STEAM LEARNING ECOLOGIES

Empowering Women and Girls in STEM: Bridging the Gender Gap in Science, Technology, Engineering, and Mathematics

Edlyn Vergara, Ioana Caraghiozov, Evita Tasiopoulou from European Schoolnet

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Table of contents

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Introduction

STE(A)M Learning Ecologies (SLEs) aims at promoting science education as part of local community development, through the creation of open schooling partnerships between formal, non-formal and informal education providers, civil society and enterprises. By working together on real-life problem-solving situations within local communities, these partnerships provide multiple science learning opportunities for citizens of all ages, in all manner of learning spaces.

SLEs strive to be inclusive, ensuring all members of society can meaningfully engage with science learning opportunities. However, current evidence reveals that inequalities to access and contribute to STEM fields persist today. Among these inequalities, the gender gap stands out as an historically persistent challenge, with women significantly underrepresented across various scientific disciplines, such as computer science and engineering.

SLEs have the potential to tackle this gap through their approach. The problem-based learning focus of SLEs, and their involvement of the community to co-create activities, align with research-backed strategies for engaging girls in STEM.

This toolkit aims to help SLE stakeholders integrate gender-inclusive practices into their existing project activities. The toolkit introduces several projects that focussed on tackling the gender gap in STEM across all levels of education and through various practices. Teachers can learn more about these strategies, access opensource materials, and identify what actions would align best with their ongoing activities. By doing so, SLEs initiators and stakeholders can create learning environments that not only teach STEM effectively but actively work to close the gender gap in STEM fields.

The toolkit can be accessed and used also by teachers who are not directly involved in SLEs but would like to explore resources and ideas to make their teaching practices more inclusive.

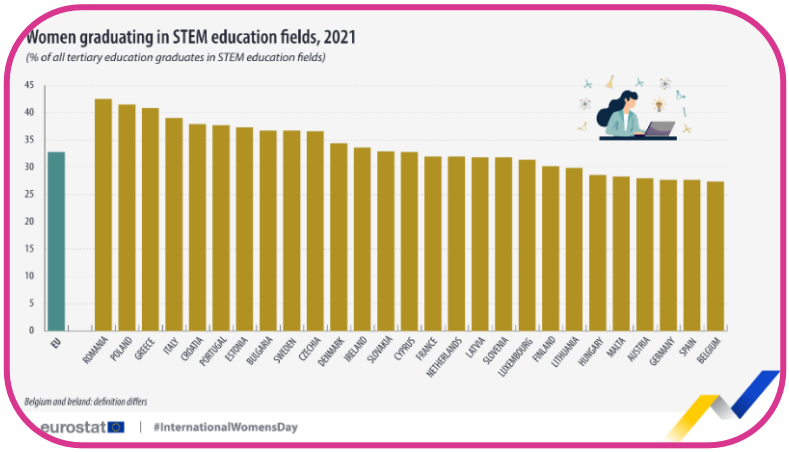
Overview of the Gender Gap in STEM

Gender equality in education ensures fair and equitable treatment for all, regardless of gender, in accessing and benefiting from educational resources, opportunities and outcomes (Kuteesa et al., 2024). It also represents a social justice issue that affects rights, opportunities, and freedoms and it is essential for long-term growth, peaceful societies, and individual well-being (Longlands, 2024).

STEM (Science, Technology, Engineering and Mathematics) is a teaching method that integrates STEM subjects to address real-world problems in the class, and discover the environment we live in. STEM fosters critical thinking, creativity, and innovation, all skills necessary to propel technological growth, tackle global issues, and influence the future.

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.



Consequently, today's persistent gender inequalities, particularly in STEM fields, hinder the realization of fundamental rights, preventing women and men from contributing to societal change, innovating cultural practices, and solving real world challenges. Bridging the gender gap in the field of education, especially in STEM subject, is a huge step in making a difference in society.

Figure 1. Women graduates as % of all tertiary education graduates. Source data set: https://ec.europa.eu/eurostat/databrowser/view/tps00217__custom_10079895/default/table?lang=en

Despite gains in gender equity and increased interest in computer science, engineering, math, and statistics among men and women over the previous decade, women continue to be underrepresented in STEM disciplines. In Europe, while women represent 52% of the population, they only account for 2 out of 5 scientists and engineers, 18% of the European information and communications technology (ICT) workforce, and 32.8% of tertiary education STEM graduates. As can be seen in Figure 1, the gap in women's representation in STEM studies and careers varies significantly across EU countries.

