper, 83.

https://www.academia.edu/978107/The_gender_dimension_of_education_in_Romania

Abstract: "The main aims of this research were to have a coherent image on the perception of gender aspects in education especially at the level of secondary and upper secondary schools and to offer suggestions for gender policies in education. In order to fulfil the first aim, this study investigated: a) the opinions of: students, teachers, directors, deputy inspectors and officials of the Ministry of National Education; b) the content and the methods of the curriculum for the pedagogical upper secondary schools. Students, teachers, directors and deputy inspectors' opinions on gender perception focussed on: the content of the schoolbooks, the relations between students and teachers and students themselves, the relations between different kinds of capacities and gender, the gender dimension of the evaluation process, career orientations, activities recommended and practiced for boys and girls in the school. This study tried to detect the discriminatory and the conservative tendencies that undermine an education for gender partnership in the future family, private, professional and public life. Considering the results of the research and the coherence between this research and others, the authors have formulated suggestions for gender public policies in education concerning: balanced access in education, non-sexist strategies in evaluation, the elimination of gender conservative elements in the hidden curriculum, gender partnership in the educational activities, the elimination of gender segregation as well as changes in the law of education."

Main conclusions: Gender Bias in Textbooks: The research indicates that textbooks in Romania exhibit conservative approaches to gender issues. This is evident in the imbalance between male and female authors, characters, and active roles portrayed in the educational materials. Lack of Gender Awareness: The study reveals a lack of gender awareness in the curriculum and teaching practices in Romanian schools. Need for Gender-Inclusive Education: Suggestions for gender public policies include ensuring balanced access to education, implementing non-sexist evaluation strategies, and eliminating gender stereotypes in the hidden curriculum. The research underscores the necessity of translating theoretical gender concepts into practical educational activities. Recommendations focus on fostering gender partnership in school environments and addressing discriminatory tendencies that may hinder equal opportunities for all students.

Contributions: By highlighting the impact of gender biases in textbooks, curricula, and teaching practices, the research underscores the need for gender-inclusive education from the foundational levels of schooling. Moreover, the study's recommendations for gender-sensitive policies and practices in education, such as promoting non-sexist evaluation strategies, eliminating gender stereotypes, and encouraging mutual appreciation and partnership education, provide valuable insights for addressing the gender gap in STEM fields.

Charles, M. & Thébaud, S. (ed.s) (2019). ***Gender and STEM: Understanding Segregation in Science, Technology, Engineering and Mathematics***. [Special Issue publ. in *Social Sciences 2018*]

https://doi.org/10.3390/books978-3-03897-148-1

https://www.mdpi.com/books/reprint/851-gender-and-stem-understanding-segregation-in-science-technology-engineering-and-mathematics

Abstract: "This volume features thirteen original chapters on the causes and consequences of gender segregation in scientific, technical, engineering, and mathematics ("STEM") occupations and fields of study. Although women have made great strides in equalising access to labour markets and higher education, many STEM fields — particularly in the physical sciences and engineering — remain strongholds of gender segregation in the United States and other reputably gender-progressive societies. Policymakers, business leaders and activists have launched countless initiatives to diversify access to lucrative, high status occupations and ameliorate labour shortages that diminish innovation and competitiveness. Contributors to this volume apply diverse theoretical lenses and methodological approaches to understand the individual, interactional, organisational, and cultural dynamics that drive this segregation in the United States. Results show that the gender composition of scientific and technical fields varies a great deal over time and across organisational contexts and socio-demographic groups defined by race, ethnicity, class, and sexuality. But despite this variability, STEM work and STEM workers are widely presumed to be naturally and inevitably masculine. Research presented here reveals how these stereotypes combine with cultural beliefs about natural and fundamental differences between men and women to produce gendered aspirations and reinforce inequalities in the US scientific and technical workforce."

Contributions: This special issue of the journal Social Sciences focuses on occupational segregation in STEM. It features a first article by the editors, entitled "Segregation, Stereotypes, and STEM," which provides an overview of the issue and introduces the key themes that will be explored in the subsequent articles. The remaining articles are organised into the following categories: STEM Aspirations, STEM Education, STEM Transitions, and STEM Workplaces. The publication covers a wide range of topics related to occupational segregation in STEM, from the factors that influence girls' and women's interest in STEM fields to the challenges they face in pursuing STEM careers. Overall, this special issue of Social Sciences provides a valuable resource for anyone interested in learning more about occupational segregation in STEM.