Closing the gender gap in STEM education is essential to boost economic output, improve health outcomes, promote social solidarity, and help dismantle discriminatory attitudes and behaviours (Walker et al., 2019; Herz and Sperling, 2004). For example, an increase in women's participation in the job market is linked to higher productivity and wages for all. Consequently, boosting gender diversity in STEM is expected to yield economic advantages for both genders and society.

Conversely, a lack of female representation in STEM careers can have adverse effects on society. For example, by generating goods and services that are detrimental to women and children (Cheryan et al., 2024).

Understanding the causes of the gender gap in STEM

Personal Factors

Gender inequality and bias in STEM education are influenced by several personal factors-the internal influences that shape a person's behaviour and choices. These factors include interest in STEM subjects, gender stereotypes, self-efficacy, and sense of belonging (Wang et al. 2023).

Gender stereotypes involve assigning certain features, characteristics, and duties to individuals based on their gender (UNICEF, 2017). For example, women are often expected to assume caretaking roles,

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

such as nursing or teaching careers, whereas guys are expected to hold leadership positions, pursuing scientific, engineering, or business careers (OECD, 2022). Stereotypes portray males as strong, intellectual, and the family's primary provider, whereas females are viewed as affectionate, caring, physically weak, and less intelligent (Pm & Jayaraman, 2019; Wang & Degol, 2013). These stereotypes can have long-term consequences, impacting students' educational goals and professional choices. For example, they can deter women from pursuing STEM careers, perpetuating gender imbalances that affect the labour market and society (European Institute for Gender Equality, 2022). Additionally, stereotypes have led women to face expulsion or rejection from STEM fields based on preconceived assumptions about their skills, limiting their professional opportunities (Jin, 2023).

Self-efficacy is someone's genuine conviction in their capacity to plan, execute and achieve specific goals and has long played an important role in people's motivation, choice of activities and learning (Artino, 2012). People who lack self-efficacy for completing a certain activity may avoid it, whereas those who think they are capable are more likely to take part (Artino, 2012). Therefore, women having a low self-efficacy and trust to themselves that they will succeed and perform the tasks related to STEM fields affects their career choice. According to Bhati & Sethy (2022), the acquisition of needed skills and talents is insufficient for a person to do a task; they must believe in their ability and be able to complete the assignment under challenging conditions, and therefore, to function effectively, both competence and efficacy conviction are essential.

Attitudes, motivation, and interest are also crucial personal elements that influence learners' dispositions toward STEM. STEM identities play an important role in directing these dispositions and, ultimately, academic and career choices. STEM identity is shaped by being recognized as a STEM person, having interest in STEM, and feeling competent in STEM-related tasks. (Dou & Cian, 2021). However, societal stereotypes often hinder women from being recognized, or recognizing themselves, as a STEM person. Individual interest in STEM occupations is also directly affected by self-efficacy and views of STEM careers, and indirectly by environmental influences such as parents, classmates, schools, and media. (Wang et al., 2023).

Environmental Factors

The underrepresentation of women in STEM-related fields is rooted in broader societal, cultural and economic issues, as well as family dynamics. Family-related factors include disparities in parental education levels, family gender values, the number of girls and boys in the family, socio-economic status, and the family's science and cultural capital.

Additionally, cultural and societal norms also influence women's participation in STEM fields. Several social constructs related to STEM perpetuate gendered believes, such as men being naturally better at using certain electrical apparatus or excelling in mathematical skills (Baltaetal.,2023; Evagorou M., et al.,2024). These norms continue to act as barriers to achieving gender equity in STEM studies and careers.

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Family Context

Family and peer context are additional factors influencing the gender gap in STEM (Wang et al., 2023). Within this level, Wang et al. (2023) identified several influences on gender disparity:

Parents with traditional gender beliefs manage their children's behaviour to adhere to common gender norms.

Parents who work in STEM occupations have a greater effect on their daughters' decisions to pursue STEM careers. These parents have more access to resources and can help their daughters familiarize themselves with STEM careers. They can also contribute to breaking the old notion that STEM careers and family life cannot be matched.

Peers are key social ties for teenage girls, and their impressions of STEM topics and occupations influence whether they will select STEM disciplines.

Cultural Norms and Societal Expectations

Gender role socialization[1] contributes significantly to the underrepresentation of women in STEM. Traditional gender role views encompass attitudes and expectations regarding proper duties, actions, and obligations for both men and women (Chan, 2022). Women are depicted as feminine, emotional, and altruistic, and they are meant to be more interested in arts, humanities, and social sciences; males are regarded masculine, logical, and competitive, and they should be more interested in STEM (Chan, 2022; Diekman et al., 2010).