2) Recommendations for national, European and international policies and activities

Brussino, O., & McBrien, J. (2022). ***Gender stereotypes in education: Policies and practices to address gender stereotyping across OECD education systems***. OECD Pub.

https://dx.doi.org/10.1787/a46ae056-en

Abstract: "In spite of advances in recognising that girls and boys, and women and men, do not have to be bounded by traditional roles, gender stereotypes persist in education and beyond. Children and youth are affected by gender stereotypes from an early age, with parental, school, teacher and peer factors influencing the way students internalise their gender identities. As such, not only is intervening in pre-primary education necessary, but also measures at the primary and secondary levels are key to eradicate gender stereotypes and promote gender equality. Based on the analytical framework developed by the OECD Strength through Diversity project, this paper provides an overview of gender stereotyping in education, with some illustrations of policies and practices in place across OECD countries, with a focus on curriculum arrangements, capacity-building strategies and school-level interventions in primary and secondary education."

Main conclusions: Policy gaps are particularly strong in terms of monitoring and evaluating programmes in place across systems and translating smaller scale projects implemented by non-governmental organisations and civil-society organisations into scaled-up practices and broader policies. Acknowledging these gaps and identifying policies and practices across OECD countries can be useful to understand how education systems can contribute to dismantling gender stereotyping inside and outside of the classroom. This can be achieved by intervening in key policy areas, including governance and curriculum arrangements, capacity building and school-level interventions. Preparing teachers and school staff with knowledge and skills to address gender stereotypes is a key policy area.

Contributions: The highlight of this publication is its comprehensive analysis of policy instruments to address the gender gap in STEM. The paper offers policy recommendations and strategies to promote more equitable and inclusive education systems.

Chavatzia, T. (2017). ***Cracking the code: Girls' and women's education in science, technology, engineering and mathematics (STEM).*** UNESCO publ.

https://unesdoc.unesco.org/ark:/48223/pf0000253479

Abstract: "Despite significant improvements made in recent decades, education is not universally available and gender inequalities are widespread, often at the expense of girls. Complex and inter-related socio-cultural and economic factors affect not only girls' opportunities to go to school but also the quality of education they will receive, the studies they will follow and ultimately their career and life paths. A major concern is girls' low participation and achievement in science, technology, engineering, and mathematics (STEM) education. STEM underpins the 2030 Agenda for Sustainable Development, and STEM education can provide learners with the knowledge, skills, attitudes and behaviours required for inclusive and sustainable

societies. Leaving out girls and women from STEM education and professions not only deprives them the opportunity to contribute to and benefit from STEM but also perpetuates the gender gap and wider social and economic inequalities. This report is intended to stimulate debate and inform STEM policies and programmes at global, regional and national levels. Specifically, it aims to: i) document the status of girls' and women's participation, learning achievement, and progression in STEM education; ii) 'crack the code', i.e., decipher the factors that contribute to girls' and women's participation, achievement and progression in STEM education; and iii) identify interventions that promote girls' and women's interest in and engagement with STEM studies. It is intended as a resource for education sector stakeholders in ministries of education, science and labour, especially decision-makers and planners, curriculum developers, and practitioners and institutions providing STEM education, including teachers and teacher training institutions. It is also expected to be useful for civil society practitioners, including NGOs engaging girls in STEM, and others with an interest in this field, including employers in STEM sectors."

Main conclusions: Girls' disadvantage is not based on cognitive ability, but in the socialisation and learning processes within which girls are raised and which shape their identity, beliefs, behaviours and choices. Getting more girls and women into STEM education and careers requires holistic and integrated responses that reach across sectors and that engage girls and women in identifying solutions to persistent challenges. This requires political will, strengthened capacity and investments to spark girls' interest and cultivate their aspirations to pursue further STEM studies, and ultimately STEM careers. System-level changes are needed to improve the quality of STEM education to take account of the specific learning needs of girls. Engaging girls in STEM from an early age and ensuring that their overall education experience – the teaching and learning process, contents and environment – are gender-responsive and free from gender discrimination and stereotypes, are also important. The paper categorise explaining factors in: psychological factors impacting girls' STEM studies; curriculum design and gender stereotypes; role of stereotype threats; representation in learning materials.

Contributions: The document sheds light on the complex interplay of individual, family, school, and societal-level factors that impact girls' engagement in STEM subjects and careers. It presents relevant categorisations and examples, and also recommendations for interventions.

UNESCO. (2019). ***Exploring STEM competences for the 21st century***. Series: Current and Critical Issues in Curriculum, Learning and Assessment. February 2019, No.30, IBE/2019/WP/CD/30.

https://learningportal.iiep.unesco.org/en/library/exploring-stem-competences-for-the-21st-century

Abstract: "STEM education seeks to develop and provide innovative solutions to global issues, in particular those directly related to the 2030 Sustainable Development Goals. As Industrial Revolution 4.0 gains momentum and influences every aspect of our everyday lives, the boundaries between STEM disciplines (Science, Technology, Engineering and Maths) and also between STEM and non-STEM fields, are becoming more and more blurred. Quantum-leaps in technology are forcing us to rethink the way we educate students in STEM and non-STEM fields alike. The time has come for the education sector to rethink traditional curriculum boundaries, where knowledge and skills are segregated according to subjects. The IBE has led discussions to identify and make explicit the competences that transcend knowledge areas with a view to assisting member states to develop competency-based curricula that prepare young people with the re-

quired competences to live sustainable, fulfilled and healthy lives in the rapidly changing world of the 21st century. There is, currently, limited research into the prerequisite knowledge, skills, attitudes, values and experiences that are a necessary part a competency-based curriculum and also limited consideration of the challenges that teachers face in implementing a competency-based curriculum effectively. This is especially true for Science, Technology, Engineering, and Mathematics (STEM) education, since the concept of STEM as a connected, and potentially integrated, field of study is relatively new. Accordingly, there is an increasing need for an integrated STEM framework to assist teachers, trainers and curriculum developers to meet the demands for effective 21stC STEM education. The purpose of this paper is to identify and describe the contributory elements of STEM competence (i.e. the requisite knowledge, skills, attitudes and values) associated with the four core STEM subjects and the potential approaches to teaching STEM that must be considered in order to effectively implement STEM within the curriculum. By highlighting the underlying principles and foundations of each contributory discipline, this paper aims to provide a basis for the development of a STEM competence framework that might help fully illustrate and enable the coherent and effective integration of a competence-based approach across the STEM field."

Main conclusions: The boundaries between STEM and non-STEM areas are blurring. With quantum-leaps in digitalisation and artificial intelligence, technology is changing the way we live our lives and forcing a rethink the traditional segregation of knowledge and Skills in STEM and non-STEM fields. The time for a competence-based curriculum has come, in which STEM has an important but not exclusive role. The paper contributes to identifying and making explicit the competences that the younger generation require to live a sustainable and healthy life in the 21st century. This agenda requires consideration of all areas of the curriculum including the Arts broadly, and the Physical and Social Sciences which bring important humanistic and aesthetic dimensions to STEM challenges, processes and solutions.

Contributions: The highlight of this publication is its focus on providing a basis for the development of a STEM competence framework that might enable the integration of a competence-based approach across the STEM field. It discusses the prerequisite knowledge, skills, attitudes, values and experiences that are a necessary part of a competency-based curriculum and also the challenges that teachers face in implementing a competency-based curriculum effectively. The paper identifies and describes the contributory elements of STEM competence (i.e. the requisite knowledge, skills, attitudes and values) associated with the four core STEM subjects and the potential approaches to teaching STEM that must be considered in order to effectively implement STEM within the curriculum.

Schmader, T. (2023). **Gender inclusion and fit in STEM**. *Annual Review of Psychology*, 74, 219-243.

https://doi.org/10.1146/annurev-psych-032720-043052

Abstract: "Despite progress made toward increasing women's interest and involvement in science, technology, engineering, and math (STEM), women continue to be underrepresented and experience less equity and inclusion in some STEM fields. In this article, I review the psychological literature relevant to understanding and mitigating women's lower fit and inclusion in STEM. Person-level explanations concerning women's abilities, interests, and self-efficacy are insufficient to explain these persistent gaps. Rather, women's relatively lower interest in male-dominated STEM careers such as computer science and engineering are likely to be constrained by gender stereotypes. These gender stereotypes erode women's ability to experience self-con-

cept fit, goal fit, and/or social fit. Such effects occur independently of intentional interpersonal biases and discrimination, and yet they create systemic barriers to women's attraction to, integration in, and advancement in STEM. Dismantling these systemic barriers requires a multifaceted approach to changing organisational and educational cultures at the institutional, interpersonal, and individual level."

Main conclusions: Person-level explanations concerning women's abilities, interests, and self-efficacy are insufficient for explaining these persistent gaps, both because these effects are small on average and because they vary considerably across time, field, and culture. Rather, women's relatively lower interest in male-dominated STEM careers such as computer science and engineering are likely to be constrained by cultural stereotypes.

Contributions: The most relevant contribution of this paper is that it presents a literature review on the factors (individual and social) behind the gender gap in STEM.

European Commission/EACEA/Eurydice. (2023). ***Promoting diversity and inclusion in schools in Europe. Eurydice report.*** Luxembourg: Publications Office of the European Union.

https://data.europa.eu/doi/10.2797/443509

Abstract: "This report investigates what national/top-level education authorities across Europe do to address discrimination and to promote diversity and inclusion in schools, with a special focus on targeted initiatives to support those learners who are most likely to experience disadvantage and/or discrimination. It shows that students with special educational needs or disabilities are a main target group in all analysed areas – data monitoring, strategic policy frameworks, policies and measures to promote access and participation, national curricula, learning and social-emotional support initiatives, and teacher education and training. Another very frequently targeted student group across most of the thematic areas is migrant and refugee students, followed by ethnic minority students, in particular Roma students. This corresponds to the two most often reported grounds of discrimination in school education, that is, special educational needs/disability and ethnic background."