The influence of social and cultural expectations can have a substantial impact on an individual's motivation to pursue a STEM profession (Mansour, 2024). The growing underrepresentation of women in various STEM fields are, at least partly, a result of these norms and expectations, which reinforce the assumption that science and technology are more acceptable for males (Nosek et al., 2009).

Different cultures may have different perspectives on STEM subjects, job possibilities, and social expectations, which can impact people's interests and decisions (Mansour, 2024). For example, in Japanese culture, which places more of an emphasis on masculinity, collectivism, and a close-knit culture, has a greater social-structural impact on gender discrepancy in STEM (Yoshikawa et al., 2018). Therefore, understanding cultural settings and how they influence STEM career choices is critical to encouraging inclusion and diversity in STEM areas, as these cultural values, attitudes, and conventions determine people's judgments of appropriate jobs and their professional goals.

[1] Gender role socialization is the process through which people learn and internalize the expectations, behaviours and roles associated with their given gender in a community. Children are taught what is suitable for men and women in their society from an early age, and they are pushed to adapt to these norms by the environment they live in, including their family, peers, friends and media.

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Organizational Factors

Organizational factors encompass the overall school environment, including curricula, school practices and culture, instructor biases and competencies, textbooks and role models (Evagorou M. et al., 2024). All these influences the participation, interest and motivation of female students to learn STEM, and further pursue a career in the field.

Schools play a crucial role in the development of students. Curricula influence the choice of young girls in subjects related to STEM. As part of an organizational factor, teachers also serve as driver of motivation and interest of students. According to Wang et al. (2023), the quality of teachers' instruction practices can act as a catalyst of positive beliefs for students and influence the motivation and STEM related achievement of students.

The adoption of an **inclusive curriculum and teaching methods** are critical in ensuring that all girls can learn STEM (science, technology, engineering, and mathematics) concepts. Educators should modify their curriculum and teaching methods to emphasize the relevance of learning experiences to real-world applications. Finally, a gender-sensitive and inclusive curriculum that appeals to both boys and girls is pivotal for recruiting and retaining female STEM students (Evagorou M., et al., 2024; Wright & Delgado, 2023).

The **representation of male and female roles** in textbooks can directly or indirectly communicate that there are gender differences in students' STEM abilities, perpetuating gender stereotypes and preventing girls from pursuing STEM jobs (Wang et al., 2023). Visual representation in textbooks often show men in positions of power -such as leaders, engineers, scientist or doctors- while women are depicted as housewife or secretaries in a company. This representation not only conveys a bias treatment, but they also cast judgement towards the capabilities and skills of women.

In school settings, **teachers** play an important role in shaping the perspective of young girls towards roles in various field. Teachers have the power to encourage and attract students, especially girls, towards STEM careers. To help teachers debunk this disparity in school and in STEM education, it is crucial to provide them with opportunities to grow and build necessary skills and competencies. This can be done through designing and implementing **teacher development programs** that allow teachers to improve their capacity to influence and persuade young girls into STEM, and providing resources and methods for teachers will help them in engaging females in STEM study.

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Strategies, resources and materials to address the three factors

Introduction to the materials

As discussed above, understanding the gender gap in STEM is a multifaceted challenge which is influenced by numerous intersecting factors, each reinforcing the other. Addressing this complex issue requires equally multifaceted solutions, tailored to the educational level and context, the needs of students, the stakeholders involved and the resources available.

The initiatives presented in the table below showcase how different stakeholders across Europe have developed approaches to address these interconnected factors. Each project tackles specific barriers while recognizing that lasting change requires interventions at multiple levels - from building individual confidence to transforming organizational practices.

In the table, each initiative is introduced by a description of its main objectives and outputs, the targeted school levels, the specific dimensions of inequality addressed, and the type of resources that are offered. Educators can access directly the resources through the provided links or choose to explore the project's page.

Please note that the table below does not represent an exhaustive list of the projects, initiatives, and materials available to educators and educational stakeholders to tackle gender inequalities in STEM. This toolkit aims to provide a starting point for educators interested in exploring resources, training and ideas, but we encourage also independent exploration

STREAM IT, a currently ongoing EU funded project addressing gender inequalities in STEM education and R&I, has recently produced a research report **thar gathers previous and running initiatives and European projects on STEAM education and gender equality**. Additionally, it has made available a collection of best practices on STEAM approaches and tools.

Educators interested in further exploring resources can access these outputs at this link.

Analysis of the strategies

The table below and the initiatives it introduces reveal several key strategies that have been implemented to address the gender gap in STEM education across Europe.