Main conclusions: The report emphasises the importance of valuing diversity and the inclusion of all learners in education and training, as recognised in key EU policy documents. Top-level education authorities play a crucial role in monitoring, preventing, and addressing discrimination in school education. Various legislation, strategies, and action plans are in place across Europe to promote diversity and inclusion in schools. Efforts are being made to facilitate access to schools and participation of learners facing barriers, including those with special educational needs or disabilities. Curricula and assessment methods are being adapted to promote diversity and inclusion in schools. Collaboration with parents and families, promoting local/school autonomy, and removing administrative barriers are essential for creating inclusive learning environments.

Contributions: This report form Eurydice provides a comprehensive overview of the challenges, mechanisms, legislation, strategies, and actions taken to promote diversity and inclusion in European schools. It is a very important contribution to the monitoring and incrementation of policies across state members.

3) Resources, projects and pedagogical practices

European Commission. (2022). ***Bridging the gender gap in STEM – Strengthening opportunities for women in research and innovation***. Publications Office of the European Union.

https://data.europa.eu/doi/10.2777/774922

Abstract: "Strengthening women's participation in Science, Technology, Engineering and Mathematics (STEM) fields is not only a matter of equal opportunities and social justice, but also crucial to meet pressing societal challenges like the twin green and digital transitions. The EU is undertaking steps to foster gender equality in research and innovation at all stages across the European Research Area and European Education Area. In line with the European Strategy for Universities, the European Commission is working on addressing the under-representation of women in STEM fields through a roadmap of activities, including a manifesto on gender-inclusive STE(A)M education and careers. Targeted actions for long-term structural change include the development of Gender Equality Plans (GEPs), fostering greater participation of young girls in STEM activities, improving the recruitment, retention and promotion of women in research and innovation, and supporting women entrepreneurship in the EU and beyond. This leaflet highlights eight pioneering EU-funded projects supporting the goal of gender equality and inclusiveness in STEM."

Contributions: Summary on eight pioneering EU-funded projects supporting the goal of gender equality and inclusiveness in STEM: Scientix 4 - Inquiry-based science education in Europe, coordinated by European Schoolnet (EUN), in Belgium; LeTSGEPs - Leading Towards Sustainable Gender Equality Plans in research performing organisations, coordinated by the University of Modena and Reggio Emilia in Italy; CALIPER - Linking research and innovation for gender equality, coordinated by ViLabs OE in Greece; R&I PEERS - Pilot experiences for improving gender equality in research organisations, coordinated by the University of Salerno in Italy; Critical Making - Studying RRI Principles in the Maker Community, coordinated by the Centre for Social Innovation (ZSI) in Austria; EQUALS-EU - Europe's Regional Partnership for Gender Equality in the Digital Age, coordinated by Oslo Metropolitan University (OsloMet) in Norway; shemakes.eu - Opportunity Ecosystems Bridging the Gender Gap, coordinated by CEDECS-TCBL in France; ALLINTERACT - Widening and diversifying citizen engagement in science, coordinated by the University of Barcelona in Spain**.**

European Commission. (2021). ***Educational toolkit to help fight gender stereotypes in secondary school – Challenging learners to discover a world of opportunities based on the example of the transport sector.*** EU Publications Office.

https://learning-corner.learning.europa.eu/learning-materials/educational-toolkit-help-fight-gender-stereotypes-secondary-school_en

Abstract: "This toolkit has been developed for secondary school teachers, advisors and other school professionals and also secondary school young learners (14–15 years old). It aims to support teachers and other school professionals to organise discussions in the classroom to effectively address gender stereotypes, based on the example of the transport sector. It also allows school leaders and school counsellors to chal-

lenge gender stereotypes in schools, where an environment free of stereotypes may lay a firm foundation for children to grow up freely and develop their unique interests and talents."

Contributions: It is a very complete toolkit. It contains the following toolsets: background information; initial teachers' self-assessment; sender stereotypes; work; transport; continuing teachers' self-assessment.

Galvão, C., Reis, P., Freire, S., & Almeida, P. (2011). **Enhancing the popularity and the relevance of science teaching in Portuguese science classes.** *Research in Science Education, 41*, 651-666.

https://www.researchgate.net/publication/225413637_Enhancing_the_Popularity_and_the_Relevance_of_Science_Teaching_in_Portuguese_Science_Classes

Abstract: "*PARSEL Project* emerged from the urgent need to overcome the problem of lack of scientific literacy in the population, which should be a priority in a society where science occupies a central place. Indeed, nowadays for any citizen to participate in a responsible and informed way in society he has to be scientifically acknowledgeable. Nevertheless, not only are scientific levels low in the general population, but also there is an increasing number of students who avoid science and technology courses and related professions. Within this context, PARSEL aims at raising science and scientific courses' popularity and relevancy as well as at enacting teachers' professional development. In order to achieve these goals, the PARSEL group developed 54 pan-European modules, which were tested and evaluated by several teachers in several European countries and Israel. Teachers maintained a close relationship with the university, were highly encouraged to appropriate the modules and to adapt them to their local conditions and, also to discuss and share their experiences. In Portugal, modules were tested by a group of eight teachers and their students. This paper presents data concerning teachers' evaluation. Data was collected by means of interviews, observation and written documents and reveals that teachers positively evaluated PARSEL's impact on their own professional development. Furthermore, they considered modules as well as the teaching-learning approach essential for making science learning relevant and popular for their students."

Main conclusions: Most participant teachers were familiar with the recent discussion about science education, its contradictions and tensions, as most of them were enrolled in master or Ph.D. programs in the area of science education. Teachers made positive evaluations concerning PARSEL. Some of the teachers were expecting negative reactions from the students as they are used to a traditional approach to teaching science, an approach that has worked efficiently in making them achieve good grades. However, traditional approaches to teaching science are associated with superficial learning and disinterest in science and science subjects.

Contributions: The paper presents some strategies to enhance the popularity and relevance of science teaching in science classes, based on the experience of the PARSEL (Popularity and Relevance of Science Education for Scientific Literacy) Project: - developing meaningful practical activities; context-based approach; inquiry-based learning; focus on key competencies; student-centred learning.

Reis, P., Baptista, M., Tinoca, L., Kampschulte, L., Karcz, W., Pellowski, M., & Zahler, A. (2023). ***Hands-on Remote Guidebook. Hands-on Remote Guidebook***.

https://www.researchgate.net/publication/370818201_Hands-on_Remote_Guidebook

Abstract: "The COVID-19-crisis is perceived as a 'turning point' regarding the use of technology in education and training and, connected to this, the need for high-quality digital content being readily available and affordable for learners and educators has been underlined. At the same time, there is interest in capacitating teachers for developing their own teaching contents – based on the hands-on remote scheme. This guidebook aims to assist teachers in doing so by laying out the general principles and theoretical background of this scheme. Transforming the teaching of hands-on experiments into the digital realm allows not only to improve the education situation for (vocational) students under any pandemic conditions but also allows a closer link between work at home and work at school. In addition, the approach seems likewise usefully in situations beyond the pandemic: The type of digital collaboration proposed can support international teams in their cooperation – and possibly save some air travel and CO2 emissions, especially in view of the climate crisis. The hands-on remote approach can also enable distance learning during local weather events - also an important consideration at this time, due to class cancellations and learning delays caused by Corona. Educators from other fields (e.g., out-of-school learning places like museums, science centres, or student laboratories) may as well be interested in creating their own resources and developing new ideas based on the foundations laid in this project. This guidebook is made available in two versions – digital and printed – with the purpose of enhancing the visibility of the project and inspiring new users to apply the teaching modules and the project's core idea of hands-on remote teaching in group settings. The dissemination of this guidebook in different events – teachers' professional development initiatives, school information events and conferences – will ensure a long-term and flexible use of the material and ideas developed in the "Hands-on-Remote" project."

Contributions: This guidebook wants to enable vocational training teachers to carry out classic hands-on student experiments with virtual support in flexible locations – at home, in several locations at the same time, or with appropriate distance in a classroom. It gives examples of experiments, modules and evaluation.

Trbovc, J. M., & Hofman, A. (2015). ***Toolkit for Integrating Gender-Sensitive Approach into Research and Teaching.*** University of Trento, Italy.

https://eige.europa.eu/sites/default/files/garcia_toolkit_gender_research_teaching.pdf

Abstract: "This Toolkit is based on the reports that map gender perspectives in existing research and curricula, with six project partners involved in the GARCIA project conducted in Belgium, Iceland, Italy, the Netherlands, Slovenia and Switzerland. In each national context, we examined two test departments within one research institution: one from social sciences and humanities field (SSH) and the other from the field of science, technology, engineering and mathematics (STEM). The report includes the qualitative and quantitative analysis of research projects and curricula at two test departments during the year 2013, as well as the analysis of the gender structure of the project teams, lecturers and students, if available. The GARCIA project partners analysed available data on the on-going research projects (e.g. project outline, web presentation, project summary) and courses, focusing specifically on objectives, tasks, methodology, theoretical back-

ground and expected results. The attention was given to detecting both presence and absence of a gender perspective in research and curricula contents, focusing not only on inclusion, but also on the exclusion of particular content – the so-called 'hidden curriculum' which reinforces stereotypes about gender, ethnicity, race, class, and power relations. The report also includes a comparative perspective between STEM and SSH fields, which allows a more detailed insight into interdisciplinary dynamics."