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

To tackle personal factors like self-efficacy and stereotypes, many projects employed **role model and mentoring programs** that are aimed at helping girls envision themselves in STEM fields (as seen in *FEMALES, FeSTEM, Girls Go STEM*). Other projects, like *RoboGirls* and *Girls in STEM*, created **resources for hands-on activities** that help girls build self-efficacy by engaging directly with technology and tasks. These approaches align with evidence-based strategies, which emphasize the importance of connecting STEM to girls' everyday lives and empowering them to tackle challenges, which helps them develop both practical skills and the confidence to pursue STEM studies and careers (Billington et al., 2014, as cited in Evagoru et al., 2024).

At environmental level, projects like *She Chooses STEM for the Future* and *Girls in STEM Toolkit* (GiST) recognize that family and the broader community play a role in shaping girls' perception of- and spirations towards- STEM. For this reason, these projects designed **resources that can be used to involve parents** in empowering girls at home by providing guidance and tools to challenge broader cultural stereotypes. Engaging the family in these programs is particularly important as it helps counter societal messages that discourage girls from choosing STEM subjects and creates a supportive environment that validates their interests and aspirations inside and outside the school.

At the organizational level, multiple solutions are available to schools and teachers willing to create inclusive learning environments. Teachers and teacher trainers' **professional development programs** (PD) are key to bringing about this change. For this reason, projects such as *STING* and *IN2STEAM* have created PD programs that provide educators with tools to recognize and address stereotypes, and to plan and design hands-on projects such as inquiry-based learning. *NGSS* demonstrates how **curriculum reform** can integrate gender-sensitive approaches from early on in primary education.

In the table, you will notice initiatives typically **combine multiple levels and approaches** - for example, pairing teacher training with hands-on activities, or combining practical STEM experiences with exercises on gender stereotypes. They also recognize the importance of starting early, from pre-primary and primary education, and progress throughout students' academic and professional careers. For example, projects like *NGSS* target primary education, while others like *Women STEM-UP* and *EUGAIN* support the transition through higher education. Involving the wider community,

The *Girls in STEM Toolkit project* provides a platform for students, educators and families to discover STEM, encourage girls to pursue STEM careers, and discover activities that can spark students' interest in the field. Educators can find materials, a professional training on challenging stereotypes in STEM, and building STEM confidence in all students.

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Table 1 Projects to address the Gender Gap in STEM

Project title	Project Description and Tags
Next Generation Science Standards Through STEAM (NGSS)	The NGSS project promotes STEM+Arts in early childhood education by using Social and Emotional Learning (SEL) integrated with interactive techniques (e.g. theatre, gamified learning, physical education, etc.), addressing the development of social and emotional skills alongside cognitive ones. One of the project's aims is to promote a gender-neutral approach to STEM education while also increasing young learners' environmental knowledge and sensitivity. The project also increases the competence development of teachers and educators to successfully teach STEM+Arts ideas to young children in early childhood education, with an emphasis on girls, to build creativity, critical thinking, and problem-solving skills. Additionally, it offers approaches in developing gender-inclusive teaching techniques and open materials focusing on STEM+Arts learning in schools with a real-world context, which then increase and encourage girls' interest in STEM areas. **School Level:** Pre-primary and primary **Dimensions:** Inclusive Learning Environments Attitudes, Interest and Motivation **Resources**: digital toolkits, online guidebook with project ideas **Project Link:** NGSS – Project **Materials:** Digital Tool Kit For Teachers and Pupils – NGSS ; Online Guidebook – with project ideas **Languages:** English, Turkish, Polski, Greek, Romanian, Lietuviu, Bulgarian
in2STEAM	IN2STEAM project strives to strengthen, support and cultivate a creative educational approach that incorporates STE(A)M learning (applying art and design principles to scientific education) in primary school. It includes gender-inclusive techniques and resources to create a positive change of attitudes towards non–stereotypical choices in education that draw more girls into STEM fields. The project offers a guideline on how to implement practical STE(A)M projects in the class; an online activity kit to help educators develop their project; and a guideline on assessing pupils.

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Project title	Project Description and Tags
	School Level: Primary **Dimensions:** Attitudes, Interest and Motivation; Gender Stereotypes; Inclusive Learning Environments **Resources:** digital toolkit, online activity kit for students and teachers; assessment model **Project Link:** IN2STEAM | Inspiring Next Generation of Girls through Inclusive STE(A)M Learning in Primary Education **Materials:** Outputs | IN2STEAM ; in2steam-io3-toolkit_for_teachers-en.pdf; online-activity-kit; Assessment_Model **Languages:** English, Greek, Italian, Polski, Portuguese, Turkish
GE-STEAM	The project tackles gender equality in pre-school, primary, and lower secondary education and intends to minimize stereotypes in education by producing a series of creative and interactive materials. One of the outputs produced for teachers is the "Training Programme for Deconstructing Gender Stereotypes in STEAM". This training programme consists of modules with various activities that tackle and help to address gender stereotypes. A platform of Open Educational Resources for the three school levels is also available, to provide teachers with ready-to-use resources to address gender biases. **School Level:** Pre-school, Primary and Secondary **Dimensions:** Gender Stereotypes **Resources:** training programme, STEM repository for teachers, guidelines for STEAM and hands on activities, Peer-mentoring and Business mentoring. **Project Link:** Gesteamproject **Materials:** OUTPUTS ; IO1_Training-Program_EN.pdf **Languages:** English, Romanian, Bulgarian, Spanish
Girls in STEM Toolkit (GiST)	Girls in STEM Toolkit (GiST) aims to address girls and women's underrepresentation in STEM, boost students' confidence and help

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Project title	Project Description and Tags
	teachers make a meaningful difference in the learning experience of students in STEM-related subjects and courses. The project offers a toolkit for teachers to explore different education practices to address the gender gap in STEM field. The toolkit equips them with information, skills, and resources to help create a learning environment that promotes STEM equality for all learners. STEM lesson plans can be utilized to provide a learning environment that is gender neutral and encourage young women to pursue careers in STEM fields by helping them envision themselves as engineers, scientists, or mathematicians. Additionally, parents can also find activities that can be done at home to encourage girls to get involved in STEM. Students can also explore STEM careers and pathways and learn about role models autonomously on the project's website. **School Level:** Primary and Secondary **Dimensions:** Teacher Professional Development; Self-efficacy; Role Models; Inclusive Learning Environments; Family Context **Resources**: professional learning materials, lesson plans, career advice resources, professional development course **Project Link**: The Girls in STEM Toolkit | The GiST **Materials**: Free STEM resources for teachers |The GiST; families-resources; students-resources **Language:** English
Mind the Gap	As a continuation of the Gender ABC project, Mind the Gap's goal is to help combat gender stereotypes in education in Italy, Spain, and Portugal, by lowering the impact of gendered expectations on girls' and boys' educational, career, and life choices. Additionally, this project helps teachers, professionals and other people in touch with children to detect and overcome gender stereotypes in education through various activities, trainings, and workshops. The project contains a guide to build a gender-inclusive educational environment for educators with activities they can implement to foster inclusiveness and combat gender stereotypes in the education sector.

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Project title	Project Description and Tags
	School Level: primary and secondary **Dimensions**: Inclusive Learning Environments · Gender Stereotypes **Resources**: Educational toolkit **Project Link**: EUROPE – MI+ND THE GAP: Step up for gender equality | Aidos **Materials**: EN_guide_WEB_2.pdf **Languages**: English, Italian, Catalan, Spanish, Portuguese
She Chooses STEM for the Future	She Chooses STEM for the Future is an initiative that addresses the need for effective, creative instruments to bring young women closer to science disciplines. The objective of the project is to establish common and transferable STEM methodologies, to promote and disseminate gender equality, to involve women in science through interactive discussions, to detect and challenge societal biases through dialogue and dissemination, and to encourage an interdisciplinary STEAM approach that also aims to inspire artistic creativity and personal expression. The project produced a guideline that teachers and parents can use to implement inclusive teaching practices. These help teachers increase students' interest in STEM courses and outline cost-effective activities for upper secondary education. The project also developed a toolkit of resources to inspire girls to pursue STEM opportunities. **School Level**: Secondary **Dimensions**: Inclusive Learning Environments · Attitudes, Interest and Motivation · Self-efficacy · Gender Stereotypes · Family Context **Resources**: toolkit, guidebook **Project Link**: Home - SHE CHOOSES STEM for the future **Materials**: Project Result - SHE CHOOSES STEM for the future ; Toolkit-EMPOWERING STEM-EN.pptx **Languages**: English, Spanish, Italian, Portuguese, Bulgarian, Romanian