Contributions: The publication gives orientation on how to integrate the gender dimension in research and teaching (undergraduate, graduate and doctoral courses), and how to apply it while conceiving new projects and students' curricula. The toolkit also includes 2 checklists, and a list of other toolkits on these matters. Some of the recommendations and tools might also be useful in secondary education.

Informatics Europe. (2023). ***Best practices from school to university***.

https://eugain.eu/wp-content/uploads/2023/03/eugain-booklet-best-practices-from-school-to-university.pdf

Abstract: "Gender-balance in informatics, in academia and in industry, cannot be achieved without increasing the numbers of women graduating in informatics from university. Likewise, gender-balance in informatics programs at university cannot be achieved without ensuring that girls in primary and secondary school have the opportunity to learn informatics. Families and educators play a significant role as enablers, and in this booklet, we have brought together representative examples of how to attract girls to informatics and keep them engaged and succeeding through to the end of the first year of a first cycle degree program. As a strategy to arouse interest in girls' early years and to spark their curiosity, we have also offered specifics of effective primary school practices. (...) The last two sections of the booklet, which deal with attracting female students to, and helping them succeed in, post-secondary education in informatics, may be the most directly applicable to the university departments in their recruiting efforts. However, these sections would not be as effective without the early planning activities aimed at children who are still in the initial stages of their educational careers. So, in our opinion, a concerted effort including families and educators of all orders is required."

Main conclusions: Gender balance in informatics, both in academia and industry, relies on increasing the number of women graduating in informatics from university. Achieving gender balance in informatics programs at the university level necessitates providing opportunities for girls in primary and secondary schools to learn informatics. Families and educators play crucial roles as enablers in attracting girls to informatics and ensuring their success in the field. Effective primary school practices, such as after-school programs, summer camps, and competitions, can encourage female students to pursue informatics.

Contributions: This publication is based on collaborative efforts and experiences shared by over 150 members from 45 countries involved in the EUGAIN project funded by COST Action. The study incorporates insights, strategies, and examples of best practices (gathered from various institutions and research communities) to promote gender diversity in the field of Informatics, from early intervention (kindergarten level) to school and university levels.

Miralles-Cardona, C., Chiner, E., & Cardona-Molto, M. C. (2022). **Educating prospective teachers for a sustainable gender equality practice: survey design and validation of a self-efficacy scale.** *International Journal of Sustainability in Higher Education, 43*(2), 379-403.

DOI: 10.1108/IJSHE-06-2020-0204 https://www.researchgate.net/publication/353805307_Educating_prospective_teachers_for_a_sustainable_gender_equality_practice_survey_design_and_validation_of_a_self-efficacy_scale

Abstract: "This study aims to assess future teachers' beliefs in their capabilities for sustainable gender equality (GE) practice after graduation and to analyse differences across degree and sex using a self-efficacy scale specifically designed and validated for this study. Design/methodology/approach – A survey was administered to three cohorts of undergraduate and graduate student teachers at the University of Alicante, Spain. Using a convenience sample that represented the three teacher majors in early childhood, elementary and secondary education, 610 students were asked to rate their confidence in gender knowledge, skills and awareness using a six-point Likert scale. Findings – Upon graduation, teachers reported unrealistic perceptions of their ability to practice a sustainable GE. The level of self-efficacy was found moderate in the three teacher cohorts with no statistically significant differences across degrees in any of the three efficacy components, but gender attitudes were rated significantly higher by female students. Originality/value – This study provides a reliable and valid instrument specifically helpful for guiding the education for the sustainable development (SD) of GE in instructional settings. Because there is no systemic approach to teaching sustainability nor valid and reliable instruments to assess gender competence for practicing a gender pedagogy, this tool will hopefully provide teacher education institutions a conceptual and practical framework on how GE can successfully be mainstreamed into the curriculum. Infusing SD of GE in curricula and assessing interventions as a habitual practice could be useful to monitor sustainability performance over time and assess contributions to SDG5."

Main conclusions: Upon graduation, teachers reported unrealistic perceptions of their ability to practice a sustainable GE. The level of self-efficacy was found moderate in the three teacher cohorts with no statistically significant differences across degrees in any of the three efficacy components, but gender attitudes were rated significantly higher by female students.