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Project title	Project Description and Tags
Robogirls	The RoboGirls project seeks to increase teachers' capacity to plan and implement new, immersive STEAM activities and events through robotics and coding to close the gender gap. The project contains innovative pedagogical content, dynamic resources, and gamified technologies. Robogirls also conducted series of blended learning trainings, events for teachers and students to introduce STEM practices. The projects' goal is to develop teachers' competence to undertake hands-on STEAM programs utilizing robots and other technical tools while adhering to gender equality principles, and in which helps increase girls' confidence and self-esteem in STEAM, encouraging them to choose a related vocation in the future. **School Level:** Secondary **Dimensions:** Inclusive Curriculum; Self-Efficacy **Resources:** teacher training, e-learning toolkit, comprehensive guide, e-learning platform, career choice simulator **Project Link:** Home - Robogirls **Materials:** Robogirls e-learning: Log in to the site **Languages:** English, Spanish, Greek, Croatian
FEMALES	This project highlights the concept of role models as an effective approach in sparking women and girls' interest towards STEM subjects and empower them to consider pursuing a career in those areas. To support educators, the project produced an e-learning platform-MOOCs which helps teachers introduce role models in STEM. The platform also offers materials that teachers can use in their teaching practice. **School Level:** Secondary **Dimensions:** Inclusive Learning Environments; Role Models; Gender Stereotypes **Resources:** role models educational tools and resources, teacher training **Project Link:** Females Project **Materials:** Output 2 – Females Project ; Females e-Learning Platform

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Project title	Project Description and Tags
	Languages: English, Spanish, Italian, Romanian, Turkish, Greek
EUGAIN	This initiative addressed the underrepresentation of women in ICT fields. It aimed to improve gender balance in informatics by developing a series of best practices and initiatives that support women's transition from school, to university, to PhDs and the workplace. The project outlined various activities such as workshops and trainings that allows women to explore and engage in STEM field, specifically in informatics. **School Level:** Secondary School, Higher education **Dimensions:** Attitudes, Interest and Motivation Inclusive Learning Environments **Resources:** trainings and workshops **Project Link:** EUGAIN • COST ACTION CA19122 – European Network For Gender Balance in Informatics **Materials:** Best Practices – EUGAIN • COST ACTION CA19122 **Languages:** English
Girls in STEM	The 'Girls in STEM aims to promote inclusivity, diversity, and non-discrimination in education and to support the early development of STEM abilities in female students. The project's goal is to encourage girls to pursue STEM (science, technology, engineering, and math)-related interests and encouraging them to see the possibilities of pursuing STEM fields through hands-on activities. To do so, the project created three toolkits for educators to prepare for and facilitate projects covering three topics: Reverse Engineering, E-Textiles, and Digital Art. **School level:** secondary and higher education **Dimensions:** Attitudes, Interest and Motivation **Resources:** educational toolkit **Project Link:** GirlsInSTEM **Materials:** Toolkits **Languages:** English

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Project title	Project Description and Tags
Women STEM-UP	The "Women STEM UP" initiative addresses the gender gap in STEM higher education. The initiative uses a gender-based strategy to attract and retain women in STEM, focusing on tackling stereotypical views and boosting female confidence and creativity. The project's goal is to provide female undergraduate students and lecturers with tools, resources, and an open community platform that empowers women to build careers in STEM. The project also includes an online training course "Online Training Program Women Step-Up: Gender and Inclusion in STEM Areas" - a complete training plan to provide STEM university professors and lecturers with the information, skills, and resources they need to create a more inclusive learning environment. **School Level:** Higher Education **Dimensions:** Gender Stereotypes · Self-efficacy · Attitudes, Interest and Motivation **Resources**: training programmes, mentoring resources **Project Link:** Home – Women Stem Up **Materials:** Training programme – Women Stem Up ; Mentoring – Women Stem Up **Languages:** English
Girls Go STEM	Girls Go STEM is a project that encourages women in pursuing STEM careers. This project mainly focuses on empowering young women through mentoring and by reducing gender stereotypes that lead to low participation of women in STEM studies and careers. To do so, it created a guideline on integrating gender considerations in teachers' practices. **School Level:** Higher Education **Dimensions:** Self-efficacy · Attitudes, Interest and Motivation **Resources**: educational guideline **Project Link:** Girls go STEM **Materials:** Microsoft Word - GISTEM Guidelines **Languages:** English

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Project title	Project Description and Tags
FeSTEM Project	FeSTEM is a project that highlights the importance of role models in the development of interest and engagement of female students to STEM related subjects. This project aimed to help higher education students to have the confidence and belief that they have the ability and skills to pursue a career in STEM-related field. One of the notable outputs of this project is a toolbox that contains various digital educational materials that supports teachers in promoting an environment that foster gender-inclusive teaching and learning. This role modelling-based initiative also encourages the development of networking opportunities for young women to establish a support system. **School Level:** Higher education **Dimensions:** Attitudes, Interest and Motivation; Role Models; Inclusive Learning Environments **Resources**: trainer guide, educational toolkits, online learning platform **Project Link**: FeSTEM | Female Empowerment in Science, Technology, Engineering and Mathematics in Higher Education **Materials**: Resources | FeSTEM ; festem-io2-en.pdf ; Gender Sensitive Toolbox **Languages:** English
STEM Teacher Training Innovation for Gender Balance (STING)	The STING project promotes gender awareness in STEM education through a modular teacher professional development program. The program has been designed as a toolkit for teacher trainers and teachers to use to raise gender awareness in STEM teaching and learning, as well as to assist other teachers in incorporating gender awareness into their professional practice. The project developed a toolkit with various activities that helps address gender stereotypes in various instances. An example activity is the 'Architect Game', which aims to identify stereotypes in education and daily life. **School Level**: All levels **Dimensions:**

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Project title	Project Description and Tags
	Inclusive Curriculum · Gender Stereotypes · Inclusive Learning Environments **Resources**: teacher training, educational toolkit **Project Link**: STING project: STEM Teacher training innovation for Gender balance **Materials**: toolkit_en_2017_05_09.pdf ; Toolkit web resources | STING project: STEM Teacher training innovation for Gender balance **Languages**: English, Basque

Conclusions

This toolkit's main objective was to provide an introduction to understanding the causes of the gender gap in STEM, and possible solutions developed and tested by other projects. Educators who are either part of the SLEs project, or simply interested in STEM education and open schooling, can use this toolkit to navigate a complex issue, and start considering solutions that can be implemented in ongoing or future projects.

In general, the initiatives we presented showcase how, to address the gender gap, it's important to approach the problem from multiple angles. These initiatives often seek to question and remove gender stereotypes that frequently discourage women from pursuing STEM careers, such as the belief that STEM disciplines are "for males" or that women are less capable in these areas. Aside from gender stereotypes, they also aim to boost women's self-efficacy, interest and enthusiasm for STEM, and break the social and cultural norms depicted towards men and women.

Furthermore, these projects promote change by enabling different stakeholders including educators, teachers, parents, and curriculum developers, to enhance the structural components of STEM education. This involves modifying curriculum to make them more inclusive, improving teaching methods, and creating resources that are more engaging and accessible to both women and men, and generally aim to create a more equitable and supportive environment for all.

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

References

Artino, A. R., Jr. (2012). Academic self-efficacy: from educational theory to instructional practice. *Perspectives on Medical Education*, *1*(2), 76–85. https://doi.org/10.1007/s40037-012-0012-5

Bertocchi, G., & Bozzano, M. (2019). Gender gaps in education. In IZA Institute of Labor Economics, *IZA Discussion Paper Series*. https://docs.iza.org/dp12724.pdf

Beroíza-Valenzuela, F., & Salas-Guzmán, N. (2024). STEM and gender gap: a systematic review in WoS, Scopus, and ERIC databases (2012–2022). *Frontiers in Education*, *9*. https://doi.org/10.3389/feduc.2024.1378640

Billington, B., Britsch, B., Karl, R., Carter, S., Freese, J., and Regalla, L. (2014). SciGirls Seven: How to engage girls in STEM. Minneapolis, MN: Twin Cities Public Television. http://tpt.vo.llnwd.net/o26/scigirls/ScigirlsSeven_Print. pdf

Bremond, P. (2024, April 30). *Bridging the gender gap in STEM*. Dianova. https://www.dianova.org/opinion/bridging-the-gender-gap-in-stem/

Chan, R. C. H. (2022). A social cognitive perspective on gender disparities in self-efficacy, interest, and aspirations in science, technology, engineering, and mathematics (STEM): the influence of cultural and gender norms. *International Journal of STEM Education*, *9*(1). https://doi.org/10.1186/s40594-022-00352-0

Cheryan, S., Lombard, E. J., Hailu, F., Pham, L. N. H., & Weltzien, K. (2024). Global patterns of gender disparities in STEM and explanations for their persistence. *Nature Reviews Psychology*. https://doi.org/10.1038/s44159-024-00380-3

Cheryan, S., Plaut, V. C., Handron, C., & Hudson, L. (2013). The stereotypical computer scientist: Gendered Media Representations as a Barrier to Inclusion for Women. *Sex Roles*, *69*(1–2), 58–71. https://doi.org/10.1007/s11199-013-0296-x

Education. (2024, December 10). European Institute for Gender Equality. https://eige.europa.eu/gender-mainstreaming/policy-areas/education

Evagorou, M., Puig, B., Bayram, D. and Janeckova, H. (2024). Addressing the gender gap in STEM education across educational levels, NESET report, Luxembourg: Publications Office of the European Union. doi:10.2766/260477.