Contributions: Provides a reliable and valid instrument specifically designed to guide the education for sustainable development of gender equality in instructional settings. By developing and validating a self-efficacy scale tailored for assessing future teachers' beliefs in their capabilities for sustainable gender equality practice, this study offers a valuable tool for teacher education institutions to integrate gender equality competencies into their curricula effectively. Furthermore, the study addresses a significant gap in the field by highlighting the lack of a systemic approach to teaching sustainability and the absence of valid and reliable instruments for assessing gender competence in practicing gender pedagogy. The newly developed self-efficacy scale, known as the TEGEP scale, not only contributes to enhancing teacher education programs but also serves as a framework for mainstreaming gender equality education into the curriculum.

Göbl, B., Comber, O., Felber, J., Fenkart, H., Mayer, H., & Motschnig, R. (2021, April). **Dig-equality ff-a playful approach for researching and fostering gender education in secondary schools.** In *IEEE Global Engineering Education Conference (EDUCON)*(964-967). IEEE.

https://ieeexplore.ieee.org/document/9453993

Abstract: Despite continuous efforts to promote ICT related career paths, statistics still show a clear underrepresentation of women in both ICT professions and education. The Dig-Equality FF project develops a set of educational materials for young adolescents to address these issues early on. This paper presents a part of this toolbox: a gamified survey and reflection tool aiming to identify and tackle potential obstacles on the way to a gender balance in the field of ICT. This playful educational tool gathers data to analyse prevalent gender stereotypes regarding job sectors among young adolescents but also to spark discussion and reflect on related aspects. Thus, we aim to alleviate potential misconceptions and point out new perspectives."

Main conclusions: The Dig-Equality FF project demonstrates the potential of playful and gamified approaches to address gender stereotypes and barriers in ICT education, with a focus on engaging students, gathering data, and promoting discussions on gender equality in the field. The playful survey and reflection environment played a central role in the project's research and educational activities in schools. By engaging students in a scenario where they explore and colonise a foreign planet, the project provides a more interactive and engaging way for students to reflect on gender stereotypes and career choices in ICT. Valuable feedback for educational tool design: The gathered data, including students' feedback and user stories, provides valuable pointers for the design of educational tools.

Contributions: The paper presents an innovative and playful approach to engaging students in reflecting on and discussing gender-related topics in ICT careers, trough gamification tools. By developing a gamified survey and reflection tool like PlanetXplorer, the project aims to identify and tackle potential obstacles to achieving gender balance in ICT professions and education. It also gives examples to group discussions on gender stereotypes, explore diverse career paths in technology.

Plan International Norway. (2019). ***What are successful ways to get more girls into tech in Scandinavia?*** PIN/Telenour Group.

https://www.telenor.com/wp-content/uploads/2019/09/The-Gender-Gap-in-Technology-in-Scandinavia_Full-report.pdf

Abstract: "With the support from Telenor, Plan International has commissioned this report in order to identify successful ways of getting more girls into technology in Scandinavia. The report identifies barriers that limit girls and young women in relation to technology and maps out successful initiatives that can support girls and women to pursue careers in technology in Sweden, Norway and Denmark. Plan International sees tech companies as powerful allies in addressing gender biases in our society. It is our goal, that the report will provide evidence and guidance for the tech industry so it can support equal opportunities for young women. Our hope is that it motivates tech companies to join in our mission to create gender equality!"

Main conclusions: The report presents results from literature analysis and from interviews with women and experts about gender imbalance in digital technology in Scandinavia. It discusses the facts, the factors and the different kinds of barriers girl and women face to pursuing education and jobs within the digital technological sector. It concludes for a lack of coherent strategies that address the truly multifaceted and multi-levelled nature of this phenomenon, there and a very limited long-term, rigorous investigations that have tracked the impact of particular strategies and approaches over time in controlled circumstances. The report highlights the role that technology companies, in partnership with other actors, can play in closing the gender divide in Scandinavian tech sector.

Contributions: This highly practical guide presents, in an engaging and informative way, the causes and barriers that keep girls and women away from technological fields. It also, and above all, outlines strategies and actions to overcome these barriers. The aspect that makes this document stand out is its focus on the role of technology companies in combating this phenomenon of gender segregation in STEM fields. This focus could prove useful in fostering collaboration between the education system and the business world.

Solabarrieta, D. (2017). ***STEM Teacher Training Innovation for Gender Balance TOOLKIT.*** Elhuyar Foundation.

https://stingeuproject.files.wordpress.com/2016/12/toolkit_en_2017_05_09.pdf

Abstract: "The STING project promotes the integration of gender awareness into STEM education using a modular teacher professional development program. The program has been developed as a toolkit that teacher trainers and teachers can use to raise gender awareness in STEM teaching and learning, as well as to support other teachers to build gender awareness in their professional practice. (...) Whilst women have made significant progress, they are still in the minority in most STEM disciplines, and the proportion of women tends to decrease as seniority/tenure increases. Despite the fact that numbers of males and females participating in, and excelling at, science are roughly equal throughout primary and secondary school, fewer women enter STEM majors in college, and fewer still graduate with a STEM degree. The pattern continues as lower percentages of women pursue advanced degrees in STEM areas and fewer yet obtain jobs in STEM areas."