Europe needs more women in STEM. (n.d.). https://www.eppgroup.eu/what-we-do/with-eu-countries/ireland/europe-needs-more-women-in-stem

Eurostat. (2024, March 8). Women totalled almost a third of STEM graduates in 2021. *Eurostat*. https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20240308-2

Gender gaps in education and employment. (n.d.). EU Science Hub. https://joint-research-centre.ec.europa.eu/scientific-activities-z/gender-gaps-education-and-employment_en

Ibuola, R. (2024). Addressing the gender gap in the STEM field. In *Education and human development*. https://doi.org/10.5772/intechopen.114008

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Jin, X. (2023). How gender stereotype in education impact female students' development in secondary school. *Journal of Education Humanities and Social Sciences*, *12*, 229–234. https://doi.org/10.54097/ehss.v12i.7644

Kuteesa, N. K. N., Akpuokwe, N. C. U., & Udeh, N. C. A. (2024). GENDER EQUITY IN EDUCATION: ADDRESSING CHALLENGES AND PROMOTING OPPORTUNITIES FOR SOCIAL EMPOWERMENT. *International Journal of Applied Research in Social Sciences*, *6*(4), 631–641. https://doi.org/10.51594/ijarss.v6i4.1034

Longlands, H. (2024, February 12). *What do we mean by gender equality and how do we measure it?* -. https://www.gendereddata.org/what-do-we-mean-by-gender-equality-in-education-and-how-can-we-measure-it/

Luttenberger, S., Steinlechner, P., Ertl, B., & Paechter, M. (2019). It takes more than one swallow to make a summer: Measures to foster girls' and women's pathways into STEM. *Frontiers in Psychology*, *10*. https://doi.org/10.3389/fpsyg.2019.01844

Nowak, J. K. & Doctoral School of Social Sciences, University of Białystok, Poland. (2021). Gender inequality in education. In *Human, Technologies and Quality of Education* (Vol. 2021, pp. 424–426) [Journal-article]. https://www.apgads.lu.lv/fileadmin/user_upload/lu_portal/apgads/PDF/HTQE-2021/htqe.2021.31-Nowak.pdf

Mansour, N. (2024). Exploring the impact of social, cultural, and science factors on students' STEM career preferences. *Research in Science Education*. https://doi.org/10.1007/s11165-024-10210-4

OECD (2022). Gender stereotypes in education: Policies and practices to address gender stereotyping across OECD education systems. https://one.oecd.org/document/EDU/WKP(2022)9/en/pdf

PM, A., & Jayaraman, P. (2019). Gender Stereotype in Education. https://www.researchgate.net/publication/344475448_Gender_Stereotype_in_Education

Tiwari, N., et al. (2024). From classroom to career: Closing the gender gap in STEM. https://www.kearney.com/service/leadership-change-organization/article/from-classroom-to-career-closing-the-gender-gap-in-stem

UNICEF (2017). GENDER EQUALITY: Glossary of Terrms and Concepts. https://www.unicef.org/rosa/media/1761/file/Gender%20glossary%20of%20terms%20and%20

Unterhalter, E., Howell, & Parkes. (2019). Achieving gender equality in and through education. *Global Partnership for Education*. https://www.globalpartnership.org/sites/default/files/2019-07-kix-gender-final-english.pdf

Verdugo-Castro, S., Sánchez-Gómez, M. C., & García-Holgado, A. (2023). Factors associated with the gender gap in the STEM sector: Comparison of theoretical and empirical concept maps and qualitative SWOT analysis. *Heliyon*, *9*(6), e17499. https://doi.org/10.1016/j.heliyon.2023.e17499

Wang, N., Tan, A., Zhou, X., Liu, K., Zeng, F., & Xiang, J. (2023). Gender differences in high school students' interest in STEM careers: a multi-group comparison based on structural equation

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

model. *International Journal of STEM Education*, *10*(1). https://doi.org/10.1186/s40594-023-00443-6

Wang, M., & Degol, J. L. (2016). Gender gap in Science, Technology, Engineering, and Mathematics (STEM): current knowledge, implications for practice, policy, and future directions. *Educational Psychology Review*, *29*(1), 119–140. https://doi.org/10.1007/s10648-015-9355-x

Writers, S. (2022, November 4). *Why is gender diversity important in STEM? | BestColleges*. BestColleges.com. https://www.bestcolleges.com/resources/why-gender-diversity-important-stem/

Yoshikawa, K., Kokubo, A., & Wu, C. (2018). A Cultural perspective on gender Inequity in STEM: the Japanese context. *Industrial and Organizational Psychology*, *11*(2), 301–309. https://doi.org/10.1017/iop.2018.19

Zambrano, J. (2023). Women in Leadership Positions | MIT Professional Education. *MIT Professional Education*. https://professionalprograms.mit.edu/blog/leadership/the-gender-gap-in-stem/

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Funded by the European Union

This project is funded by the European Union's Horizon programme under grant agreement No 101094648. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.