Main conclusions: The toolkit encourages educators to critically examine their own beliefs and behaviours regarding gender stereotypes in the classroom. By engaging in discussions, activities, and reflections provided in the toolkit, teachers can work towards creating a more equitable learning environment for all students, regardless of gender. Additionally, the toolkit highlights the significance of storytelling as a tool for promoting conceptual learning in science and suggests strategies to optimise engagement for all students, including those of different genders. Ultimately, the toolkit aims to inspire teachers to rethink their approaches to STEM education and foster a more inclusive and supportive learning environment for all students.

Contributions: The greatest contribution of the STEM Teacher Training Innovation for Gender Balance Toolkit lies in its practical approach to addressing the gender gap in STEM fields through teacher professional development. By providing a structured framework of activities and resources for teachers training, the toolkit empowers educators to reflect on their teaching practices, challenge gender biases, and implement strategies to create more inclusive STEM classrooms. It is a valuable resource for educators seeking to make a positive impact on gender balance in STEM education. Additionally, the toolkit's focus on integrating gender awareness into STEM teaching and learning aligns with broader efforts to increase diversity and equity in STEM fields, making it a valuable tool for promoting long-term systemic change.

2. Inclusive language guides

(Suggestions gathered from project partners).

French - Belgium

Bureau de valorisation de la langue française et de la Francophonie. *(2019). Inclusivement: guide d'écriture pour toutes et tous*. Université de Montreal. https://francais.umontreal.ca/fileadmin/francophonie/documents/Guide_de_redaction_inclusive/UdeM_Guide-ecriture-inclusive.pdf

Dister, Anne & Moreau, Marie-Louise. (2020). *Inclure sans exclure:* Les bonnes pratiques de rédaction inclusive. Fédération Wallonie-Bruxelles, 84. https://dupala.be/upload/files/283_Inclure-sans-exclure-web-aout-version-cliquable-corr.mot-manquant-.pdf

Institut National de la Recherche Scientifique. (n.d.). *Inclusivement vôtres!: Guide de rédaction inclusive.* Institut National de la Recherche Scientifique (online). https://inrs.ca/wp-content/uploads/2021/03/Guide-redaction-inclusive-inrs-vf.pdf

Liénardy, Cyril; Tibblin, Julia; Gygax, Pascal; Simon, Anne-Catherine. (2023). Écriture inclusive, lisibilité textuelle et représentations mentales. *Discours: Revue de linguistique, psycholinguistique et informatique* (33). http://journals.openedition.org/discours/12636

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Italian - Italy

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Cavallo, Arianna; Fumettibrutti; Gheno, Vera; Negri, Gianmarco; Passoni, Diego & Prearo, Massimo. (2021). *Questioni di un certo genere. Le identità sessuali, i diritti, le parole da usare: una guida per saperne di più e parlarne meglio*. Milano, Iperborea.

Di Michele, Valentina; Fiacchi, Andrea & Orrù, Alice. (2022). *Scrivi e lascia vivere. Manuale pratico di scrittura inclusiva e accessibile,* Palermo: Flacowski.

Manera, Manuela. (2021). *La lingua che cambia. Rappresentare le identità di genere, creare gli immaginari,*

aprire lo spazio linguistico. Eris, Torino.

Orletti, Franca. (2001). *Identità di genere nella lingua, nella cultura, nella società.* Armando Editore, Roma.

Sabatini, Alma. (1993). *Raccomandazioni per un uso non sessista della lingua italiana.* Estratto da "Sexism in the Italian Language" a cura di Alma Sabatini per la Presidenza del Consiglio dei Ministri e la Commissione Nazionale per la Parità e le Pari Opportunità tra Uomo e Donna, 1987. Rome, Istituto Poligrafico e Zecca dello Stato. https://www.funzionepubblica.gov.it/sites/funzionepubblica.gov.it/files/documenti/Normativa%20e%20Documentazione/Dossier%20Pari%20opportunit%C3%A0/linguaggio_non_sessista.pdf

Portuguese - Portugal

Abranches, Graça. (2009). *Guia para uma linguagem promotora da igualdade entre mulheres e homens na administração pública.* Comissão para a Cidadania e Igualdade de Género, Lisbon. https://www.cig.gov.pt/wp-content/uploads/2015/11/Guia_ling_mulhe_homens_Admin_Publica.pdf

Câmara Municipal da Figueira da Foz. (n.d.). *Guia de promoção para uma linguagem inclusiva - Igualdade de Género.* Plano de igualdade de género. CMFF, Figueira da Foz. https://dokumen.tips/documents/guia-de-promoo-para-uma-linguagem-inclusiva.html?page=1

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